FINAL REPORT
2021-2023

FISH STOCK ENHANCEMENT INCLUDING HILSA AND LIVELIHOOD IMPROVEMENT FOR SUSTAINABLE FISHERIES AND CONSERVATION IN RIVER GANGA

Sponsored by

National Mission for Clean Ganga,
Department of Water Resources,
River Development & Ganga Rejuvenation,
Ministry of Jal Shakti,
Govt. of India

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Duration: November 2020 – September 2023

ICAR - CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

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FISH STOCK ENHANCEMENT INCLUDING HILSA AND LIVILIHOOD IMPROVEMENT FOR SUSTAINABLE FISHERIES AND CONSERVATION IN RIVER GANGA

Name of the sponsoring agency (Ministry/ Department/ Autonomous Body/ Central PSE)	:	**National Mission on Clean Ganga (NMCG), Ministry of Jal Shakti, Govt. of India, New Delhi**
Proposed duration of the proposal/Scheme	:	**Three years (2020-2023)**
Total cost of the proposal over the proposed duration	:	**Rs. 13,84,09,928/-**

Submitted to:
National Mission for Clean Ganga (Ministry of Jal Shakti), 1st Floor, Major Dhyan Chand National Stadium, India Gate, New Delhi- 110 002

Foreward

Indians consider the Ganga to be the most sacred holy river that sustains millions of people living along its banks for nutrition and livelihood. Despite its significant contribution to the country, it has been losing its native flora and fauna, including fish species and aquatic mammals, due to various anthropogenic pressures and inherent reasons. With financial assistance from the Ministry of Jal Shakti as a part of the National Mission for Clean Ganga (NMCG) programme, the ICAR-Central Inland Fisheries Research Institute (CIFRI), Barrackpore, has played a key role in monitoring and assessing the ecology and fish diversity, fish catch, fishers' livelihoods, and river habitat of the river Ganga. It has also built a repository of biological and ecological data on Ganga River System. The studies during the period 2021-2022, have focused on the significance of conserving and promoting indigenous fish species, including hilsa, and raising awareness about dolphin conservation. The study's three main components are: (I) enhancing depleted fish stocks through captive breeding of indigenous stock and ranching programme at the chosen sites in the river Ganga; (II) improving hilsa fisheries in the middle stretch (Prayagraj to Farakka) of the river Ganga and (III) to sustain and conserve the Indian Major Carps (IMCs) and Mahseer fish stock, increase fish production and productivity, improving economic situation of the locals, and sustain the use of fishery resources along the Ganga River, a total of 24.45 lakh fingerlings of Indian major carps (IMCs) and Mahseer were ranched in five Ganga basin states, *viz*., Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal, during the year 2021–2022. Through 58 multi-state awareness campaigns in five states-Uttarakhand, Uttar Pradesh, Jharkhand, Bihar, and West Bengal-more than 3500 fishers, students, and participants from riparian communities were educated about the value of ranching and were aware to follow conservational measures for the protection and enhancement of indigenous germplasm in the river. Additionally, emphasis was placed on conservation efforts and stock development for the valued and flagship species, hilsa *Tenualosa ilisha* (Farakka to Fraserganj). A large-scale ranching effort was conducted in Murshidabad, West Bengal, upstream of the Farakka barrage. A total of 50,055 hilsa adults were ranched upstream of Farakka during 2021-2022. Of these, 1,313 adult hilsa were tagged to understand the migratory path in the river Ganga. A total of 8326 fishers representing the states of W.B., Bihar, Jharkhand, and U.P. were aware of hilsa and dolphin conservation. The awareness of dolphin conservation resulted in significant findings.

(B. K. Das)

Highlights

- A total of 57 different river ranching programs were carried out in five states, and 64.15 lakh fingerlings of Indian major carps (IMCs) and Mahseer were released.
- Year-wise ranching indicated the gradual rise in fish ranching over the year from 2020 (2.0 lakhs), 2021 (11.2 lakhs), 2022 (22.07 lakhs), and the present 2023 (28.88 lakhs).
- A significant impact of river ranching was observed when compared with the time series data of ICAR-CIFRI records, showing that the landing of IMC increased by 28% and 49% at Prayagraj and Buxar compared to 2020.
- 181 fish species (172 native and 9 exotic) were recorded from the Ganga. The richest fish species were found in Bijnor (103), Narora (89), Prayagraj (84), Farakka (83), and so on, with the lowest at the site Harsil (4).
- Nine different exotic fish were recorded from the entire river Ganga. Common carp (Cyprinus carpio) had the greatest distribution of 54%, spanning the entire middle section of the river.
- ICAR-CIFRI has also assessed the current stock status of 11 fish species in the Ganga, including medium carp, catfish, and small indigenous fish.
- The results of the CPUE showed that West Bengal has the highest CPUE, followed by Uttar Pradesh, Jharkhand, Uttarakhand, and Bihar.
- The shifting of a few warm-water fish species has been noticed in the upper stretches of the river, primarily due to climate change.
- A total of 205 awareness programs in different states were conducted, and 10496 local fishermen and entrepreneurs were sensitized about sustainable fishing in the Ganga.
- 227 lakhs of IMC seeds were produced (2020–2023) through induced breeding of riverine wild fish germplasm.
- 27,000 fingerlings and 127 live brooders of Mahseer are maintained and raised by ICAR-CIFRI in Koteswar, Uttarakhand.
- Bijnor in Uttar Pradesh can be designated to be the ‘fish protection site’ or ‘fish sanctuary’ based on congregation of juveniles
- 93 genera of plankton were recorded across all stretches with maximum abundance at site Bhagalpur (Bihar) and minimum at Fraserganj (West Bengal). The study also listed 20 different pollution indicating algal genera.
- A total of 75 genera of phytoplankton belonging to 8 groups were recorded across the sampling stations.
- 38 different families of benthic fauna were observed throughout the study in River Ganga while a 11 species were recorded in the lower and estuarine stretch of river Ganga.
- Species like *Filopaludina bengalensis* and *Physella acuta* are marked as potent bioindicators of heavy metal contamination like copper, lead and cadmium.
- ICAR-CIFRI has surveyed two important Gangetic tributaries viz. River Koshi and River Haldi in order to record and found present fisheries and limnological status.
- As a apart of ex-situ conservation 227 lakhs IMC spawn were produced by artificial breeding during the period 2021-2023
- A total of 27000 Mahseer fingerlings ranging in size from 2 to 5 centimetres were collected from several tributaries of the upper stretch of river Ganga for rearing and breeding
- 46 wetlands (from North to South) close to the main channel (River Hooghly) have been identified and analyzed according to their seasonal spread of water

Highlights

- ICAR-CIFRI was successfully employed to transport live hilsa, yielding favorable results in terms of survivability rates.
- An expression kinetic study of the HSP70 gene-associated transportation stress of *ilisha* was assessed.
- A total of 91,588 Hilsa brood fish were released upstream of the Farakka barrage during the period.
- The length-weight relationship (LWR) of a total of 31,867 specimens
- Artifical breeding of Hilsa has been carried out at two places, viz., Farakka and Godakhali in West Bengal, and fertilization rates of 56% and 87.9% were achieved, respectively.
- The detailed reproductive biology of Hilsa shad has been carried out during the monsoon and late winter months.
- Histology of Hilsa mature eggs has been carried out to understand the reproductive physiology of this species.
- Identification and characterization of the Hilsa gonadotropin-releasing hormone (GnRH) gene and its pathway have been deciphered for the first time.
- A total . of 22,47,000–23,57,000 eggs and 16,900 spawn of Hilsa were ranched upstream of the Farakka barrage for the improvement of the natural Hilsa population.
- Wild Hilsa fingerlings were captured, and studies were undertaken on their captivity.
- Standardization of the rearing of Hilsa seeds in grow-out systems, viz., FRP, earthen pond, and raceway, was done.
- A total of 243 Hilsa broods were in stock at circular cages installed by ICAR-CIFRI in the Ganga River at Farakka.
- A total of 3,065 Hilsa numbers were tagged to assess their upstream migration starting from October 2020 up to September 2023.
- Among the total tagged adult Hilsa, more than 7.8% recovered from different locations from their release point, with maximum recovery from the middle stretch.
- A total of 493 awareness programs were conducted at different sites in Farakka, where 14317 local fishermen and entrepreneurs were sensitized about the conservation of hilsa and dolphins.
- ICAR-CIFRI Under the NMCG program in the lower stretch of the Ganga (Farakka to Kakdwip), the survey could estimate as many as 289 dolphin populations.
- Workshops, webinars, and the Dolphin Day celebration were carried out successfully as a part of the holistic conservation of the river Ganga.
- The print media has been published in different regional languages like Bengali, Hindi, and English during the period 2020–23.
- Two booklets, 23 research articles, and 45 conference scientific papers on the Ganga were published.

Executive Summary

The ICAR-Central Inland Fisheries Research Institute at Barrackpore is responsible for managing India's inland open waters, including the mighty Ganga. ICAR-CIFRI has been periodically monitoring the fish, fisheries, and ecology of the Ganga River through many programs, notably the Ganga Action Plan (GAP). Currently, as part of the National Mission for Clean Ganga (NMCG), the Ministry of Jal Shakti has launched a massive project titled "Fish Stock Enhancement Including Hilsa and Livelihood Improvement for Sustainable Fisheries and Conservation in River Ganga" from 2020 to 2023. In this regard, the following notable accomplishments were achieved between the periods 2020 and 2023.

Fish ranching programs were undertaken in several deficient portions of the Ganga to enhance fish production and conserve native fish populations in order to restore selected Ganga fish species (IMCs and Mahseer) through ranching. A total of 57 different river ranching programs were carried out in five states (Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal), and 64.15 lakh fingerlings of Indian major carps (IMCs) and Mahseer were released (three times more than the previous year). Amongst all the states, maximum ranching was conducted in the state of West Bengal (53%), followed by Uttar Pradesh (27.1%), Bihar (12.5%), Jharkhand (7.2%), and Uttarakhand (0.20%). Year-wise ranching indicated a gradual rise in fish ranching over the years, from 2020 (2.0 lakhs), 2021 (11.2 lakhs), and 2022 (22.07 lakhs) to the present (28.88 lakhs).

A significant impact of river ranching was found when the present landing data from Prayagraj, Uttar Pradesh, was compared with the time series data of ICAR-CIFRI records, showing that the landing of IMC increased by 24.70% when compared to 1959 (11.70 metric tons). Similar results were also achieved from sites like Varanasi (an increase in IMC landing of 41.03%) and Buxar, Bihar. Similarly, from November 2020 to August 2023, quarterly field campaigns were conducted to analyze the fish community structure of the Ganga River, which was represented by 181 fish species (172 native and 9 exotics) belonging to 122 genera, 57 families, and 20 orders. According to the survey, the richest fish species were found in Bijnor (103), Narora (89), Prayagraj (84), Farakka (83), and so on, with the lowest at the site Harsil (4). Commercially important food fishes accounted for 65% of the total fish variety in the river, while ornamental fishes, sport fishes, and other species of minor value accounted for 31%, 2.0%, and 2.0%, respectively. Among the exotic fishes, common carp (Cyprinus carpio) had the greatest dispersion of 54%, spanning the whole middle section of the river. The study found new distributions of fish from Bijnor, Uttar Pradesh, like Bengala barb (Megarasbora elanga), Zebra fish (Danio rerio), and Loach (*Nemacheilus corica*). Warm

water tank goby (*Glossogobius giuris*) is reported from upstream of Tehri, Uttarakhand. For the first time, an exotic brown trout (Salmo trutta fario) is recorded under the NMCG from the Ganga River at Harshil, Uttarakhand. An exotic sucker catfish (Pterygopliicthys disjunctivus) range extension was also observed from the Ganga's Patna and Barrackpore stretch.

ICAR-CIFRI has also assessed the current stock status of 15 river Ganga fish species, including medium carps (Labeo calbasu), catfish (Clupisoma garua, Ailia coila, Eutropiicthys vacha, and Rita rita), and small indigenous fishes (Gudusia chapra, Cabdio morar, Johnius coitor, Salmostoma bacaila, and Rhinomugil corsula). The reproductive biology status of nine different Gangetic fish species is being studied by CIFRI under the present scenario of climate change.

A study on the annual catch and effort from the Ganga was carried out, covering 2378 km2 and 379 fishing villages from 45 districts in five states. The results showed that the middle and lower stretches are more productive than the upper stretch of the Ganga. During the project duration from November 2020 to September 2023, a total of 140 awareness programs in different states like Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal were carried out for sustainable fisheries. A total of 9528 local fishermen and entrepreneurs were sensitized about the negative impact of operating the zero-meshed net and other destructive fishing techniques, such as the use of toxic chemicals or poisoning by fishing.

A total of 227 lakhs of IMC seeds were produced through induced breeding of riverine wild fish germplasm as a technique of moving toward ex-situ conservation for the restoration of the Ganges' indigenous fish stock. For conservation and brood stock development of Mahseer in the upstream, a total of 27,000 fingerlings and 127 live brooders are maintained and raised by ICAR-CIFRI in Koteswar, Uttarakhand. Based on the congregation of the highest fish juveniles and fish species, site Bijnor in Uttar Pradesh can be designated as the ‘fish protection site’ or ‘fish sanctuary’. The multi-decadal study of the water quality of the Ganga River has indicated a significant variation in several physico-chemical parameters over the year. However, restoration strategies and climate change have impacted riverine water quality. From a pollution point of view, the highest polluted site with increased organic loading was observed at the middle stretch (Narora to Ballia) of the river compared to the upper stretch (Harsil to Bijnor). The analysis also revealed a total of 93 genera of plankton belonging to 9 groups and 6 phyla were recorded across all stretches during the study period, with maximum abundance at site Bhagalpur (Bihar) and minimum abundance at Fraserganj (West Bengal). The study also listed 20 genera of pollution-indicating algae, with the highest index value at Prayagraj and Varanasi, respectively, and the minimum at Harsil.

The highest benthic diversity (23 phylum molluscan species from 9 distinct families) was observed from Bijnor to the Ballia stretch of the river. Satellite mapping of the wetlands along the riverine stretch of the state of West Bengal revealed 46 wetlands, out of which 4 have retained their connection to the main river (open wetlands), while the rest of the 42 have lost their connection to the main river (closed wetlands). Preliminary studies on ecological aspects and fisheries were also undertaken in two tributaries of the Ganga, viz., the River Haldi (West Bengal) and the River Koshi (Bihar).

Among the heavy metals, accumulations of chromium (Cr), arsenic (As), cadmium (Cd), and lead (Pb) were observed in two edible Gangetic freshwater benthic species, viz., *Filopaludina bengalensis* and *Parreysia corrugata*. The maximum accumulation of all the estimated heavy metals was observed in *Parreysia corrugata* (order: Unionoida). Further accumulation of potent endocrine disruptive chemicals (Bisphenol A or BPA) was found in bivalves collected from the Ganga River from Buxar to the Tribeni stretch. A study on the target hazard quotient (THQ) of BPA accumulation in humans through consumption of prized *Tenualosa ilisha* (Hilsa) revealed the highest THQ at Barrackpore among the other lower stretch regions and in Kakdwip among the estuarine regions in men. In women, similar results were also observed.

One of the most significant commercial fish in the Indo-Pacific is the hilsa shad (*Tenualosa ilisha)*. The species is anadromous, meaning it spends its entire life in the ocean before migrating to a freshwater river system to reproduce. It is clear from various published data that there has been a significant drop in both the middle stretch and the stretch above the Farraka barrage. Therefore, to increase the hilsa population upstream of the Farakka barrage, the study was carried out with major objectives: i) to increase the natural stock of hilsa in the Ganga River (upstream of the Farakka barrage) through the ranching of wild-collected hilsa seed and juveniles. ii) to increase the natural stock of hilsa in the Ganga River (upstream of Farraka Barrage) through artificial breeding of hilsa and growing and ranching the seeds and juveniles, as well as developing captive broodstock. iii) to monitor the migration of hilsa through floy tagging and advanced techniques through tags; iv) to create an awareness program among the fishermen for conservation of depleted fish and Gangetic Dolphins all along the river bank of the Ganga from Prayagraj to Farakka *via* Balia, Buxar, Patna, Bhagalpur, and Rajmahal.

A total of 91,209 Hilsa fishes (16,900 spawn) were released upstream of the Farakka barrage during the period, with 15,100 Hilsa in the years 2020–2021, 50,055 in the years

2021–2022, and 26,054 in 2022–2023, respectively. The number of ranched Hilsa was almost 3.3 times higher during the second year compared to the first year of the phase II project, but in the third year it was 1.7 times higher. A population study of the Hilsa shad was done with more than 31,867 specimens and indicated negative allometric growth. Between November 2021 and April 2023, a total of 188 Hilsa (121 males and 67 females) in Farakka and 78 Hilsa (60 males and 18 females) in Godakhali were utilized for artificial breeding, of which the fertilization rates ranged from 72–80% and 57–60%, respectively, from both sites. Studies on the biological aspects of Hilsa indicated peak Gonado somatic index (GSI) values during the October and November months in the river Ganga. Different mature to spent stages of male and female Hilsa were found throughout the year. In the spent stage, ova diameter ranges from 0.15-0.39 mm, and during breeding, almost 92% of ova diameter ranges from 0.72-0.84 mm. When studied for fecundity, specifically in the months from September to November, the absolute fecundity of female Hilsa ranged from 81,454 to 7,37,100. In the late winter months, particularly during the Hilsa's winter migration in February and March, the absolute fecundity of female Hilsa ranged from 27,084 to 2,79,665. Across the entire year, the fecundity of female Hilsa ranged from 18,311 to 7,37,100 in absolute numbers. Interestingly, the months of September and March exhibited the highest fecundity among Hilsa specimens. Fertilized Hilsa seed was subjected to grow-out rearing in different captive conditions at the Hilsa ranching station at Farakka and supplemented with live fish food organisms, especially green algae (Chlorella), with regular monitoring of physic-chemical parameters. Experimental designs on captive rearing of Hilsa were carried out in different confined areas like an earthen pond, a pen in a river, a raceway, and circular FRP cages at Farakka, West Bengal. In 2021–22, one circular cage and in 2022–23, two more circular cages were installed to develop Hilsa brood stock. A total of 243 brooders of Hilsa developed in cages I, II, and III. The cage-reared Hilsa showed a 58% increase in body weight, but simultaneously, mortality of the fish was also high, touching 87.5% of the stocked Hilsa during the rearing period. Two pens were also installed in Ganga at the upstream end of Farakka Barrage with the lengths and widths (69 × 36 and 36 × 33 feet) of a total of 72 Hilsa brooders in raceways (32 × 12.5 × 1.5 feet). 600 Hilsa spawn and 30 juvenile Hilsa were stocked in the experimental pond (6 × 6 × 1.5 feet). 400 spawn were stocked for Hilsa brood stock development in captive conditions.

The challenges faced during the rearing of Hilsa included weather and physiological. A total of 97 Hilsa (weighing 170–485 g) were collected from different places, like upstream of the Farakka barrage. All of Hilsa recovered from the untagged condition in different places upstream of Farakka Barrage. It was noticed that fishers were catching Hilsa from Khursela, Bihar, up to 225 km from the ranching point upstream of the barrage. The resurgence of young Hilsa from upstream suggests that the sustained ranching of adult Hilsa in the middle stretch of the Ganga River contributes to fostering natural breeding processes, ultimately aiding in the restoration of the Hilsa population upstream in the Ganga River. A total of 3,038 Hilsa numbers were tagged to assess their upstream migration starting from October 2020 up until September 2023. Out of the total ranched Hilsa (91,209), 3.34% of adult Hilsa were tagged and released during the project tenure. Among the total tagged adult Hilsa, more than 7.8% recovered from different locations from their release point. Above 50% of adult Hilsa recovered from the middle stretch of the Ganga, while 17% of Hilsa recovered from the feeder canal, from Aduha to Baidyabati, West Bengal. 27% of the Hilsa was retrieved in the Beniyagram, Jafarganj, Hossenpur, and Dhuliyan, Murshidabad districts, where the Ganga flows toward Bangladesh downstream of the Farakka Barrage. The total awareness program for Hilsa and dolphin conservation in the last 3 years was 493, and the number of participants was 14,317. Of these, 86 were carried out mainly in Farakka and the adjacent places. A number of dolphin conservation activities, like workshops, seminars, etc., including rescue operations, have been undertaken by ICAR-CIFRI under the present project.

The Gonadotropin Releasing Hormone (GnRH) gene required for maturation in Hilsa was identified using the PCR method and successfully amplified and isolated as the complete GnRH gene for the Hilsa sample. The obtained GnRH gene sequence was submitted for the submitted for the first time to the NCBI database for public access. The amino acid analysis of a total of 10 nos. of Hilsa was carried out. The analysis revealed the availability of 16 different amino acids in Hilsa muscle (weight ranges from 300 to 650 g). Antioxidant analysis of Hilsa was also carried out during the period. The analysis revealed that Hilsa muscle (weighing 300 to 650 g) contained more than 70% of antioxidants. Females contained more antioxidants than male Hilsa in blood serum; this is the first report about the antioxidant property of Hilsa. Biochemical evaluation of Hilsa milt showed that the antioxidant assay indicated that the DPPH radical scavenging efficacy of Hilsa milt was 66.5±2.5%, which was closer to the synthetic antioxidant Butylated Hydroxyltolune and exhibited significant reducing power ability.

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1. INTRODUCTION

The Ganga is the most iconic river in India in terms of ecological and spiritual significance. The Ganga River rises from the Garhwal Himalaya at 6,000 meters and flows through the Sivalik Hills before draining into the lowlands in Haridwar. After passing five states in the northern plains, it finally drains into the churning seas of the Bay of Bengal via the Sunderbans delta, the world's largest mangrove system. The river is extremely important since it supplies water for cultivation, fishing, electricity generation via numerous hydrological projects, human daily needs, religious pilgrimage, and supports an extensive group of villages and cities along its 2,500-kilometer-long journey. The Ganga basin, with an extent of 860,000 square kilometers scattered across 11 states, is the world's most populous river basin. It inhabits over 600 million Indians, accounting for about half of the country's population, and generates more than 40% of the country's GDP. The basin supplies more than one-third of India's surface water, with 90% of it used for irrigation. Despite its iconic significance and sacred legacy, the Ganga is currently experiencing major ecological challenges as well as threats to its biodiversity and environmental sustainability.

The ICAR-Central Inland Fisheries Research Institute (CIFRI), Barrackpore, and its Regional Center in Prayagraj have been continuously monitoring and evaluating the ecology and fisheries, including fish diversity, catch, fishermen's way of life, and habitat of the Ganga River since its inception. They have also built up a repository of biological and ecological data on the Ganga River system. Through the program "Fish Stock Enhancement, including Hilsa and Livelihood Improvement for Sustainable Fisheries and Conservation in the River Ganga," the National Mission for Clean Ganga (NMCG) has provided financial support to ICAR-CIFRI for the restoration and conservation of native fish species in the Ganga River. River ranching programs were conducted by releasing fingerlings of Indian major carps (IMCs) and Mahseer, produced by induced breeding. Ranching is presently being conducted across different stretches of the river, covering states like Uttar Pradesh, Jharkhand, and West Bengal. At the same time, ICAR-CIFRI has also received funding for a project titled "Hilsa Fisheries Improvement in River Ganga at Farakka" from the National Mission for Clean Ganga, with the objectives of ranching, tagging of hilsa in the upstream of Farakka barrage, and raising awareness among fisherman related to conservation of hilsa in the river.

1.1. MAJOR COMPONENTS

1.1.1. Enhancement of depleted fish stock through captive breeding of indigenous stock and ranching programme at the selected sites in river Ganga.

1.1.2. Hilsa fisheries improvement in the middle stretch (Prayagraj to Farakka) of river Ganga through broodfish release and captive broodstock development.

1.1.3. Community participation and awareness programme on fish conservation in the entire stretch of river Ganga for improving the livelihood of the poor fishers.

1.2. OBJECTIVES

1.2.1. To restore selected fish species (IMC and Mahseer) of river Ganga through ranching

1.2.2. To assess the stock of selected fishes (IMC and Mahseer) of river Ganga

1.2.3. To create awareness among stakeholders regarding sustainable fisheries

1.2.4 To produce seeds of selected fishes (IMC and Mahseer) of river Ganga using riverine germplasm

1.2.5 To identify the key riverine stretch/wetlands important with respect to fish conservation.

1.2.6 To increase the natural stock of hilsa in river Ganga (upstream of Farraka barrage) through ranching of wild-collected hilsa seed/juveniles

1.2.7. To increase the natural stock of hilsa in river Ganga (upstream of Farraka barrage) through artificial breeding of hilsa and growing and ranching the seeds/juveniles as well as developing captive broodstock

1.2.8. To monitor the migration of hilsa through Floy tagging and advanced techniques through tags

1.2.9. To create an awareness programme among the fishermen for the conservation of depleted fish and Gangetic Dolphin all along the river bank of Ganga from Prayagraj to Farakka *via* Balia, Buxar, Patna, Bhagalpur and Rajmahal

1.3. Study area along river Ganga

Quarterly field campaigns were carried out from November 2020 to September 2023 for sampling in different sites covering the 24 sites of states likes Uttarakhand, Uttar Pradesh, Bihar, and West Bengal. The sampling sites of the river are tabulated below (Table 1 and Fig. 1).

Table 1. State and distance-wise distribution of sampling stations in river Ganga

River Ganga

State	Stations	Distance between two stations (Km)
Uttarakhand	Harshil	0
	Tehri	133.09
	Haridwar	133.02
Uttar Pradesh	Bijnor	97.47
	Narora	182.58
	Farrukhabad	211.35
	Kanpur	186.88
	Prayagraj	264.87
	Mirzapur	124.58
	Chunar	58.70
	Varanasi	33.86
	Ghazipur	47.68
	Ballia	35.15
Bihar	Buxar	127.62
	Patna	151.20
	Bhagalpur	282.89
West Bengal	Farakka	202.79
	Jangipur	54.01
	Berhampore	70.07
	Balagarh	185.46
	Tribeni	26.37
	Godakhali	90.66
	Diamond Harbour	36.84
	Fraserganj	73.19

Fig. 1. Study area along the river Ganga

2. OBJECTIVES

OBJECTIVE I: TO RESTORE SELECTED FISH SPECIES (IMC AND MAHSEER) OF RIVER GANGA THROUGH RANCHING

River ranching is an aquaculture strategy in which a fish population is kept in captivity during the first stage of its life cycle and then resealed in a specific ecosystem to maintain and perpetuate the population without compromising the stock characteristics of the local fish fauna. River ranching programs can improve inland water ecosystem health, prevent habitat degradation, protect aquatic species, assess ecological services, and optimize socioeconomic advantages. This approach also ensures the commercialization of small-scale fisheries and increases production in the inland fisheries industry. There is, nevertheless, a need to provide a steady supply of high-quality fingerlings of the desired fish species for river ranching. On-field broodstock development and fingerling-raising facilities were maintained by ICAR-CIFRI. Since the year 2016, the ICAR-Central Inland Fisheries Research Institute (CIFRI) has been allocated to undertake a scientific river ranching program in the Ganga River to restore the indigenous prized fish stock under the flagship initiative of the National Mission for Clean Ganga, New Delhi. Fish ranching programs were carried out in several areas of the Ganga River as a component of the CIFRI-NMCG project with the goal of restoring and conserving fish populations. As part of this, ICAR-CIFRI has undertaken a tremendous effort to implement the "National Ranching Programme" from 2022–2023 across several states. ICAR-CIFRI carried out 57 different ranching activities (Table 2) over time to conserve and restore Indian Major Carps (IMC) and Mahseer in the river, releasing 64.15 lakh fingerlings (formed through induced breeding of Gangetic brooders) of IMC, Mahseer, and indigenous fish and prawn species.

During the period 2020–2023, Ganga fish ranching was conducted in four different states, viz., Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal. Amongst all the states, maximum ranching was conducted in the state of West Bengal (53%), followed by Uttar Pradesh (27.1%), Bihar (12.5%), Jharkhand (7.2%), and Uttarakhand (0.20%) (Fig. 2). Year-wise ranching depicted in Fig. 3. indicates the gradual rise in fish ranching over the years from 2020 (2.0 lakhs) to the present in 2023 (28.88 lakhs). The decrease in ranching in the year 2020 is mainly due to the effect of COVID-19 all across the globe.

Table 2. List of river ranching programmes of Indian Major Carps (IMCs) and other indigenous fishes conducted for sustainable fisheries for the period 2020-2023

Sl No.	Date	Sites	Species	No. (lakhs)
1	04.11.2020	Barrackpore, West Bengal	IMC	0.50
2	21.11.2020	Prayagraj, Uttar Pradesh	IMC	1.50
3	26.01.2021	Barrackpore, West Bengal	IMC	0.35
4	05.03.2021	Prayagrag, Uttar Pradesh	IMC	0.15
5	08.03.2021	Prayagraj, Uttar Pradesh	IMC	0.15
6	12.03.2021	Prayagraj, Uttar Pradesh	IMC	0.20
7	16.03.2021	Prayagraj, Uttar Pradesh	IMC	0.15
8	17.03.2021	Barrackpore, West Bengal	IMC	0.20
9	18.03.2021	Prayagraj, Uttar Pradesh	IMC	0.30
10	19.04.2021	Koteshwar jheel, Uttarakhand	Mahseer	0.01
11	10.07.2021	Daspara Ghat, Barrackpore	IMC	0.50
12	10.07.2021	Prayagraj, Uttar Pradesh	IMC	0.03
13	10.07.2021	Garhwal, Uttarakhand	Mahseer	0.01
14	05.08.2021	Maharajpur, Jharkhand	IMC	1.0
15	05.08.2021	Sahibganj, Jharkhand	IMC	1.0
16	05.08.2021	Farakka, West Bengal	IMC	1.0
17	05.08.2021	Jangipur, West Bengal	IMC	1.0
18	05.08.2021	Berhampore, West Bengal	IMC	1.0
19	06.10.2021	Barrackpore, West Bengal	IMC	0.75
20	01.11.2021	Belur Math, Howrah, West Bengal	IMC	2.0
21	02.11.2021	Chandannagar, Hooghly, West Bengal	*Labeo bata* (bata), *Heteropneustes fossilis* (singhi), *Macrobrachium rosenbergii* (giant river prawn), and *Systomus sarana* (sarana)	0.60
22	15.11.2021	Prayagraj, Uttar Pradesh	IMC	0.60
23	23.11.2021	Gandhi Ghat, Barrackpore	IMC	0.20

24	17.03.2022	Prayagraj, Uttar Pradesh	IMC	0.50
25	28.03.2022	Prayagraj, Uttar Pradesh	IMC	0.20
26	14.05.2022	Gandhi Ghat, Barrackpore	IMC	2.0
27	17.05.2022	Ayodhya, Uttar Pradesh (River Saryu) **	IMC	2.0
28	25.05.2022	Farakka, West Bengal	IMC	2.0
29	26.05.2022	Nabadwip , West Bengal	IMC	2.0
30	31.05.2022	Dakshineshwar, West Bengal	IMC	2.0
31	02.06.2022	Bhagalpur, Bihar	IMC	2.0
32	03.06.2022	Patna, Bihar	IMC	2.0
33	02.08.2022	Sahibganj, Jharkhand	IMC	2.0
34	19.08.2022	Varanasi, Uttar Pradesh	IMC	2.0
35	12.10.2022	Farakka, West Bengal	IMC	0.8
36	21.11.2022	Barrackpore West Bengal	IMC and *M. rossenbergii*	1.3
37	21.11.2022	Farakka, West Bengal	IMC	0.12
38	06.12.2022	Balagarh, West Bengal	IMC	1.15
39	26.02.2023	Prayagraj, Uttar Pradesh	IMC	0.10
40.	02.04.2023	Fatehpur, Uttar Pradesh	IMC	0.30
41.	05.04.2023	Mayapur, Nadia, West Bengal	IMC,	2.1
42.	11.04.2023	Mirzapur, Uttar Pradesh	IMC	2.0
43.	17.04.2023	Kanpur, Uttar Pradesh	IMC	2.0
44.	19.04.2023	Varanasi, Sant Ravi Das Ghat, Uttar Pradesh	IMC	2.12
45.	25.04.2023	Farakka, West Bengal	IMC	2.0
46.	26.04.2023	Sahibganj, Jharkhand	IMC	0.60
47.	05.05.2023	Barrackpore, West Bengal	IMC	2.0
48.	06.05.2023	Barendrapara Ghat, Bally, West Bengal	IMC	2.5
49.	09.05.2023	Balagarh, West Bengal	IMC	2.0
50.	09.05.2023	Tribeni, West Bengal	IMC	2.1

51.	23.05.2023	Bhagalpur, Bihar	IMC	2.0
52.	17.06.2023	Rishkesh, Uttarakhand	Mahseer	0.10
53.	30.06.2023	Patna, Bihar	IMC	2.0
54.	01.07.2023	Ballia, Uttar Pradesh	IMC	2.10
55.	23.08.2023	Kalna, West Bengal	IMC	1.56
56.	08.09.2023	Raibarelly, Uttar Pradesh	IMC	1.00
57.	27.09.2023	Barrackpore, West Bengal	IMC	0.30
			Total ranching (lakhs)	**64.15**

Abrreviation: IMC- Indian Major Carps (*Labeo rohita*, *Labeo catla* and *Cirrhinus mrigala*)

** Tributary of river Indo-Gangetic basin

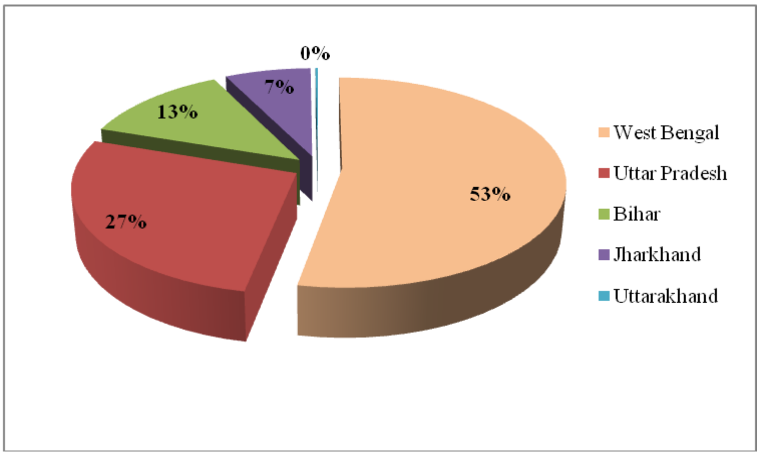


Fig. 2. State wise depiction of the percent (%) share of river ranching

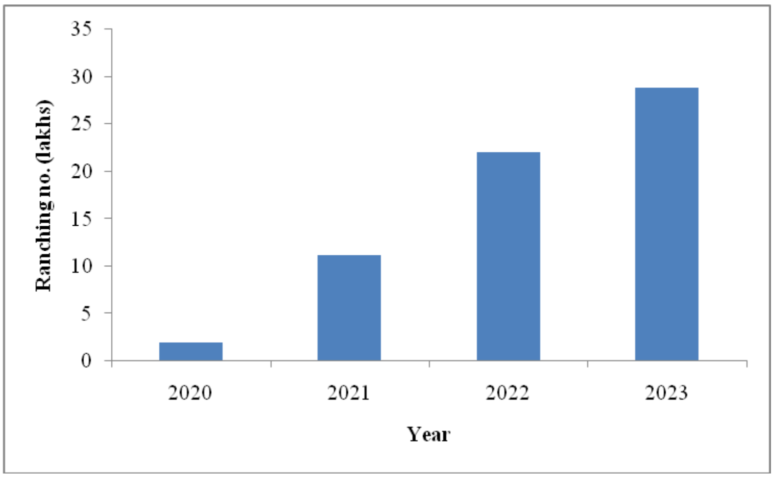


Fig. 3. Year wise depiction of the river ranching in lakhs (2020-2023)

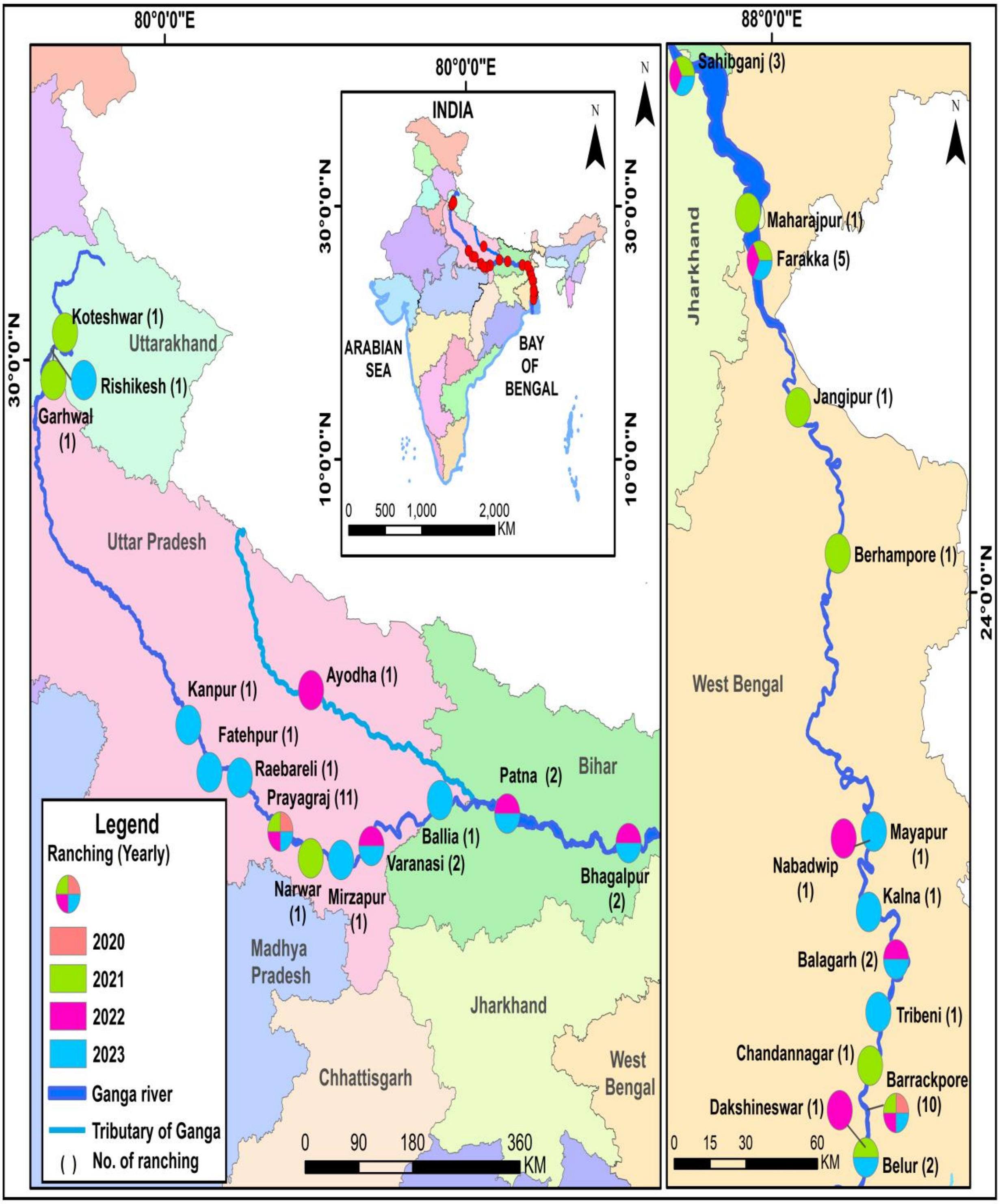


Fig. 4. Maps showing number of river ranching programme (site wise) along the river Ganga stretch during 2020-2023

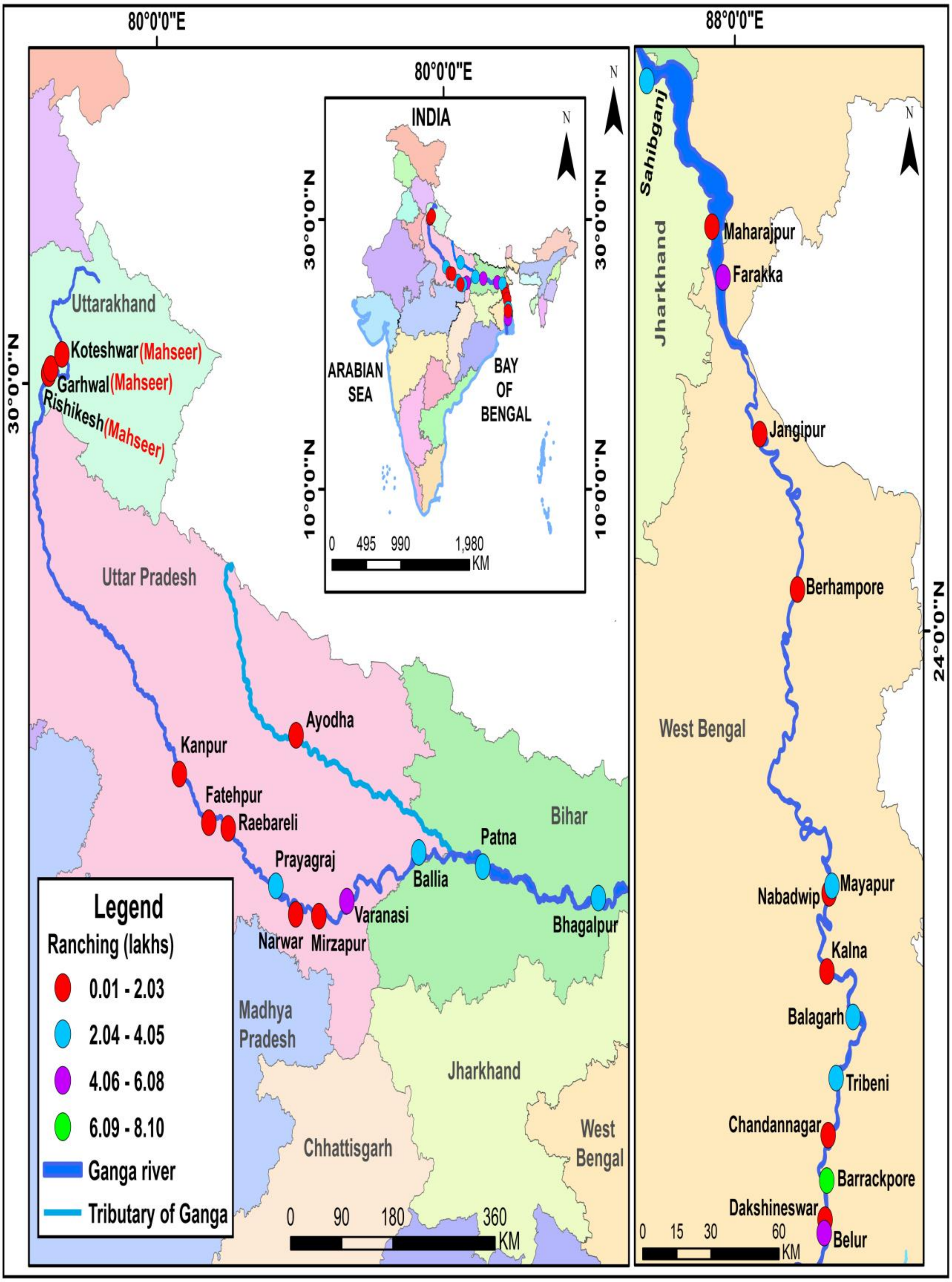


Fig. 5. Maps showing amount of river ranching programme (in lakhs) along the river Ganga during the period of 2020-23 stretch during 2020-23

2.1. River Ranching Programme at Gandhi Ghat, Barrackpore, 4 November 2020

A ranching programme was organized at Gandhi Ghat, Barrackpore, on the eve of Ganga Utsav on November 4, 2020, by the ICAR-Central Inland Fisheries Research Institute, Barrackpore. A total of 50,000 fish species, combining fingerling and advanced fingerling of Rohu, Catla, and Mrigal, were released in the river.

Fig. 6. Ranching Programme at Gandhi Ghat, Barrackpore, 4th November, 2020

2.2. River Ranching Programme at Prayagraj, 21 November 2020

Fifteen thousand fingerlings of Indian Major Carp (IMC) were released into the Ganga River on the occasion of World Fishery Day on November 21, 2020, organized by ICAR-CIFRI, Prayagraj.

Fig. 7. Ranching Programmes at Prayagraj, 21 November 2020

2.3. Ranching programme at Daspara ghat, Barrackpore, 26 January 2021

ICAR-CIFRI organized a ranching cum tagging program on January 26, 2021, on the occasion of the 72nd Republic Day of India, at Daspara Ghat, Barrackpore, West Bengal. As a part of the event, a total of 35,000 fingerlings of Rohu, Catla, Mrigal, and Calbasu have been released into the Ganga. Besides ranching, 100 fish were tagged with an external floy tag to know the migration pathway; hence, management measures can be taken to conserve these natural fish genetic resources.

Fig. 8. Ranching Programme at Daspara Ghat, Barrackpore on 26th January 2021

Fig. 9. Tagging of IMC on 26th January 2021

2.4. Ranching programme at Sangam (Prayagraj), 5 March 2021

The ranching cum mass awareness program was held on March 5, 2021, at Sangam Nose (Prayagraj). About 15,000 fingerlings of Indian major carps (IMCs), including Calbasu (Labeo calbasu), were released into the river Ganga by the ICAR-CIFRI, Prayagraj. Mrs. Anamika Chaudhari (province convenor, Ganga Vichar Manch) was present as a chief guest on this occasion. She described and advised the people on how to improve the Ganga biodiversity and control pollution in the river Ganga.

Fig. 10. Ranching programme at Sangam, Prayagraj, on 5 March, 2021

2.5. Ranching programme at Raj Ghat (Varanasi), 8 March 2021

Ranching cum mass awareness program was held on March 8, 2021, at Raj Ghat (Varanasi), during which 15,000 IMC fingerlings were released in the Ganga River by the ICAR-CIFRI (Prayagraj). On this occasion, Ravindra Prasad, CEO of the Fisheries Department, Varanasi, was present as a chief guest and Ex. P.S. Dr. B. K. Singh as a special guest, and both dignitaries advised the fishermen and other participants on how to maintain the biodiversity of the Ganga River and almost improve the water quality.

Fig. 11. Ranching programme at Prayagraj, 8th March 2021

2.6. Ranching cum mass awareness program at Manda (Prayagraj), 12 March 2021

In the Ranching Cum mass awareness program held on March 12, 2021, at Narvar Chaukhatta (Manda), 20,000 IMC fingerlings were released in the Ganga River by the ICAR-CIFRI (Prayagraj). Manvendra Singh, an ex-official of FCI, and Rajesh Sharma (a member of Ganga Vichar Manch) graced the program as chief guests and special guests.

Fig. 12. Fish Ranching programme at Prayagraj, 8th March 2021

2.7. Ranching programme at Kada Dham (Kaushambi), 16 March 2021

Fifteen thousand IMC fingerlings were released in the Ganga River at Kada Dham (Kaushambi) by the ICAR-CIFRI (Prayagraj) on March 16, 2021. During the program, Shri Rajesh Sharma (Ganga Vichar Manch) was present as a chief guest, and he described the importance of the Ganga River and its conservation and also advised following the fishing ban or closed fishing season.

Fig. 13. Ranching programme at Kadadhaam (Kaushambi) on 16thMarch 2021

2.8. Ranching programme at Daspara Ghat, Barrackpore, 17 March 2021

A total of twenty-thousand indigenous catfish fingerlings (Mystus vittatus) were released in the river Ganga on the occasion of the 75th Foundation Day (Platinum Jubilee) of CIFRI at Daspara Ghat, Barrackpore, on March 17, 2021, to enhance the indigenous fish stock. As a part of this program, an awareness campaign was also organized to create awareness regarding sustainable fisheries among local fishers. More than 150 fishermen actively participated in this awareness program.

Fig. 14. Ranching programme at Barrackpore, 17 March 2021

2.9. Ranching program at Ram Ghat (Prayagraj), 18 March 2021

In the Ranching Cum mass awareness program held on March 18, 2021, at Ram Ghat (Prayagraj), 30,000 IMC fingerlings were released in the Ganga River at Ramghat (Prayagraj) by the ICAR-CIFRI (Prayagraj). On this occasion, Shri Shekhar Kumar Yadav (Judge of the High Court, Prayagraj, UP) was present as Chief Guest. Shri Rajesh Sharma (Member of Ganga Vichar Manch) and Suresh Chandra (Head of Harihar Ganga Arti Samiti Prayagraj) also attended the program and advised people not to pollute the Ganga River.

Fig. 15. Ranching programme at Ramghat (Prayagraj) on 18th March 2021

2.10. Ranching program at Koteshwar Jheel, Uttarakhand on 19 April 2021

ICAR-CIFRI, Prayagraj Regional Centre in collaboration with State Fisheries Department Officials of Tehri organised fish ranching programme at Koteshwar jheel (below Tehri Dam) Uttarakhand on 19 April 2021. A total of 1000 fingerlings of Mahseer were ranched to enhance the indigenous fish stock of the Ganga River. The entire programme was conducted by maintaining COVID guidelines and mask as well as sanitizers were distributed among the local fishermen.

Fig. 16. Mahseer ranching programme at Koteshwar Jheel (below Tehri Dam) Uttarakhand on 19th April 2021

2.11. Ranching programme at Daspara Ghat, Barrackpore, 10 July 2021

A ranching-cum-tagging program was organized by ICAR-CIFRI to celebrate 'National Fish Farmers' Day' under the NMCG project at Daspara Ghat, Barrackpore, on July 10, 2021. A total of fifty thousand fish species, including advanced fingerlings of Rohu, Catla, and Mrigal, were released in the river Ganga for the restoration of wild germplasm. Five hundred adult carp (Rohu, Catla, and Mrigal) were tagged and released to the river to identify the fundamentals of migration range during the ranching program. Dr. Basanta Kumar Das, Director, ICAR-CIFRI, and Principal Investigator, ICAR-CIFRI-NMCG Project, highlighted the importance of the ranching and tagging processes as well as sensitized the local fishermen about the purpose of tagging.

Fig. 17. IMC ranching-cum-tagging programme at Daspara Ghat, Barrackpore, 10th July 2021

2.12. Ranching programme at Sangam Nose, Parayagraj, 10 July 2021

The fish ranching program was organized by ICAR Prayagraj Regional Center at Sangam nose, Parayagrajon, on the occasion of National Fish Farmers's Day, July 10, 2021. Mrs. Abhilasha Gupta, 'Nandi' Mayor of Prayagraj, graced the program as chief guest and Mr. Rajesh Sharma (Province Coordinator of Ganga Vichar Manch, Prayagraj) as special guest. Mr. K. P. Upadhya (Wildlife Institute of India, Dehradoon, Uttrakhand) also participated along with his team in this program. Three thousand fingerlings of Indian major carp have been released in the Ganga at the Sangam nose of Prayagraj. The mayor requested that the fishermen not catch the brooders and fingerlings during monsoon season and also suggested that pilgrims, priests, and the public not pollute the river.

Fig. 18. River ranching programme at Sangam nose, Parayagraj on 10th July 2021

2.13. Ranching programme at Garhwal, Uttarakhand on 10 July 2021

On the occasion of 'National Fish Farmers' Day', a river ranching program of mahseer fish was conducted by the ICAR-CIFRI and NMCG teams in association with the Department of Fisheries, Tehri, at Garhwal, Uttarakhand, on July 10, 2021. One thousand fingerlings of Mahseer were ranched through this program.

Fig. 19. Mahseer ranching at Garhwal, Uttarakhand on 10th July 2021

2.14. Ranching programme at Maharajpur, Sahebganj, Farakka, Jangipur, and Berhampore, 5 August 2021

ICAR-Central Inland Fisheries Research Institute, Barrackpore, organized a multi-locational river ranching program under the NMCG project to celebrate 'Azadi Ka Amrut Mahotsav' at five different places like Maharajpur, Sahebganj, Farakka, Jangipur, and Berhampore, covering Jharkhand and West Bengal states, on August 5, 2021, for the holistic fisheries development of the river Ganga. A total of five lakhs (one lakh in each place) of wild fish germplasm from IMC fingerlings were ranched through this ranching program.

Fig. 20a. River Ranching Programme at Maharajpur, Jharkhand

Fig. 20b. River Ranching Programme at Sahibganj, Jharkhand

Fig. 20c. River Ranching Programme at Farakka, West Bengal

Fig. 20d. River Ranching Programme at Behrampore, West Bengal

Fig. 20e. River Ranching Programme at Jangipur, West Bengal

Fig. 20(a-e). River Ranching Programme at Jharkhand and West Bengal

2.15. Ranching programme at Gandhi Ghat, Barrackpore, 6 October 2021

ICAR-Central Inland Fisheries Research Institute, Barrackpore, celebrates '75 Azadi Ka Amrut Mahotsav'. To commemorate this momentous milestone, ICAR-CIFRI organized a ranching program under the NMCG project at Gandhi Ghat, Barrackpore, West Bengal, on October 6, 2021, for the holistic fisheries development of the river Ganga.

The event was started with a blissfulGanga Arti' and graced by Dr. Trilochan Mohapatra, Honourable Secretary, Department of Agricultural Research and Education and Director General, ICAR, and Dr. Joykrushna Jena, Honourable Deputy Director General (Fisheries Science), ICAR. A total of seventy-five thousand fingerlings of IMCs were ranched through this ranching program. In addition to this, 50 Catla fish were tagged and released in the river for migration study and to take up appropriate conservation measures.

Fig. 21. Ranching programme at Gandhi Ghat, Barrackpore, West Bengal on 6th October 2021

Fig. 22. IMC tagging at Gandhi Ghat, Barrackpore, West Bengal on 6th October 2021

Fig. 23. *'Ganga Arti'* at Gandhi Ghat, Barrackpore, West Bengal on 6th October 2021

2.16. River Ranching Programme at Barendrapara Ghat, Belur Math, Howrah, 1 November 2021

On the occasion of 'Ganga Utsav', fish river ranching was conducted at Barendrapara Ghat, Belur Math, Howrah, on November 1, 2021. Two lakhs of artificially bred wild IMC germplasm from the Ganga River (Rohu, Catla, and Mrigal) seeds were released into the river. The program was graced by the holy presence of Srimat Swami Atmapriyananda Ji Maharaj, Vice-Chancellor of Ramakrishna Mission Vivekananda Educational and Research Institute, Dr. Basanta Kumar Das, Director, ICAR-CIFRI, Principal Investigator of the NMCG project, several local dignitaries, and cooperative society personnel.

2.17. River Ranching Programme at Chandannagar, Hooghly, West Bengal, November 2021

Forty thousand fish, comprising *Labeo bata* (bata), *Heteropneustes fossilis* (stinging catfish), *Macrobrachium rosenbergii* (giant river prawn), and *Systomus sarana* (sarana), were released to the Ganga on November 2, 2021, on waterways by a vessel.

2.18. Ranching programme at Sangam Nose, Prayagraj, Uttar Pradesh, 15 November 2021

At the confluence of the holy Ganga and Yamuna, a river ranching program was conducted at Sangam Nose (Prayagraj) by ICAR-CIFRI, Prayagraj Center, on November 15, 2021. Thirty thousand advanced IMC fingerlings were released in the Ganga River by the ICAR-CIFRI (Prayagraj). Dr. Joykrushna Jena, Hon'ble Deputy Director General (DDG, Fisheries Science) of ICAR, New Delhi, was the Chief Guest on the occasion.

2.19. Ranching programme at Gandhi Ghat, Barrackpore, 23 November 2021

To enlighten on the occasion of '***Ganga Mashaal Yatra'**, the* ICAR-CIFRI team organized a river ranching program at Gandhi Ghat, Barrackpore, on November 23, 2021. A total of 20,000 IMCs (*Labeo rohita*, *Labeo catla*, *Cirrhinus mrigala*, and *Labeo calbasu*) were ranched in the Ganga River for the enhancement of fish stock (Fig. 3).

Fig. 24. Ranching at different sites accros river Ganga**; A-** Belur Math, Howrah, 1st November 2021, **B-** Chandannagar, Hooghly, West Bengal, 2nd November 2021, **C-** Sangam Nose, Prayagraj, Uttar Pradesh, 15th November 2021, **D-** Gandhi Ghat, Barrackpore, 23rd November 2021

2.20. Ranching programme at Arail Ghat, Prayagraj, 17 March 2022

On the occasion of the 76th foundation day of ICAR-CIFRI (17 March 2022), a ranching cum mass awareness program was organized at Arail Ghat (Prayagraj). Fifty thousand fingerlings of Indian major carps (IMC's), including Catla (*Labeo catla*), Rohu (*Labeo rohita*), and Nain (*Cirrhinus mrigala)*, were released into the river Ganga under the NMCG program. Dr. Sunanda Chaturvedi (Principal, H.N.B.P.G. College, Naini, Prayagraj) was present as a chief guest on this occasion. While addressing the function, she explained the importance of the Ganga and called for keeping it clean. Dr. Awadesh Kumar Jha (Professor) spoke about the importance of Ganga for human civilization, and Convenor Ganaga Vichar Manch and NMCG, Mr. Rajesh Sharma, administered the oath to students and gathered the audience during the program.

2.21. Ranching program at Sangam, Prayagraj, 28 March 2022

A ranching program was held on March 28, 2022, at Sangam, Prayagraj. Ten thousand IMC fingerlings were released in the Ganga River at Sangam by the ICAR-CIFRI (Prayagraj) under the NMCG program. Mahanth Balbir Giri ji Maharaj, Head of the Baghambari Gaddi Math, was the chief guest of this program. While addressing the function, he explained the importance of the Ganga for human civilization and culture and called for keeping it clean. Mr. Rajesh Sharma Convenor, Ganga Vichar Manch, and NMCG briefed about the importance of the program.

2.22. Ranching programme at Gandhi Ghat, Barrackpore, West Bengal, 23 November 2021

'National Ranching Programme-2022' was initiated from Barrackpore, West Bengal, with the gracious presence of Honourable Director General NMCG & PD, NRCD, Mr. Shri G Asok Kumar, IAS, and Dr. B. K. Das, Director, ICAR-CIFRI. A total of two lakh artificially bred wild fish germplasm of IMC seeds (Rohu, Catla, and Mrigal) were released into the river on May 14, 2022, at Gandhi Ghat, Barrackpore.

2.23. Ranching programme at Guptar Ghat, Ayodhya, Uttar Pradesh, 17 May 2022

Two lakh IMC were released into the Saryu River, Ayodhya, Uttar Pradesh, in continuation of the event on May 17, 2022, for the conservation and restoration of these species in the river. The event was organized by ICAR-CIFRI and CIFRI Prayagraj Regional Center in the august presence of Dr. B. K. Das, Director, ICAR-CIFRI, Shri Ved Prakash Gupta, Honourable MLA, Ayodhya, as the chief guest on the occasion, and Shri Nitish Kumar, DM, Ayodhya, as the guest of honor. 25 cast nets were distributed to the active fishermen of the locality to improve their livelihood by the guests of the event (Fig. 4). It is foreseen that the fish released at Ayodhya will travel through the tributary, i.e., the river Ghaghara, and ultimately meet the river Ganga at its confluence near the town of Chapra in the state of Bihar.

Fig. 25. Ranching at different sites accros river Ganga**;** **E-** Arail Ghat, Prayagraj, 17 March 2022, **F-** Sangam, Prayagraj, 28 March 2022, **G-** Gandhi Ghat, Barrackpore, West Bengal, 23 November 2021, **H-** Guptar Ghat, Ayodhya, Uttar Pradesh, 17 May 2021

2.24. Ranching program at Gandhi Ghat, Farakka, West Bengal, 25 May 2022

As a part of ‘National Ranching Programme 2022', an awareness program was organized by ICAR-CIFRI on May 25, 2022, at Taltala Ghat, Farakka, West Bengal. The program was graced by several government . officials and dignitaries, like Amalendu Barman, ADF, Junaid Ahmed, BDO, and Naresh Talwar, SP. Dr. Basanta Kumar Das, Director, CIFRI, and Principal Investigator of the project, sensitized local fishermen and highlighted the importance of conservation of the indigenous fish population and hilsa as well as dolphins. A total of 236 local people, including fishermen, were sensitized in this program.

2.25. Ranching program at Ranir Ghat, Nabadwip, West Bengal on 26 May 2022

An awareness program was organized by ICAR-CIFRI on May 26, 2022, at Ranir Ghat, Nabadwip, West Bengal, as a part of the ‘National Ranching Programme 2022'. Dr. B. K. Das, Director, ICAR-CIFRI, District Fishery Officer of Nadia District, Mr. Ramesh Chandra Biswas, and Mr. Dhiren Murmu attended the program with other eminent guests. A total of 43 local people were sensitized during the program.

2.26. Ranching programme at Dakshineswar, West Bengal, 31 May 2021

In continuation of the event, a consecutive awareness program was organized by ICAR-CIFRI at Dakshineswar on May 31, 2022, where more than 22 local fishermen were sensitized. The event was graced by Senior Consultant, Mr. Brijesh Sikka, and Dr. Sandeep Behera, Consultant, NMCG. The dignitaries highlighted the significance of riverine resources and fish diversity in the Ganga and created awareness of hilsa and dolphin conservation among the fishers. They were also sensitized about the use of non-conventional fishing methods such as poisoning and zero-mesh nets.

2.27. Ranching programme at Sultanganj, Bhagalpur, Bihar, 2 June 2022

A total of two lakh artificially bred wild fish germplasm of IMC seeds (Rohu, Catla, and Mrigal) were released into the river Ganga to celebrate 'National Ranching Programme-2022' at Bhagalpur, Bihar, on June 2, 2022 (Fig. 5). Mr. Subrat Kumar Sen, DM, Bhagalpur, was the chief guest on the occasion, and Mr. Manoj Kumar Murmu, BDO, Sultanganj, Dr. Md. Zeaul Hoda, representative of Bihar Agriculture University, and Mr. Krishna Kanhaiya, DFO, Dept. of Fisheries, graced the occasion as the guest of honor. Dr. B. K. Das, Director, ICAR-CIFRI, sensitized the local fishermen towards the importance of ranching as a conservation strategy for the restoration of indigenous fish stock in the river Ganga.

Fig. 26. Ranching at different sites accros river Ganga**;** **I-** Gandhi Ghat, Farakka, West Bengal, 25 May 2022, **J-** Ranir Ghat, Nabadwip, West Bengal on 26 May 2022, **K-** Dakshineswar, West Bengal, 31 May 2021, **L-** Sultanganj, Bhagalpur, Bihar, 2 June 2022

2.28. Ranching programme at Patna, Bihar, 3 June 2022

Two lakh IMCs were released into the Ganga River at Patna, Bihar, in continuation of the event on June 3, 2022, for the conservation and restoration of native IMCs. The event was organized by ICAR-CIFRI in the dignified presence of Shri Tarkishore Prasad, Hon'ble Dy. Chief Minister of Bihar, as chief guest. Mr. N. Sravan Kumar, Secretary, Animal Husbandry Department, Govt. of Bihar; Sri Nishat Ahmad, Director, Bihar Fisheries Services; and Dr. Rameshwar Singh, Hon'ble Vice-Chancellor, Bihar Animal Sciences University, were the guests of honor. Dr. B. K. Das, Director, ICAR-CIFRI, sensitized the local fishermen towards the conservation of indigenous fish stock through the river ranching program.

2.29. Ranching programme at Mukteshwar Ghat, Sahibganj, 2 August 2022

To celebrate 75 Azadi Ka Amrit Mahotsav, the ICAR-Central Inland Fisheries Research Institute released 2 lakh fingerlings of IMC (*Labeo rohita*, *Labeo catla*, and *Cirrhinus mrigala*) through the river ranching program at Mukteshwar Ghat, Sahbiganj, on August 2, 2022. The program was graced by the District Magistrate, Shri Ramniwas Yadav (IAS), Sahibganj, District Fisheries Officer, and other officials.

2.30. Ranching programme at Assi Ghat, Varanasi, Uttar Pradesh, 19 August 2022

On the occasion of Holy Janmashtami, a river ranching program was organized at Assi Ghat, Varanasi, Uttar Pradesh, by the ICAR-CIFRI team under the NMCG project on August 19, 2022. About 2 lakh IMC fingerlings were released in the Ganga River. The event was graced by the Hon'ble Union Minister of Fisheries, Animal Husbandry, and Dairy Shri. Parshottam Rupala, Dr. J. K. Jena (DDG, Fy. Sc), ICAR, Dr. Sandeep Kumar Behera (Consultant Biodiversity, NMCG), Mr. Darshan Nishad, Mr. Sunil Bhai Ojha (social activist), and Shri Anil Kumar (Director of Fisheries, Department of Fisheries, Uttar Pradesh).

2.31. Ranching programme at Assi Ghat, Varanasi, Uttar Pradesh, 20 October 2022

Another river ranching program was held at Assi Ghat, Varanasi, Uttar Pradesh, by ICAR-CIFRI under the NMCG project on October 20, 2022. Five thousand IMC fingerlings were released into the Ganga River (Fig. 6). The event was graced by Sri G. Ashok Kumar, D.G., NMCG, who released the advance fingerling into the Ganga River, which was followed by a Ganga Arti and Swachchhata Campaign. The program was attended by Dr. Sandeep Behera (Consultant, NMCG), officials from State NMCG-UP, the Forest Department of Uttar Pradesh, the Ganga Task Force, Ganga Vichar Manch, staff of ICAR-CIFRI, Prayagraj, and local people living on the banks of the Ganga River.

Fig. 27. Ranching at different sites accros river Ganga**; M-** Patna, Bihar, 3 June 2022, **N-** Mukteshwar Ghat, Sahibganj, 2 August 2022, **L-** Assi Ghat, Varanasi, 19 August 2022, **O-** Assi Ghat, Varanasi, 20 October 2022

2.32. Ranching programme at Taltala Ghat, Farakka, West Bengal, 22 October 2022

A river ranching program was conducted at Taltala Ghat, Farakka, West Bengal, by ICAR-CIFRI under the NMCG project on October 22, 2022. A total of 0.8 lakhs of artificially bred wild germplasm of Indian Major Carps fingerlings were released in the Ganga River under NTPC CSR in association with the Namami Gange Programme (Fig. 7). The event was graced by several dignified persons like Mr. R. D. Deshpandey (GM Farakka barrage), Mr. Abheejet Kumar (DGM, EGN, NTPC), Mr. Sandeep Kumar, Supt. Eng (Farakka barrage), Mr. Deepak Nayak (in charge, KVK, Malda), Dr. B. K. Das (PI, CIFRI-NMCG Project), and other scientific staff of the CIFRI-NMCG team.

Fig. 28. Ranching programme at Taltala Ghat, Farakka, West Bengal 22 October 2022

2.33. Ranching Programme at Barrackpore, West Bengal

ICAR - Central Inland Fisheries Research Institute, Barrackpore celebrated World Fisheries Day on 21 November 2022 at Daspara Ghat, Barrackpore with a river ranching Programme of Indian Major Carps and freshwater prawns (*M. rosenbergii*) The Programme was graced by his holiness Shri. Swami Shivapurnanada Maharaj, Asstt. Administrative head, IRDM F/C, and Vice Chairman SSKVK, Ramakrishna Mission Vivekananda Educational and Research Institute, Prof. Ashis Kumar Panigrahi, Pro-Vice-Chancellor, University of Burdwan and several other Subject Matter Specialists (SMSs) from various Krishi Vigyan Kendra in West Bengal.

2.34. Ranching Programme at Balagarh, West Bengal

In continuation of this, a ranching cum awareness program was organized on December 6, 2022, at Balagarh Ferry Ghat District-Hooghly in the presence of Dr. Basanta Kumar Das, Director CIFRI, and the PI NMCG project. As a token of respect for the women fishermen of the Ganges, the ranching was carried out by 32 active fishermen during the event.

Fig. 29. Ranching programme at Barrackpore, West Bengal 21 November 2022

Fig. 30. Ranching programme at Balagarh, West Bengal 6 December 2022

2.35. Ranching Programme at Prayagraj, Uttar Pradesh

For the conservation and restoration of fish in the Ganga, a total of 10,000 (ten thousand) fish fingerlings were released from Ram Ghat, Sangam, and Praygraj by the ICAR-Central Inland Fisheries Research Institute on February 26, 2023. Advance-size fingerlings of Indian Major Carp, viz. Catla, Rohu, and Mrigal fish, were ranched in the presence of Dr. Dilip Kumar, Advisor (FAO), Dr. Sandeep Behera, Senior Consultant Biodiversity, NMCG, New Delhi,and Dr. B.K. Das (Director, CIFRI).

Fig. 31. Ranching programme at Ram Ghat, Sangam, Uttar Prdesh 26h February 2023

2.36. Ranching programme at Fatehpur, Uttar Pradesh

For the conservation and restoration of fish in the Ganga, a total of 0.30 lakh fish fingerlings were released from Bhitora Ghat, Fatehpur, on April 2, 2023. Fish fingerlings of Indian Major Carp, viz. Catla, Rohu, and Mrigal fish, were ranched in the presence of Mr. G. C. Yadav, Assistant Director Fisheries, Govt. of Uttar Pradesh, and Mr. Rajesh Sharma, Co-coordinator Ganga Vichar Manch.

2.37. Ranching programme at Nabadwip, West Bengal

A river ranching program was conducted at the Swarupganj Ghat of Nabadwip beside the holy Mayapur ISKCON temple on April 5, 2023. On this occasion, 2.10 lakhs of IMC fingerlings (>10 g) were released in the Ganga River under the presence of Dr. Sandeep Behera, Senior Consultant, NMCG; Mr. Srinivas Patil, ADM (Development); Nadia; Mr. Pradip Baurin (DFO, Nadia); and Mr. Surojit Bag, Assistant Director of Fisheries, Nadia, West Bengal.

2.38. Ranching programme at Mirzapur, Uttar Pradesh

A total of 0.20 lakh advance-sized fingerlings of Indian Major Carp, viz. Catla, Rohu, and Mrigal, were ranched in Narghat at Mirzapur, Uttar Pradesh, on April 11, 2023, in the presence of Mr. Abhishek Verma, Fisheries Officer, Govt. of Uttar Pradesh, and Mr. Rajesh Sharma, Co-Coordinator Ganga VicharManch.

2.39. Ranching programme at Kanpur, Uttar Pradesh

A total of 0.50 lakhs of advance-size fingerlings of Indian Major Carp, viz. Catla, Rohu, and Mrigal fish, were ranched in Atal Ghat at Kanpur, Uttar Pradesh, on April 17, 2023, under the gracious presence of Sri G. Ashok Kumar, Director General, National Mission for Clean Ganga (NMCG), and other eminent personalities like Dr. Vijay Lakshmi Saxsena, President, ISCA, Dr. G. P. Dixit, Director, ICAR-IIPR, Kanpur, Dr. U. K. Sarkar, Director, ICAR-NBFGR, Dr. Nurul Haq, Deputy Director, Dept. Fisheries, Uttar Pradesh, Subedar Hirugade Vishwanath of Ganga Task Force, and others.

2.40. Ranching programme at Varanasi, Uttar Pradesh

Two lakh twelve thousand (2.12 lakhs) of advance fingerlings of Indian Major Carp (IMC) fish were ranched under the National River Ranching Programme in the Ganga River at Sant Ravidas Ghat, Varanasi, on April 19, 2023. Dr. B. P. Mohanty, Assistant Director General (Inland Fisheries), was a special guest of the occasion along with other dignitaries, namely Shri Sanjeev Kumar, District Forest Officer (DFO), Shri Anil Kumar, Deputy Director, Department of Fisheries, Uttar Pradesh, and Lt. Colonel Sunil Guhani of the Ganga Task Force.

2.41. Ranching programme at Farakka, West Bengal

As a part of the program, 2 lakh (two lakh) advance fingerlings of Rohu, Catla, and Mrigal were released on April 25, 2023, at Gandhi Ghat Farakka, Murshidabad, West Bengal. The event was graced by Shri Satis S. (GM, NTPC Farakka), Shri R.D. Deshpande (GM, Farakka Barrage Authority), Shri P.K. Saha (AGM, NTPC Farakka), Shri Jiju Jasper J. (I/C Divisional Forest Officer, Malda), Shri Sanjay Kumar Mishra (District Fisheries Officer, Murshidabad, Department of Fisheries, Govt. of West Bengal), Dr. Deepak Nayak (Incharge KVK, Malda), and others.

2.42. Ranching programme at Sahibganj, Jharkhand

On April 26, 2023, 0.60 lakhs of advanced fish fingerlings of IMC were released at Ojha Toli, PuraniSahibganj Ghat, Sahibganj, Jharkhand, under the gracious presence of Shri Shantanu Thakur (Hon'ble Union Minister of State for Ports, Shipping, and Waterways), Shri Ramnivas Yadav,IAS (Deputy Commissioner, Sahibganj), and Shri Manish Tiwari (IFS), Divisional Forest Officer, Sahibganj, Jharkhand.

2.43. Ranching programme at Barrackpore, West Bengal

On the occasion of Holy Buddha Purnima, river ranching was performed by CIFRI under the NamamiGange program at Seoraphully Ghat, Barrackpore, West Bengal, on May 5, 2023. A total of 2.0 lakhs of advanced fingerlings of Indian Major Carps were released by Dr. B. K. Das, Director, ICAR-CIFRI, Dr. Harcharan Singh (Consultant NMCG), and other CIFRI officials, including local fishermen. In addition, 75 numbers of fish (average . size 500 g) were tagged to understand the migratory patterns.

2.44. Ranching programme at Belur, West Bengal

A ranching program was conducted at Belur (Barendrapara Ghat) in Howrah district adjacent to the holy Belur Math on May 6, 2023. During the event, 2.5 lakhs of advanced fingerlings of Indian Major Carps (>150 mm) were released in the Ganga River under the gracious presence of Swami Rashbehari Maharaj Ji (Belur Math, Ramakrishna Mission, and Ramakrishna Math). He highlighted the importance of Mother Ganges in our ancient purans and urged the fishermen to avoid indiscriminate fishing practices. Dr. B. K. Das addressed the local fishermen regarding the Namami Gange project and explained the importance of ranching.

2.45. Ranching programme at Balagarh and Tribeni, West Bengal

A consecutive river ranching was performed by ICAR-CIFRI at Balagarh and Tribeni, Hooghly district of West Bengal, on May 9, 2023. A total of 4.10 lakhs of advanced fingerlings of Indian Major Carps were ranched (Balagarh: 2.0 lakhs and Tribene: 2.10 lakhs) by Dr. B.K. Das, Director, CIFRI, during the program. Active participation by fisherwomen and fishermen was recorded during the event.

2.46. Ranching programme at Bhagalpur, Bihar

As a part of 'National Ranching Program 2023', ICAR-CIFRI, Barrackpore conducted a river ranching program at Sultanganj Ghat at Bhagalpur district, Bihar, under the Namami Gange program on May 23, 2023, outside of the eco-sensitive zone of the famous Vikramshila Dolphin Sanctuary, in the presence of staff from the Department of Fisheries, Govt. of Bihar, scientists from CIFRI, local fishermen, the local Panchayat head, press, and media personnel. A total of 2.0 lakh advanced fingerlings of Indian Major Carps (catla, rohu,and mrigal) were ranched in the Ganga River during the event.

2.47. Ranching programme at Rishikesh, Uttarakhand

Ten thousand Mahseer (*Tor putitora*) fingerlings were released into the Ganga river at Devprayag, Uttarakhand, by ICAR-CIFRI on June 17, 2023, in the presence of Shradhey Acharya Bal Krishna Ji, Vice Chancellor, Patanjali University, and Ayurvedacharya, Patanjali Yogpeeth Haridwar. Dr. B.K. Das, Director, ICAR-CIFRI, and Dr. Sandeep Behera, Senior . Consultant, NMCG, highlighted the importance of Mahseer in the Himalayan ecology and initiatives taken by CIFRI to restore them. Prof. (Dr.) Prakash Nautiyal from Hemvati Nandan Bahuguna University also addressed the local people and urged them to save the Ganga River.

2.48. Ranching programme at Patna, Bihar

A ranching program was conducted at Patna (Raja Ghat), Bihar, on June 30, 2023. During the event, 2.0 lakhs of advanced fingerlings of Indian Major Carps (>450 g) were released in the river Ganga under the gracious presence of Dr. Rameshwar Singh, Hon'ble Vice Chancellor of Bihar Animal Sciences University (BASU), Patna, Bihar. The event was also attended by Shri N.Jawahar, Principal Chief Conservator of Forest, Patna, Dr. Kamal Sharma (Principal Scientist), ICAR-RCER Patna, and many local fishermen. Dr. B.K. Das, Director, ICAR-CIFRI, highlighted the importance of ranching and distributed fishing nets among the local communities.

2.49. Ranching Programme at Ballia, Uttar Pradesh

ICAR-CIFRI released 2.10 lakhs of advanced fingerlings (>450 g) of Rohu, Catla, and Mrigal in the Ganga River at Ballia (Kotwa Narayanpur), Uttar Pradesh, under the 'Namami Gange' program on July 1, 2023. The river ranching was conducted by Shri Virendra Singh Mast, Hon'ble Member of Parliament from Ballia, and local state government officials. Dr. B.K.

Das, Director ICAR-CIFRI, highlighted the importance of gangetic fish fauna in the river Ganga and the initiatives ICAR-CIFRI took to restore them. Shri Virendra Singh Mast praised the efforts of ICAR-CIFRI under Namami and insisted on performing more ranching in the river stretch.

2.50. Ranching Programme at Kalna, West Bengal

One lakh fifty-six thousand (1.56 lakh) fingerlings of Indian Major Carps were released into the Ganga river at Kalna (East Burdwan District), West Bengal, by ICAR-CIFRI on August 23, 2023, by Dr. B.K. Das, Director CIFRI, and the NMCG team. Dr. Das highlighted the importance of IMC in safeguarding the geological fish biodiversity and urged them to save the River Ganga.

2.51. Ranching Programme at Dalmau (Raebareli), Uttar Pradesh

One lakh (1.0 lakh) fingerlings of Indian Major Carps were released into the Ganga River by the ICAR-Central Inland Fisheries Research Institute on September 8, 2023, at Dalmau, Raebareli, U.P. The program was organized on the occasion of the 'National River Ranching Programme', and advance-size fingerlings of Catla, Rohu, and Mrigal fish were ranched in the presence of Srimati Nirmala Paswan, Hon'ble Member of Legislative Council, U.P., Dr. U. K. Sarkar, Director, ICAR-NBFGR, Lucknow, and the CIFRI-NMCG team from Prayagraj Regional Centre.

2.52. Ranching Programme at Barrackpore, West Bengal

As a part of the National Ranching Program 2023 under the Namami Gange program, a river ranching was conducted on September 27, 2023, at Daspara Ghat, Barrackpore, West Bengal, on the occasion of the concluding workshop under the NMCG project on "Stakeholders consultation and consultative workshop on Hilsa fisheries improvement for sustainable fisheries and conservation in the river Ganga." During the event, 30 thousand advanced fingerlings of Indian Major Carps (catla, rohu, and mrigal) were ranched in the Ganga.

Fig. 9. Ranching programme at Fatehpur, Uttar Prdesh 2 April, 2023

Fig. 10. Ranching programme at Nabadwip, West Bengal 5 April, 2023

Fig. 32. Ranching programme at Mirzapur, Uttar Pradesh 11 April, 2023

Fig. 33. Ranching programme at Kanpur, Uttar Pradesh 17 April, 2023


Fig. 34. Ranching programme at Varanasi, Uttar Pradesh 19 April, 2023


Fig. 35. Ranching programme at Farakka, West Bengal 25 April, 2023

Fig. 36. Ranching programme at Sahibganj, Jharkhand, 26 April, 2023

Fig. 37. Ranching programme at Barrackpore, West Bengal, 5 May, 2023

Fig. 38. Ranching programme at Belur, West Bengal, 6 May, 2023

Fig. 39. Ranching programme at Balagarh, West Bengal, 9 May, 2023

Fig. 40. Ranching programme at Tribeni, West Bengal, 9 May, 2023

Fig. 41. Ranching programme at Bhagalpur, West Bengal, 23 May, 2023

Fig. 42. Ranching programme at Rishikesh, Uttarakhand, 17 June, 2023

Fig. 43. Ranching programme at Patna, Bihar 30 June, 2023

Fig. 44. Ranching programme at Ballia, Uttar Pradesh, 1 July, 2023

Fig. 45. Ranching programme at Kalna, West Bengal 23 August, 2023

Fig. 46. Ranching programme at Raibarelly, Uttar Pradesh 8 September, 2023

Fig. 47. Ranching programme at Barrackpore 27 September, 2023

3. Impact of river ranching

- The chronological landing of Indian Major Carps (IMC) at a few sites, viz., Prayagraj, Varanasi, Buxar, and Patna, is presented in Table 3. The impact of river ranching has been assessed by ICAR-CIFRI for the years 2020–23. The landing of Rohu, Catla, and Mrigal during 2018–2022 has shown an increasing trend in Ganga. However, there was a lesser catch in 2021 due to the lockdown due to the COVID-19 pandemic. Total annual Indian Major Carp (IMC) landing from the Prayagraj landing site of the river Ganga during November 2020 to October 2021 has been estimated at 11.38 tons. During the period 2021–2022, the IMC at Sadiyapur, Prayagraj, Uttar Pradesh was estimated to be 11.76 tons. The overall highest percentage was observed for the species *mrigala*, 30.84% (3.62 tonnes), followed by *L. catla*, 29.56% (3.47 tonnes), *L. rohita*, 25.40% (2.98 tonnes), and *L. calbasu*, 14.19% (1.66 tonnes). The period 2022–2023 marked a total production of 14.59 metric tons of IMC. Species-wise analysis of IMC revealed that *L. catla* 40.12% (5.84 metric tons) contributed the most, followed by L. rohita (32.18%), *C. mrigala* (17.71%), and *L. calbasu* (9.99%), respectively. The overall highest percent of IMCs landing was contributed by *C. mrigala* (48.00%), followed by *L. rohita* (22.00%), *L. catla* (28.28%), and *L. calbasu* (11.00%). Timeseries data extracted from ICAR-CIFRI records show that the landing of IMC at Prayagraj increased by 24.70% when compared to 1959 (11.70 tonnes).
- A fish landing of 42.84 tons was recorded in Varanasi during 2023. 48% of the total landing was shared by the miscellaneous group of fish, while catfish, exotic fish, and IMC shared 24%, 18%, and 10%, respectively. *Mrigala* (36%) was observed to be the most dominant species in the landing among IMC, followed by L. rohita (30%), L. catla (20%), and L. calbasu (14%). Previous records of IMC landing from Varanasi from 1959–60 (2.90 metric tons) when compared with the present landings (4.09 metric tons) showed an increase trend of 41.03%. However, data after 1968–1969 was not reported by ICAR-CIFRI in earlier records.
- The comparison to the previous landing records of IMC from the Buxar site of the Ganga River indicated a gradual rise in landings from the years 2018–2019. At the Buxar site after the years 1968–69, no landing records were found. The landing, which was 1.18 tons during 2018–19, rose to the present landing of 1.84 tons at present. Between December 2020 and November 2021, Patna, Bihar contributed 0.38 tonnes of IMC. Among the major carps, the percentage share of *mrigala* was recorded to be highest (0.156 t; 2.89%), followed by *L. rohita* (0.149 t; 2.74%) and *L. catla* (0.08 tonnes; 1.49%). Dimilarly, the

share of Indian Major Carp for the period 2021-2022 was recorded to be 3.06 tonnes. Among the major carps, the percentage share of *L. catla* was recorded to be highest (1.95 metric tons; 63.89%) throughout the year, followed by *L. rohita* (0.848 metric tons; 27.74%), *L. calbasu* (0.15 metric tons; 4.92%), and *C. mrigala* (0.105 metric tons; 3.44%). In comparison to the previous year's landing records of 2021 (5.42 metric tons), a sharp increase in production was noticed. Moreover, the rise in production of IMC from the previous year was also recorded. The present year marked a landing of 0.49 tons at the Patna site of the Ganga. A gradual decline in the landing of IMC was noticed from the year 1989 onwards to 2016. When compared with the previous landing of IMC at Patna, a decrease of 74% was recorded when compared to 1959 (12.70 metric tons). However, a rise in the trend of IMC was noticed at Patna after the continuation of river ranching.

Table 3. Chronological landing of IMC in different sites of river Ganga during different period

	Landing of Indian Major Carps (IMC) in tonnes			
Year	**Prayagraj**	**Varanasi**	**Buxar**	**Patna**
1959-60	11.7	2.9	30.4	12.7
1960-61	16.3	3.6	16.7	11.5
1961-62	19.9	1.2	NA	17.9
1962-63	23.5	0.9	NA	20.6
1963-64	20.8	0.9	3.1	11.9
1964-65	28.5	1.2	2.9	12.6
1965-66	21.4	3.4	6.7	13.5
1966-67	21.4	2.5	4.7	11.2
1967-68	16.8	1.2	1.3	8.5
1968-69	19.1	1.2	3.3	9.2
1972-80	31.0	NA	NA	NA
1981-90	35.8	NA	NA	NA
1989-90	NA	NA	NA	7.1
1991-00	6.6	NA	NA	NA
2004-05	11.11	NA	NA	NA
2012-13	41.88	NA	NA	NA

2015-16	16.1	NA	NA	NA
2016-17	NA	NA	1.37	0.73
2017-18	NA	NA	0.97	0.56
2018-19	NA	NA	1.18	0.75
2019-20	NA	NA	0.97	0.88
2020-21	11.4	NA	1.23	0.65
2021-22	11.8	NA	1.65	3.06
2022-23	14.6	4.09	1.84	3.55

Abbreviation: NA-Data Not Available; Data acquired from CIFRI Annual Report (1959-2000)

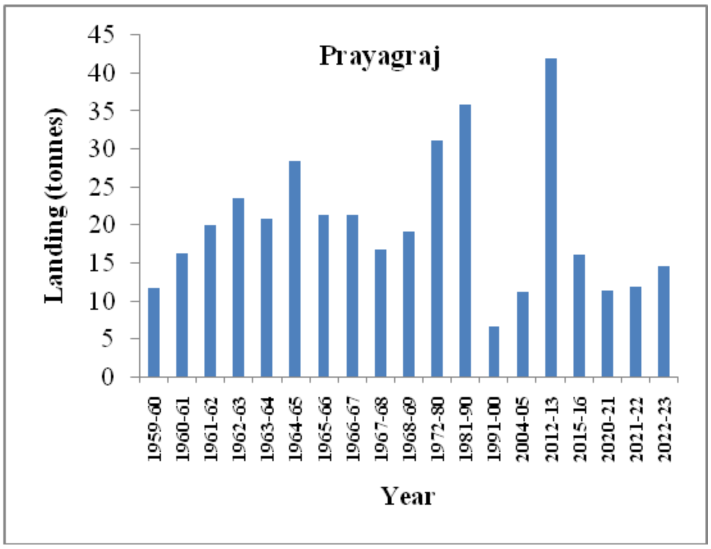


Fig. 48 A. Prayagraj

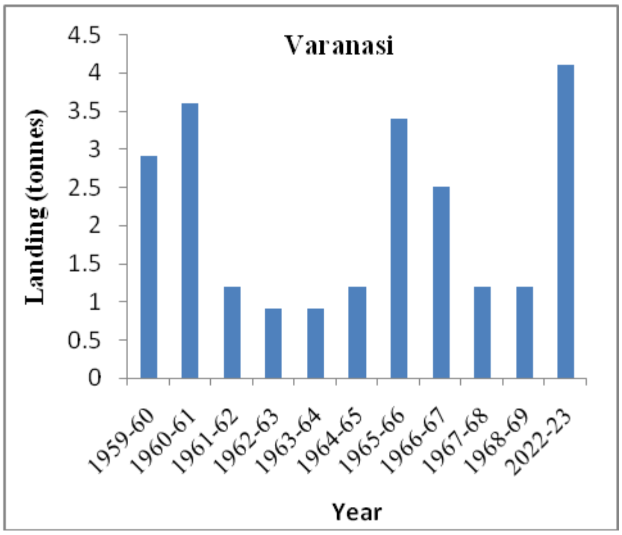


Fig. 48 B. Varanasi

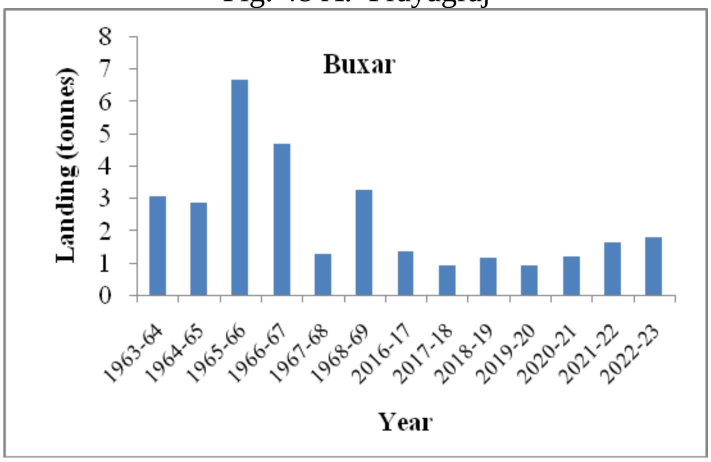


Fig. 48C. Buxar

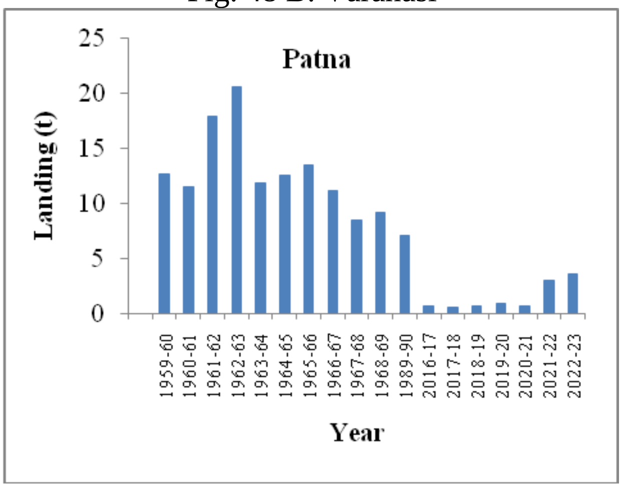


Fig. 48D. Patna

Fig. 48 (A-D) Decadal changes in landing of Indian Major carps in different sites of river Ganga

Fig. 49 (A-B) Catch of different size groups of Indian Major Carps from river Ganga

OBJECTIVE II: TO ASSESS THE STOCK OF SELECTED FISHES (IMCs AND MAHSEER) AT RIVER GANGA

4. Ichthyofaunal diversity of river Ganga

A total of 183 fish species (174 native and 9 exotic) belonging to 124 genera, 57 families, and 20 orders were recorded from the Ganga River during 2020–2023 (Table 6.). Combining all, till date, the seven-year survey (2016–23) of ichthyofaunal diversity in the river Ganga under the Namami Gange project has recorded a total of 215 fish species from the entire stretch of the river Ganga (Fig. 50). Out of the total fish species recorded, 138 species are freshwater, 43 species are habitant of both freshwater and brackish water, and 4 species are habitant of both brackish water and marine water. The fish species richness was observed to be highest in Bijnor (103) followed by Narora (89), Prayagraj (84), Farakka (83), and so forth. Among the exotic fish, the highest distribution was noticed for common carp, stretching the entire middle portion of the river.

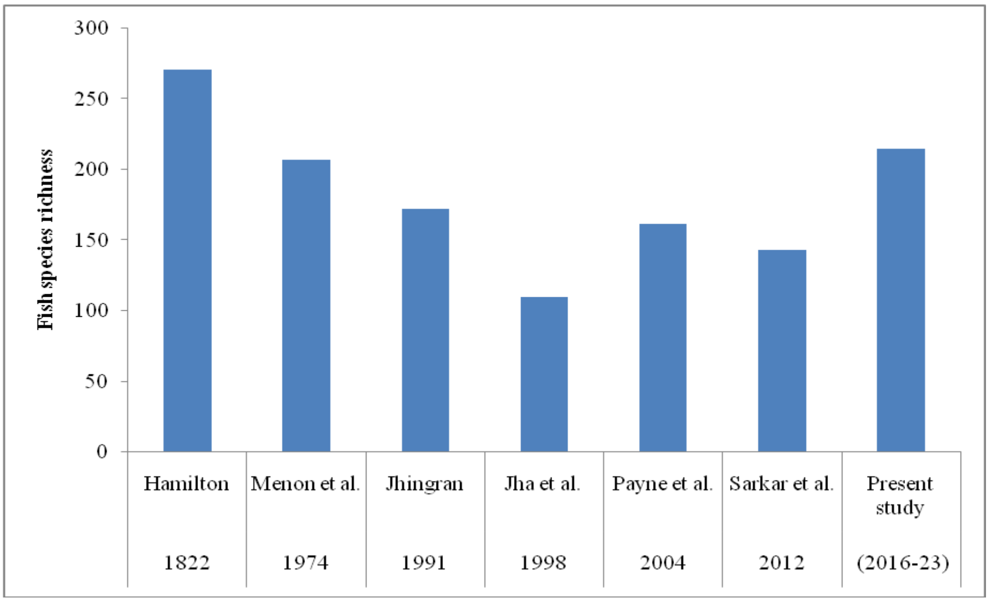


Fig. 50. Historical data on fish species recorded by different workers from river Ganga

The species, when grouped order-wise, showed the highest contribution by the order Cypriniformes (61 species), followed by Siluriformes (40 species), Perciformes (22 species), Clupeiformes (15 species), and so forth (Fig. 51.). Commercially important food fish shared 65%, whereas ornamental fish, sport fish, and other fish of lesser importance shared 31%, 2.0%, and 2.0%, respectively, of the total fish diversity in the river. Around 73% of the fish species found in the river are freshwater. Only 2% of the fish species belong purely to brackish water, and 24% of the fish fauna are inhabitants of both freshwater and brackish water.

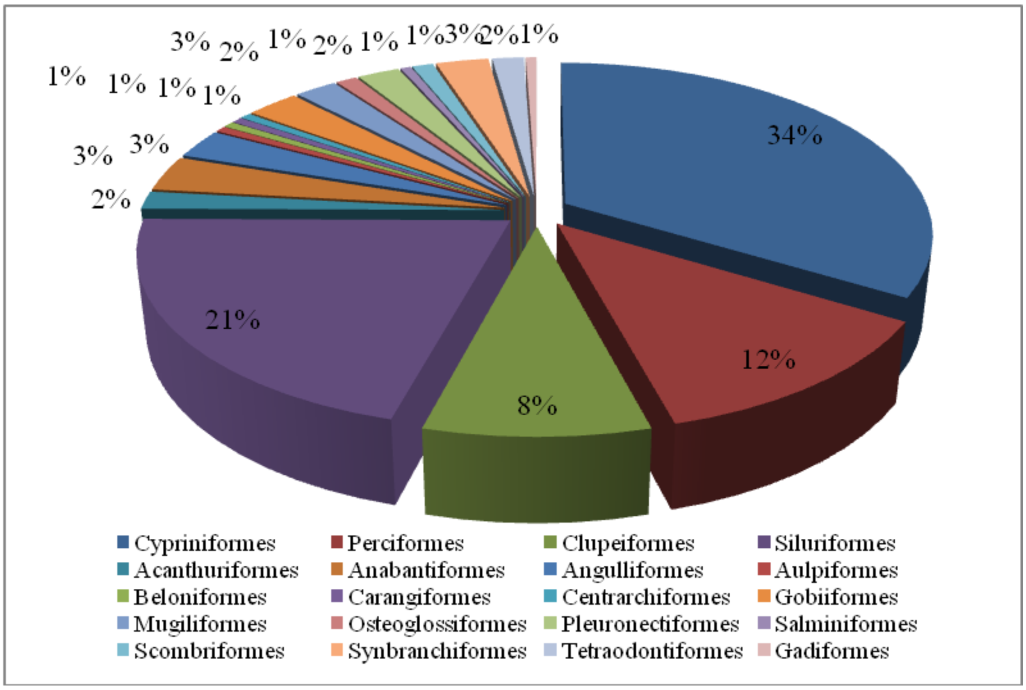


Fig. 51. Orderwise percentage of the fish species recorded for the period of 2020-2023

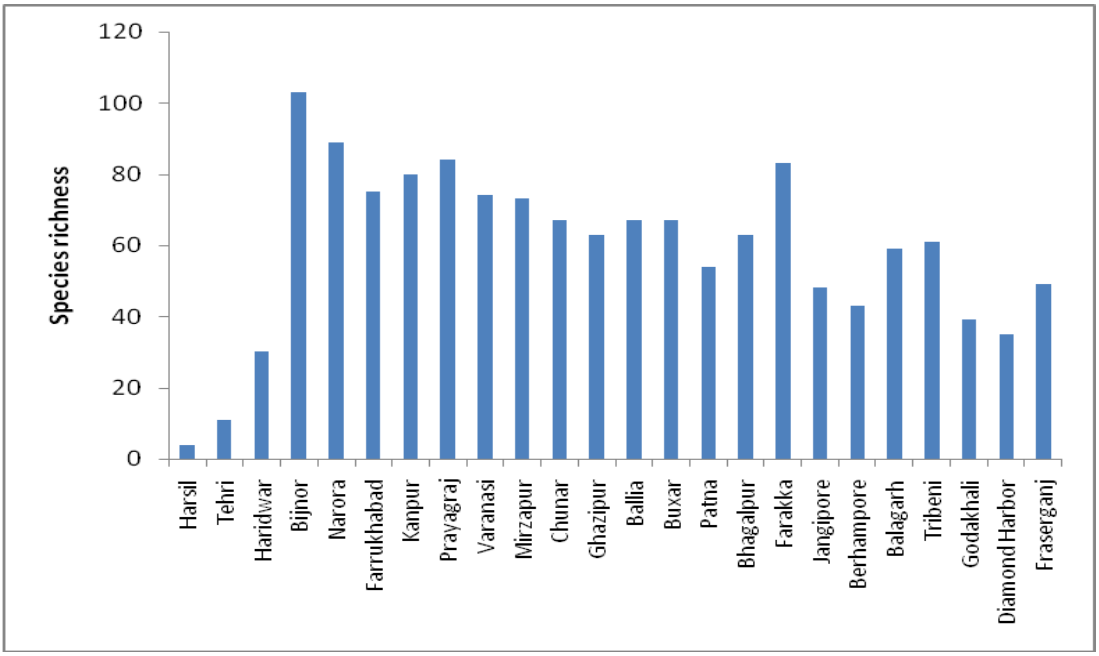
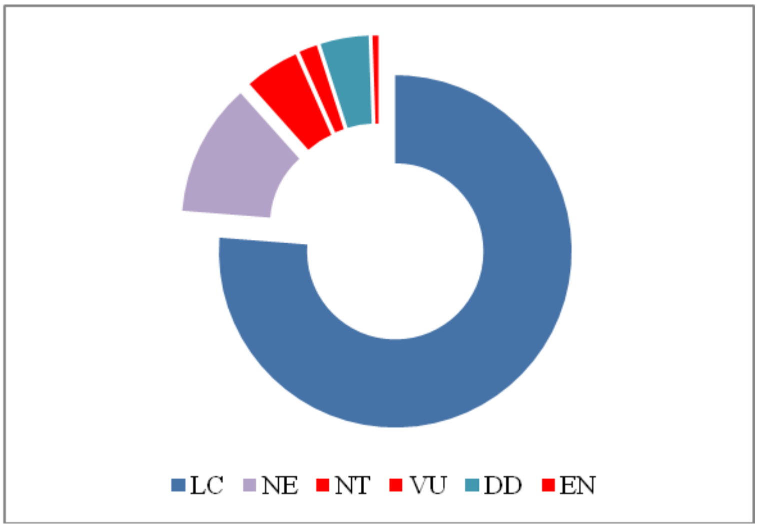


Fig. 52. Site wise fish species richness recorded from river Ganga (2020-2023)

- A total of 139 freshwater species belonging to 99 genera, 51 families, and 17 orders were collected in the Ganga River during 2020–2021. Of the total fish species, 106 species are freshwater, 8 species are habitant of both freshwater and brackish water, and 9 species are habitant of both brackish water and marine water. However, 16 fish species are found in freshwater, brackish water, and marine water. The order Cypriniformes showed the highest number of species (49), followed by Siluriformes (36 species) and Perciformes (18 species). Cyprinidae was the dominant family in the fish community, represented by 20 species and accounting for 14.39% of the total fish diversity, followed by Danionidae (18 species), Bagridae (7 species), and Aillidae (6 species).
- The fish community of the river Ganga is represented by 178 finfish species belonging to 121 genera, 56 families, and 20 orders during the period of November 2021 to October 2022. Of the total fish species, 131 species are freshwater, 43 species are habitant of both freshwater and brackish water, and 4 species are habitant of both brackish water and marine water. The order Cypriniformes showed the highest number of species (60), followed by Siluriformes (37 species), Perciformes (21 species), and Clupeiformes (14 species). The commercially important dominant family in the fish community was Cyprinidae, with 30 species, accounting for 16.9% of the total fish diversity, followed by Danionidae (19 species; 10.7%), Sisoridae (10 species; 5.6%), and Bagridae (9 species; 5.1%).

4.1. Conservation status

- The present conservation status of Gangetic ichthyofauna summarizes the currently available knowledge regarding the degree of biodiversity conservation (Fig. 53). Out of the total 181 fish species recorded during the present investigation, 137 species (76.2%) are listed under the Least Concern (LC) category as per the IUCN, while 8 species (5%) are listed as Near Threatened (NT), 3 species (1.7%) as Vulnerable (VU), and one (0.6%) as Endangered (EN) (Fig. 53).



(LC-least concern; NE-Not evaluated; NT-Near threatened; VU-Vulnerable; DD-Data deficient; EN-Endangered)

Fig. 53. Share of threatened fish species along river Ganga (2020-2023)

Tor putitora (Mahseer)

Ailia coila (Gangetic Ailia)

Ompok bimaculatus (Butter catfish)

Ompok pabda (Pabdah catfish)

Chitala chitala (Clown Knife fishh)

Parambassis lala (High fin perchlet)

Harpadon nehereus (Bombay duck)

Wallago attu (Wallago catfish)

Schizothorax richardsonii (Snow trout)

Bagarius bagarius (Giant river goonch)

Fig. 54. Pictograph of few IUCN redlisted fish species from river Ganga

4.2. Seasonal pattern of fishes in river Ganga

Period 2020-21

Spatio-temporal fish species richness in the Ganga River is presented in Fig. 55, and the highest fish species richness was observed at Bijnor and Narora stations, whereas the lowest was recorded at Tehri in both the premonsoon (Table 4) and monsoon (Table 5) seasons, which may be because this station is at the highest altitude (764 msl) among all other selected studies. Total fish species richness and non-endemic richness in the Himalayan rivers showed a gradual decline with increasing elevation, supporting Rapoport's rule in this study. The estimated diversity indices of the fish in the river for both seasons are shown in the table. The lowest diversity was observed at Tehri (H = 0.33), which also supported the findings of the maximum dominance index value of 0.87 in the premonsoon, and the highest at Farakka (H = 3.27). Among the fish species, the small indigenous fish and the only freshwater clupeid, Gudusia chapra (River shad), was found to be the most abundant in the river during the study period, contributing 16.63%, followed by the minor carp, Cabdio morar (Morari), with 11.47% of the total catch. At Harshil, only one species, i.e., Schizothorax richardsonii (snow trout), was recorded.

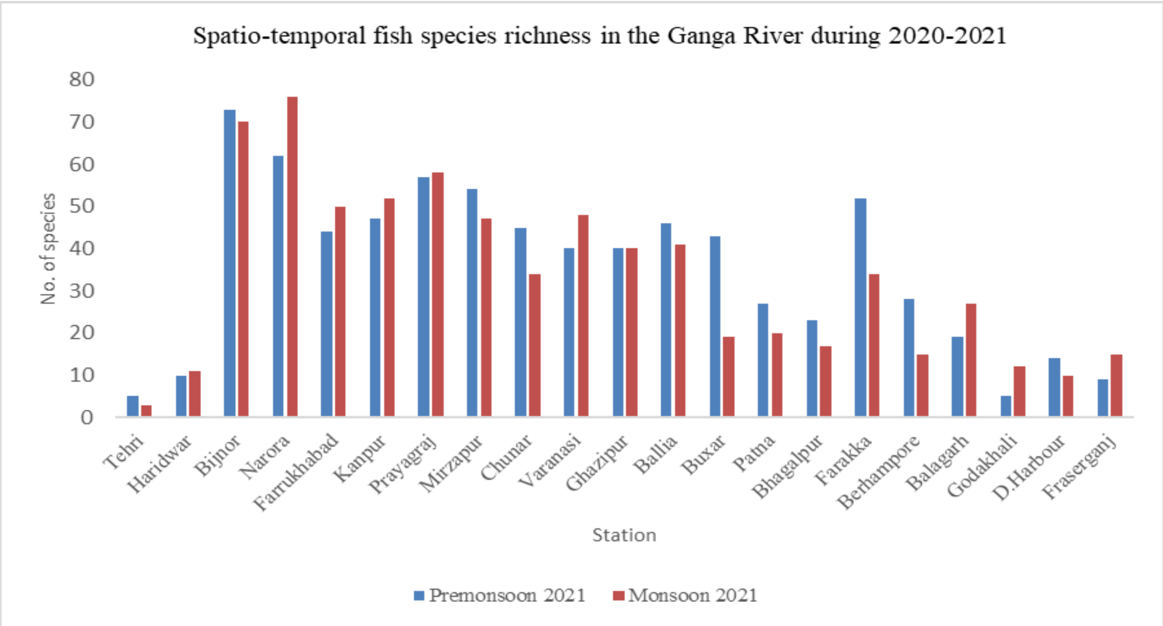


Fig. 55. Spatio-temporal fish species richness in the Ganga River during 2020-2021

Table 4. Diversity indices of fishes during premonsoon 2021 along the Ganga River

	Taxa_S	Simpson_1-D	Shannon_H	Evenness_e^H/S
Tehri	5	0.13	0.33	0.28
Haridwar	10	0.85	2.06	0.79
Bijnor	73	0.57	1.58	0.07
Narora	62	0.83	2.21	0.15
Farrukhabad	44	0.91	2.70	0.33
Kanpur	47	0.89	2.48	0.26
Prayagraj	57	0.84	2.29	0.17
Mirzapur	54	0.86	2.30	0.19
Chunar	45	0.61	1.33	0.08
Varanasi	40	0.86	2.36	0.27
Ghazipur	40	0.78	1.95	0.17
Ballia	46	0.85	2.32	0.22
Buxar	43	0.93	2.96	0.45
Patna	27	0.82	2.17	0.32
Bhagalpur	23	0.90	2.60	0.58
Farakka	52	0.95	3.27	0.50
Berhmapore	28	0.86	2.49	0.43
Balagarh	19	0.83	2.21	0.48
Godakhali	5	0.58	1.11	0.61
D.harbour	14	0.70	1.57	0.34
Fraserganj	9	0.78	1.75	0.64

Table 5. Diversity indices of fishes during monsoon 2021 along the Ganga River

Station	Taxa_S	Simpson_1-D	Shannon_H	Evenness_e^H/S
Tehri	3	0.06	0.15	0.39
Haridwar	11	0.84	2.08	0.73
Bijnor	70	0.85	2.29	0.14
Narora	76	0.86	2.57	0.17
Farrukhabad	50	0.88	2.61	0.27
Kanpur	52	0.89	2.58	0.25
Prayagraj	58	0.92	2.75	0.27
Mirzapur	47	0.81	2.14	0.18
Chunar	34	0.79	2.07	0.23
Varanasi	48	0.88	2.47	0.25
Ghazipur	40	0.86	2.52	0.31
Ballia	41	0.89	2.68	0.36
Buxar	19	0.85	2.27	0.51
Patna	20	0.80	2.00	0.37
Bhagalpur	17	0.89	2.39	0.64

Farakka	34	0.94	3.03	0.61
Berhmapore	15	0.84	2.11	0.55
Balagarh	27	0.89	2.58	0.49
Godakhali	12	0.85	2.07	0.66
D.harbour	10	0.79	1.76	0.58
Fraserganj	15	0.85	2.13	0.56

Period 2021-22

The seasonal richness of fish species across the entire river Ganga is presented in Figs. 10 and 11. During the premonsoon seasons, similar trends were observed throughout the middle stretch of the river, where maximum abundance was recorded for small indigenous fish species like *Salmostoma* sp. (32.68%), *Gudusia chapra* (14.60%), and *Cabdio morar* (10.38%). Among the large catfish, the species *Rita rita* (3.03%) exhibited the most abundance, followed by *Sperata* sp. (0.39%), *Wallago attu* (0.43%), and *Bagarius bagarius* (0.025%), respectively. The overall percentage composition of Indian major carps and minor carps was observed to be higher in comparison to pre-monsoon months, with 1.55% and 4.55%, respectively, during the period. The most abundant major and minor carp species were *Labeo rohita* (0.89%) and *Cirrhinus reba* (2.19%), respectively. In the upper sections of the river at Harsil, *Schizothorax richardsonii* was found to be the only individual species available, while at Tehri and Haridwar, Mahseer (91.39%) and *Cabdio morar* (53.64%) dominated the major portion of the catch.

During the monsoon, the percentage availability of a few SIF's increased largely in the upper and middle stretch. Species like *Channa striata* (11.62%) and *Gudusia chapra* (17.39%) dominated a major part of the landing in all the stretches. The catch during monsoon, particularly in July 2022, showed a huge landing of *Gudusia chapra* (Indian River Shad) in the entire stretch from Prayagraj to Buxar of the Ganga. The approximate catch at Buxar was recorded at around 0.2–0.3 tons per day with an average size length of 9.04±1.49 cm. The captured fish are reported to be sold at Rs. 20 per kilogram and transported to wholesale markets in populous cities such as Kolkata and Ranchi, fetching higher prices. Similar catch records were also observed in Prayagraj, where the catch has gone up to 0.3–0.4 metric tons per day. The sudden rise in the catch trend of this species may be attributed to the breeding season, which might have allowed the species to localize in the middle stretch. The approximate daily catch of catfish at Farakka was noted to be 30 kg per day, with the maximum catch of *Sperata aor* (long-whiskered catfish) having a size length of 23.83±2.39 cm. Besides other species, prawn, particularly *Macrobrachium* sp., was observed to contribute a substantial amount of catch, with an estimated daily catch of 15 kg. The Gangetic prawn beside Hilsa fetches a high market value, which may even rise to Rs. 1000 per kilogram. In the lower stretch at Godakhali, the average fish catch was estimated at 7.5 kg/day/boat.

During this period, different fish species like *Otolithoides pama*, *Polynemus paradiseus*, *Odontamblyopus rubicundus*, *Eleutheronema tetradactylum*, *Tenualosa ilisha*, *Setipinna phasa*, *Myutus gulio*, *Sillaginopsis panijus*, *Cynoglossus cynoglossus*, *Cynoglossus arel*, *Bagarius bagarius*, *Macrobrachium rosenbergii*, and *Ilisha megaloptera* were observed. *Macrobrachium rosenbergii* was the only prawn species recorded in Godakhali. Bagnets (2–10 mm cod end mesh size) and gill nets (65–100 mm mesh size) were operated during this month. The juveniles of *Polynemus paradiseus* and Hilsa are the major catch composition in bag net operations. During post-monsoon months, the availability of small indigenous fishes (SIF's) was recorded to be dominating with species like *Salmostoma* sp. (27.02%), *Amblypharyngodon mola* (16.89%), *Gudusia chapra* (9.40%), and *Heteropneustes fossilis* (12.6%). The abundance of major carp and minor carp in the post-monsoon months was only 0.128% and 3.06%, respectively. The overall abundance of catfish was evaluated at 27%, with the chief contributory species being *Hetropneustes fossilis* (16.89%), followed by *Eutropiicthys vacha* (2.64%), *Clupisoma garua* (1.74%), *Rita rita* (1.72%), and *Pseudotropius atherinoides* (1.72%). In the upper stretch at Harsil, the keystone species encountered was *Schizothorax richardsonii*, contributing about 66.6%, followed by exotic *Salmo trutta* (14.81%), *S. plagiostomus* (11.11%), and *S. progastus* (7.40%). Whereas, in Haridwar, the dominant catch during the post-monsoon was *Tor putitora* (56%), followed by *Cyprinus carpio* (40%). *Heteropneustes fossilis* was found to be the most dominant species at Bijnor with 34%, while *Gudusia chapra* was found to have supremacy at Varanasi and Prayagaj with 21.12% and 22.40%, respectively.

In the lower stretch of the Ganga, *Tenualosa ilisha* is the main target species. The freshwater section of the river was observed to be abundant with maximum species like *Cabdio morar* (16%), *Gudusia chapra* (20%), etc. The composition of small catfish was also found to be dominant, with mainly *Ailia coila*, *E. vacha*, and *C. garua*. The hilsa (*Tenualosa ilisha*) contributed about 16.24% at Farakka, with an average size range of 150–1200 g and a corresponding price of Rs. 420–2200, respectively. The average fish catch was estimated at 3-4.5 kg/day/boat in the Godakhali area. *Otolithoides pama*, locally known as 'Bhola', was observed to be the prime fish species among the catch (60%), followed by *Tenualosa ilisha*

(20%) and *Setipinna phasa* (10%). In the Fraserganj area, the contribution of Hilsa during the period was recorded to be 30% during the post-monsoon months.

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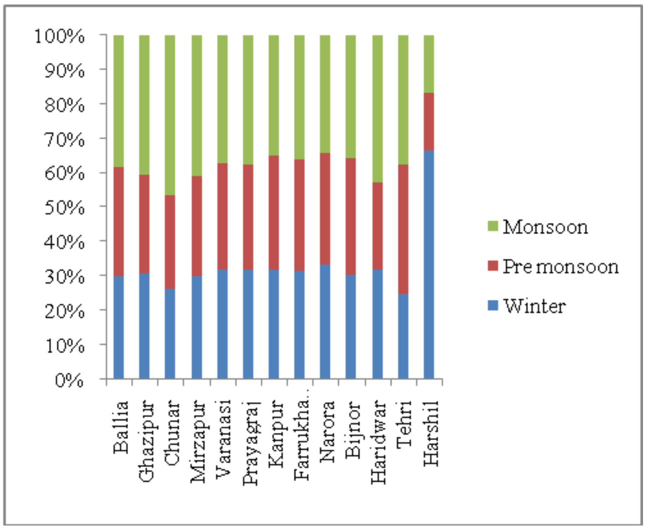

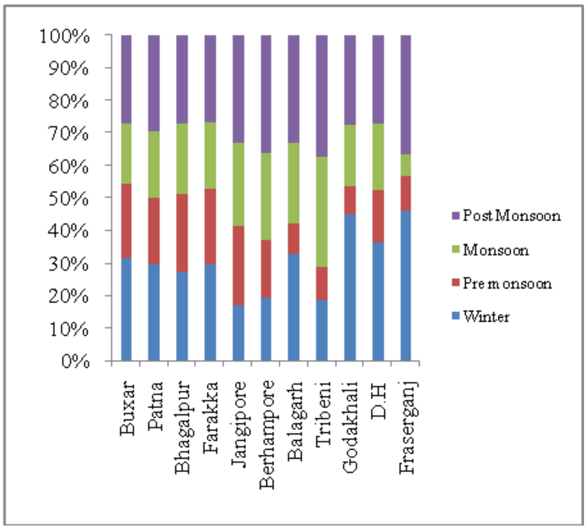

Fig. 56. Seasonal richness of fishes in Upper and Middle stretch of river Ganga (2021-22)

Fig. 57. Seasonal richness of fishes in Lower and Estuarine stretch of river Ganga (2021-22)

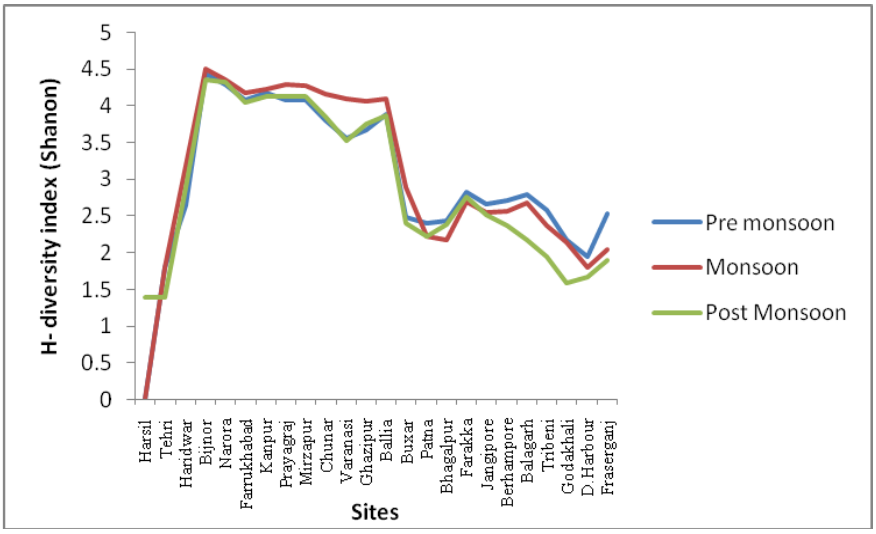

Fig. 58. H- Diversity index (Shanon) in the entire stretch of river Ganga (2021-22)

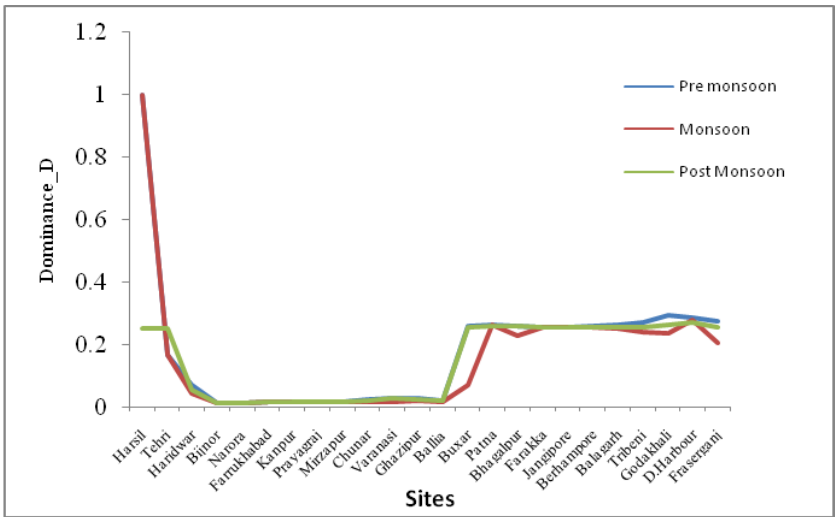

Fig. 59. Dominance-D plot in river Ganga (2021-22)

The Shannon diversity index (H) ranges from 1.5 to 3.5 and seldom comes to 4.5. A high 'H' value denotes a community that is both diverse and evenly dispersed, whereas lower numbers indicate a population that is less diversified (Hossain et al., 2013). The species diversity of finfish varied seasonally and spatially during the present investigation. The Shanon diversity index (H) was found high in different sites of the upper and middle stretch of the Ganga during the entire year and ranged from 1.38 to 4.57 (Fig. 58). The evenness index (e^H/S) also varied from 0.869 to 1.00. Higher numbers show that the population was evenly distributed among the species. The fish diversity of the river Ganga in the upper and middle stretches (Haridwar to Ballia) is subject to variation seasonally. In post-monsoon months, the Shanon diversity index (H) was recorded in the range of 1.38–4.35, whereas in pre-monsoon months, the result was found in the range of 1.0–1.44. Likewise, the 'H' diversity index analysis of the monsoon months resulted in a range of 1.79–4.50. The richness value in the lower stretch (Buxar to Godakhali) exhibited a lower range (1.59–2.76; avg. 2.56) in post-monsoon, followed by monsoon (2.14–2.89; avg. 2.47) and pre-monsoon (2.16-2.82; avg. 2.57). Similar trends were also observed in an estuarine stretch of the river (Diamond Harbour to Fraserganj), with higher ranges of 'H' in pre-monsoon months (avg. 2.23) compared to post-monsoon (1.78) and monsoon (1.98). According to Galib et al. (2015), the Shannon-Weaver diversity index (H) has a lower value from April to August, when the water level is higher and fishing is more difficult, and a higher value from December to March, when fishing is more easy and environmentally sustainable. Therefore, the higher values of the 'H' diversity index indicate that having a diverse range of species increases diversity. Similar to how monsoon season in the upper and intermediate stretches increases variety, increasing species' individual distribution uniformity will be similar.

Period 2022-23

A total of 17 fish species belonging to 15 genera were recorded from the Harsil to Haridwar stretch during the post-monsoon sampling of 2022–23, with the highest at Haridwar (12) and the lowest at Harsil (1). The relative abundance of fish species upstream of the river (Harsil, Tehri, and Haridwar) showed a higher abundance of carps, barbs, and minnows such as *Tor putitora* (78.77%), *Crossocheilus latius* (44%), *Barilius* spp. (23.95%), *Labeo dero* (12.69%), *Nemacheilus corica* (12.41%), *Cabdio morar* (10.69%), *Puntius* spp. (9.96%), *Labeo dyochelius* (4.48%), and the least abundance of *Xenentodon cancila* (0.68%). The stretch from Bijnor to Ballia (Uttar Pradesh) during the same period recorded a total of 87 fish species from 61 genera, with the highest availability from Bijnor (81) and the lowest at Ballia (20). The data indicated that among minor catfish, increased abundance was noticed for species like *Eutropiicthys vacha* (31.5%), *Heteropneustes fossilis* (22.5%), *Clupisoma garua* (18.5%), *Neotropius athrinoides* (17.5%), *Ompok bimaculatus* (4%), *Ailia coila* (2.4%), *E. murius* (0.9%), O. pabda (0.5%), and others (2.2%). In the case of large catfish, *Rita rita* (64%) was observed to be the most abundant species, followed by *Sperata seenghla* (22%), *S. aor* (12%), *Wallago attu* (9%), and *Bagarius bagarius* (2%).

The overall percentage composition of Indian major carps and minor carps was observed to be 1.3% and 9.8%, respectively, during the period. The most abundant major and minor carp species were *Cirrhinus mrigala* (43%), and *Cirrhinus reba* (55%), respectively. The least abundant major and minor carp species were *Labeo catla* (14%) and *Labeo bata* (1.11%), respectively. Exotic species contributed a total share of 2.8%, with the highest abundance of common carp (97%) from the entire stretch. The featherbacks constituting *Notopterus notopterus* and *Chitala chitala* contributed around 1.0%, with the maximum share from *N. notopterus* (87%). The total share of small indigenous fishes (SIFs) duringthepostmonsoonon was estimated to be 69%. In the lower stretch extending from Buxar to Godakhali, a total of 98 species wawereecorded during the pospostmonsoonseason,elonging to 75 gengenera,th highthe highestilability from Farakka (80) and lowest athe lowestkhali (27). The availability of the minor aajor catfishecatfishr the river has been recorded to be 17% and 4% . Among4%, respectivelye minor catfish, species like *E. vacha* (26%), *C. garua* (16%), *Mystus cavasius* (13%), *and A. coila* (12%) were found to be the most abundant,while the least abundant species were *Silonia silondia* (0.30%) and *Gagata sexualis* (0.60%), respectively. Among the large catfish, *R. rita* (37%) was observed to be the most abundant species, followed by *Bagarius* spp. (15%), *Sperata aor* (14%), *S. seenghala* (13%), *Pangasius pangasius* (11%), *W. attu* (4%), and *Clarias magur* (1%). During the period, the overall percentage composition of Indian Major Carps and Minor Cmajorwcarps and minorecarpsively in the strrespectively,ximum abundant major amostr carp species were *L. rohita* (40%) and L. calbasu (37%) respectively. The least abundant major and minor carp species were *L. ca,la* (25%) and *L. boga* (1%), respectively. In the lower stretch, the exotic species contributed about 1% during the post-monsoon months.

The overall contribution from SIF's was recorded to be 71% from Buxar to Godakhali stretch, which was found to be quite similar from Bijnor to Ballia stretch. In the estuarine stretch (Diamond Harbour to Fraserganj), a total of 66 species (Diamond Harbour = 40 and Fraserganj = 56) were recorded during the post-monsoon period, belonging to 59 genera. Fish belonging to the order Clupeiformes were observed to have the highest abundance (24%), followed by Gobiiformes (16%), Perciformes (12%), Siluriformes (8%), Angulliformes (6%), Carangiformes (6%), Mugiliformes (6%), Acanthuriformes (4%), Beloniformes (4%), Scombriformes (4%), Eupercaria (4%), Carcharhiniformes (2%), Centrachiformes (2%) and Gadiformes (2%). In the case of Clupeiformes, species like *Tenualosa ilisha* (15%), *Ilisha megaloptera* (14%), *Coilia dussumieri* (10%), *Anodontostoma chacunda* (5%), and *Escualosa thoracata* (4.7%) were observed to be the highest.

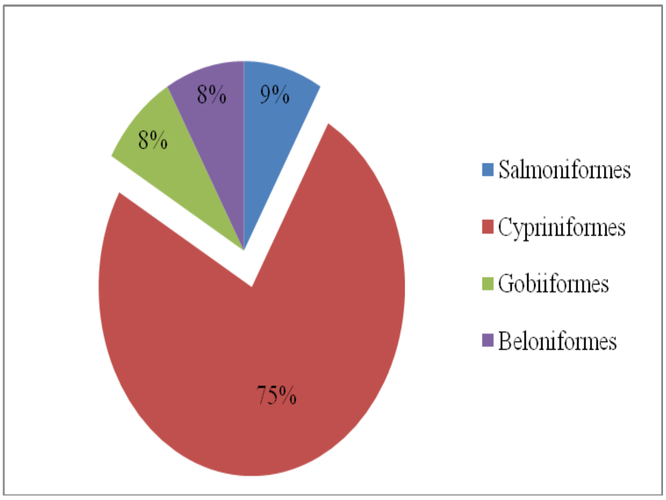

Fig. 60. Order wise (%) of the fishes reorded from upper stretch (Harsil to Haridwar) stretch of the river

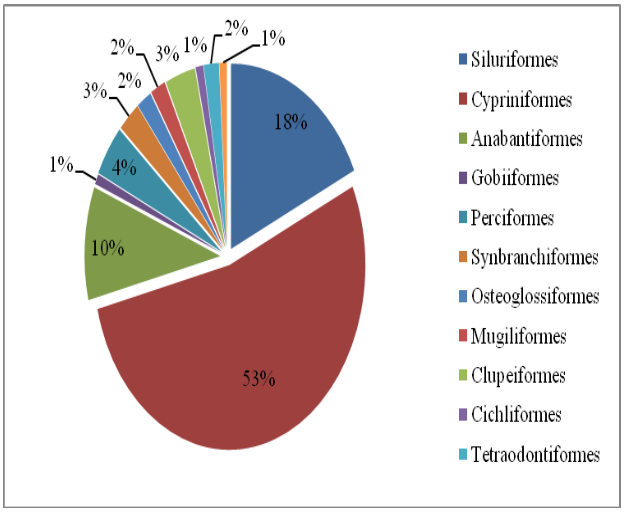

Fig. 61. Order wise (%) of the fishes reorded from middle stretch (Bijnor to Ballia) stretch of the river

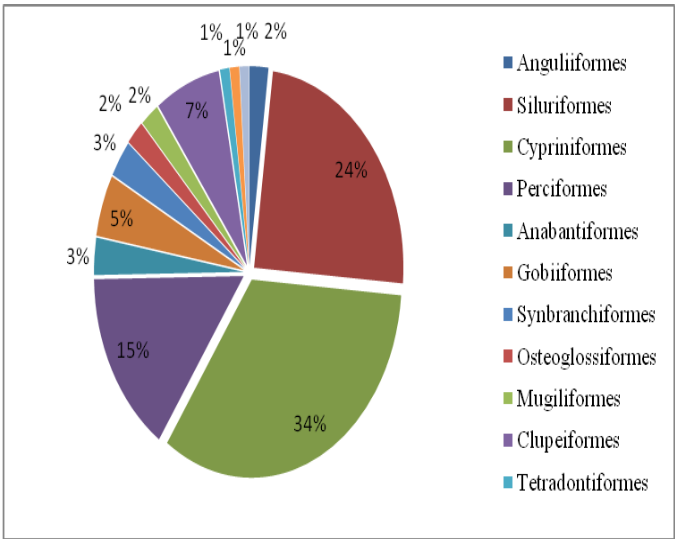

Fig. 62. Order wise (%) of the fishes reorded from Buxar to Godakhali stretch of the river

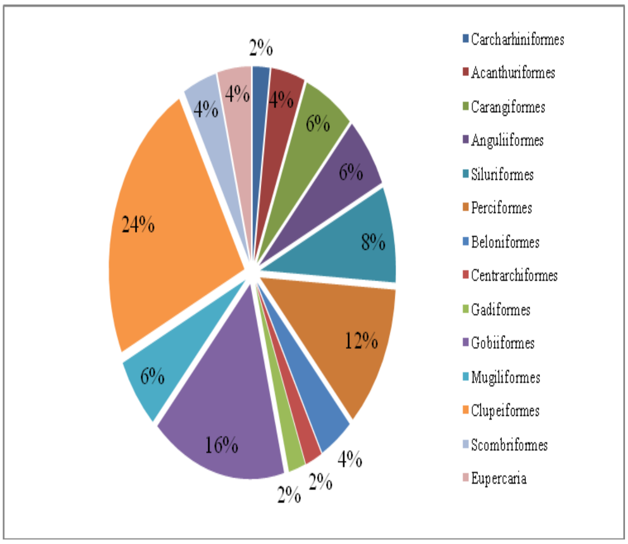

Fig. 63. Order wise (%) of the fishes reorded from D. Harbour to Fraserganj stretch of the river

During pre-monsoon 2023, the upper stretch was recorded with 18 fish species, with the highest at Haridwar (13), Tehri (7), and Harsil (1). Cypriniformes was found to be the highest (86%) contributing piscine order during the period. Species like *Crossochelius latius* (29%), *Tor putitora* (19%), *Labeo dero* (18%), and *Salmo trutta* (12%) contributed the maximum. In the middle stretch of the river, minor catfish was recorded to contribute 10.08%, while the major catfish was found with 3.38%. In case of minor catfish,species like *H. fossilis* was the most abundant with 3.0%, followed by C. garua at 1.97%. Similarly, *Rita rita* was observed to contribute the most in cases of large catfish. The share of IMC was recorded to be 0.53%. Exotics comprising C. *carpio* and *O. niloticus* was found to contribute 3.27% higher than the postmonsoon. Featherbacks contributed only 0.07%. The share of SIF's was found to be the highest among all, at 85.22%. Among SIF's species, *Cabdio morar* (26.42%) and *Salmostoma bacaila* (11.31%) were observed to be highly abundant.

In the lower stretch of the river Ganga (Buxar to Godakhali), order Cypriniformes consisted of the maximum share of the species (33 spp.), followed by Siluriformes (24 spp.), Perciformes (17 spp.), Gobiiformes (6 spp.), Clupeiformes (6 spp.), 2 spp. each for Angulliformes, Osteoglossiformes, Synbranchiformes, Mugiliformes, and Pleuronectiformes, and 1 sp. for Tetraodontiformes and Pleuronectiformes.

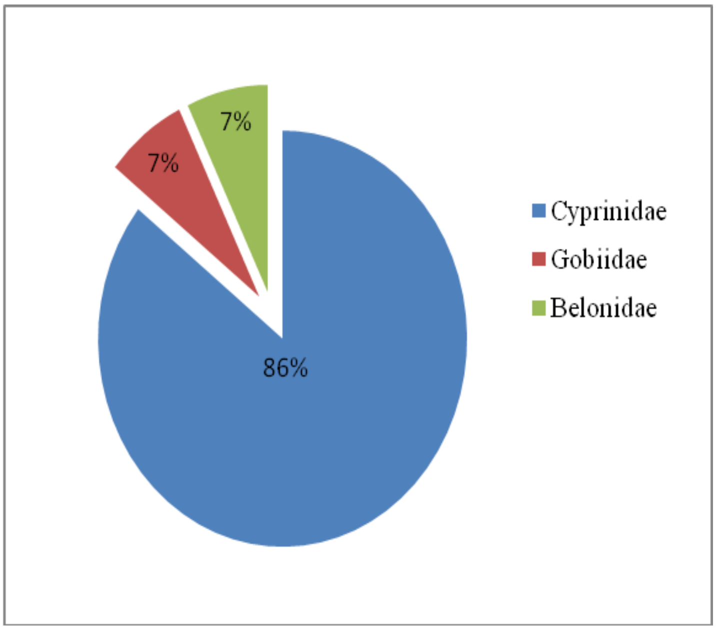

Fig. 64. Order wise (%) of the fishes reorded from upper stretch (Harsil to Haridwar) stretch of the river

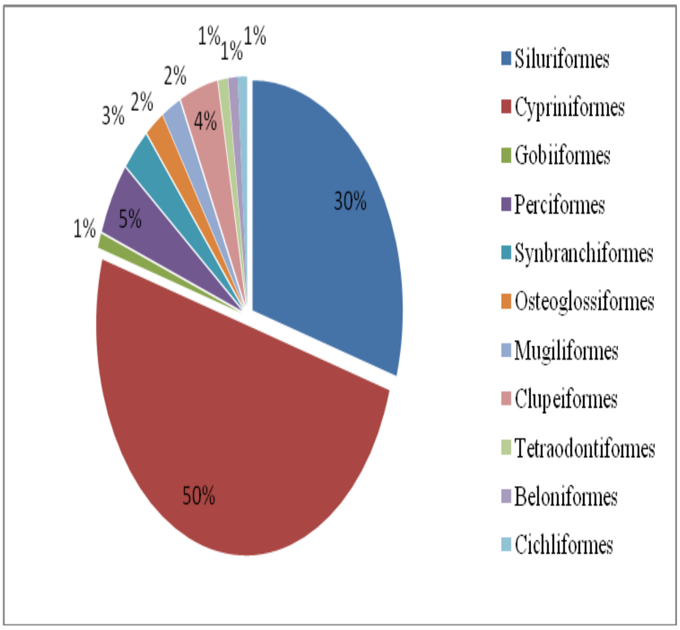

Fig. 65. Order wise (%) of the fishes reorded from middle stretch (Bijnor to Ballia) stretch of the river

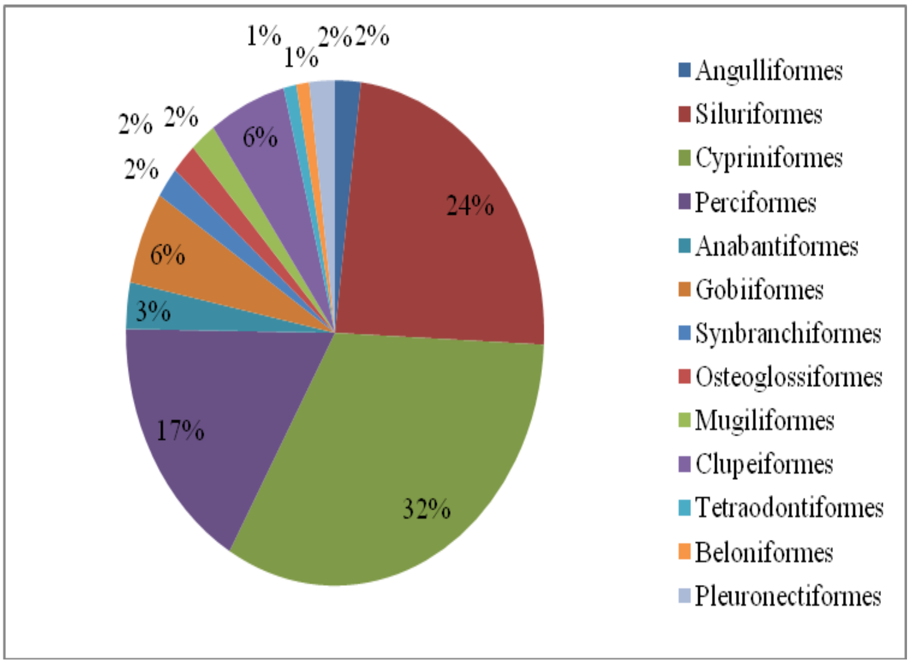

Fig. 66. Order wise (%) of the fishes reorded from Buxar to Godakhali stretch of the river

Table 6. Distribution of fish species in different sites of river Ganga during the period 2020-23; Red colour indicates 'Exotic fishes'; Yellow colour indicates

Species	Family	Order	Harsil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad	Kanpur	Prayagraj	Varanasi	Mirzapur	Chunar	Ghazipur	Ballia	Buxar	Patna	Bhagalpur	Farakka	Jangipore	Berhampore	Balagarh	Tribeni	Godakhali	D.Harbour	Fraserganj	IUCN	Habitat
Aborichthys elongatus (Hora, 1921	Nemacheilidae	Cypriniformes																									NE	Fw
Acanthocobitis botia (Hamilton, 1822)	Nemacheilidae	Cypriniformes																									LC	Fw
Arius arius (Hamilton, 1822)	Ariidae	Siluriformes																									LC	Bw
Ailia coila (Hamilton, 1822)	Aillidae	Siluriformes																									NT	Fw
Ailiichthys punctata (Day, 1872)	Aillidae	Siluriformes																									LC	Fw
Amblyceps mangois (Hamilton, 1822)	Amblyciptidae	Siluriformes																									LC	Fw
Amblypharyngodon mola (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Anabas testudineus (Bloch,1792)	Anabantidae	Perciformes																									LC	Fw
Anguilla bengalensis (Gray, 1831)	Anguillidae	Anguilliformes																									NT	Bw; Fw
Anodontostoma chacunda (Hamilton, 1822)	Clupeidae	Clupeiformes																									LC	Bw
Apocryptes bato (Hamilton, 1822)	Gobiidae	Gobiiformes																									LC	Bw; Fw
Arius arius (Hamilton, 1822)	Ariidae	Siluriformes																									LC	Bw; Fw
Arius jella (Day, 1877)	Ariidae	Siluriformes																									NE	Bw; Fw
Badis badis (Hamilton, 1822)	Anabantidae	Perciformes																									LC	Fw
Bagarius bagarius (Hamilton, 1822)	Sisoridae	Siluriformes																									NT	Fw
Bagarius yarelli(Hamilton, 1822)	Sisoridae	Siluriformes																									NT	Fw
Barilius barila (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Barilius bendelisis (Hamilton, 1807)	Danionidae	Cypriniformes																									LC	Fw
Barilius vagra (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Barilius shacra (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw

Batasio batasio (Hamilton, 1822)	Bagridae	Siluriformes																									LC	Fw
Botia long (Hamilton, 1822)	Botiidae	Cypriniformes																									LC	Fw
Botia lohachata (Chaudhuri, 1912)	Botiidae	Cypriniformes																									LC	Fw
Boleophthalmus boddarti (Pallas, 1770)	Oxudercidae	Gobiiformes																									LC	Bw;Fw
Bregmaceros mcclelandi (Thompson,1840)	Bregmacerotidae	Gadiformes																									NE	Bw; Fw
Cabdio morar (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Chaca chaca (Hamilton, 1822)	Chacidae	Siluriformes																									LC	Fw
Chagunius chagunio (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Chanda nama (Hamilton, 1822)	Ambassidae	Perciformes																									LC	Fw
Channa gachua (Bloch, 1793)	Channidae	Anabantiformes																									LC	Fw
Channa marulius (Hamilton, 1822)	Channidae	Anabantiformes																									VU	Fw
Channa orientalis Bloch & Schneider, 1801	Channidae	Anabantiformes																									LC	Fw
Channa striata (Bloch, 1793)	Channidae	Anabantiformes																									LC	Fw
Channa punctata (Bloch, 1793)	Channidae	Anabantiformes																									LC	Fw
Chelonodontops patoca (Hamilton, 1822)	Tetraodontidae	Tetraodontiformes																									LC	Bw; Fw
Chitala chitala (Pallas, 1769)	Notopteridae	Osteoglossiformes																									NT	Fw
Cirrhinus mrigala (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Cirrhinus reba (Hamilton, 1822	Cyprinidae	Cypriniformes																									LC	Fw
Clarias magur (Linnaeus, 1758)	Clariidae	Siluriformes																									LC	Fw
Clarias gariepinus (Burchell, 1822)	Clariidae	Siluriformes																									LC	Fw
Clupisoma garua (Hamilton, 1822)	Aillidae	Siluriformes																									LC	Fw
Coilia dussumieri (Hamilton, 1822)	Engraulidae	Clupeiformes																									LC	Bw; Fw
Corica soborna (Hamilton, 1822)	Clupeidae	Clupeiformes																									LC	Fw
Crossocheilus latius (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Ctenopharyngodon idella (Valenciennes, 1844)	Xenocyprinidae	Cypriniformes																									LC	Fw
Cynoglossus arel (Hamilton, 1822)	Cynoglossidae	Pleuronectiformes																									DD	Bw; Fw

Cynoglossus cynoglossus (Hamilton, 1822)	Cynoglossidae	Pleuronectiformes																									DD	Bw; Fw
Cynoglossus lingua (Hamilton, 1822)	Cynoglossidae	Pleuronectiformes																									DD	Bw; Fw
Cyprinus carpio Linnaeus, 1758	Cyprinidae	Cypriniformes																									LC	Fw
Cyprinus carpio var. specularis	Cyprinidae	Cypriniformes																									LC	Fw
Danio devario (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Danio rerio (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Drepane punctata (Linnaeus, 1758)	Drepanidae	Acanthuriformes																									NE	Bw; Fw
Eleutheronema tetradactylum (Shaw, 1804)	Polynemidae	Perciformes																									NE	Bw; Fw
Eleotris fusca (Forster, 1801)	Eleotridae	Gobiiformes																									LC	Bw; Fw
Erethistes pusillus (Müller & Troschel, 1849)	Sisoridae	Siluriformes																									NE	Fw
Escualosa thoracata (Valenciennes, 1847)	Pristigasteridae	Clupeiformes																									LC	Bw; Fw
Esomus danricus (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Eutropiichthys murius (Hamilton, 1822)	Aillidae	Siluriformes																									LC	Fw
Eutropiichthys vacha (Hamilton, 1822)	Aillidae	Siluriformes																									LC	Fw
Gagata cenia (Hamilton, 1822)	Sisoridae	Siluriformes																									LC	Fw
Gagata gagata (Hamilton, 1822)	Sisoridae	Siluriformes																									LC	Fw
Gagata sexualis (Hamilton, 1822)	Sisoridae	Siluriformes																									LC	Fw
Garra gotyla (Gray, 1830)	Cyprinidae	Cypriniformes																									LC	Fw
Gerres filamentosus Cuvier, 1829	Gerreidae	Perciformes																									LC	Bw; Fw
Glossogobius giuris (Hamilton, 1822)	Gobiidae	Gobiiformes																									LC	Fw
Glyptothorax cavia (Hamilton, 1822)	Sisoridae	Siluriformes																									LC	Fw
Glyptothorax telchitta (Hamilton, 1822)	Sisoridae	Siluriformes																									LC	Fw
Gogangra viridescens (Hamilton, 1822)	Sisoridae	Siluriformes																									LC	Fw
Gonialosa manmina (Hamilton, 1822)	Clupeidae	Clupeiformes																									LC	Fw
Gudusia chapra (Hamilton, 1822)	Clupeidae	Clupeiformes																									LC	Fw
Gymnothorax tile (Hamilton, 1822)	Muraenidae	Anguilliformes																									LC	Bw; Fw

Harpadon nehereus (Hamilton, 1822)	Synodontidae	Aulopiformes																									NT	Bw; Fw
Heteropneustes fossilis (Bloch, 1794)	Heteropneustidae	Siluriformes																									LC	Fw
Hilsa keele (Cuvier, 1829)	Clupeidae	Clupeiformes																									LC	Bw; Fw
Hypophthalmichthys nobilis (Richardson, 1845)	Xenocyprinidae	Cypriniformes																									LC	Fw
Hypophthalmichthys molitrix (Valenciennes, 1844)	Xenocyprinidae	Cypriniformes																									LC	Fw
Ilisha elongate (Anonymous [Bennett], 1830)	Pristigasteridae	Clupeiformes																									LC	Bw; Fw
Ilisha megaloptera Swainson, 1839	Pristigasteridae	Clupeiformes																									LC	
Johnius coitor (Hamilton, 1822)	Sciaenidae	Perciformes																									LC	Fw
Johnius gangeticus (Hamilton, 1822)	Sciaenidae	Perciformes																									LC	Bw; Fw
Labeo bata (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Labeo boga (Hamilton, 1823	Cyprinidae	Cypriniformes																									LC	Fw
Labeo calbasu (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Labeo catla (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Lates calcarifer (Bloch,1794)	Latidae	Perciformes																									LC	Bw; Fw
Bangana dero (Hamilton 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Labeo dyocheilus (McClelland, 1839)	Cyprinidae	Cypriniformes																									LC	Fw
Labeo gonius (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Labeo rohita (Hamilton, 1822	Cyprinidae	Cypriniformes																									LC	Fw
Lagocephalus lunaris (Bloch & Schneider, 1801)	Tetraodontidae	Tetraodontiformes																									LC	Fw
Laubuca laubuca (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Leiodon cutcutia (Hamilton, 1822)	Tetraodontidae	Tetraodontiformes																									LC	Fw
Leptomelanosoma indicum (Shaw, 1804)	Polynemidae	Perciformes																									NE	Bw; Fw
Lepidocephalichthys guntea (Hamilton, 1822)	Cobitidae	Cypriniformes																									LC	Fw
Macrognathus aculeatus (Hamilton, 1822)	Mastacembelidae	Synbranchiformes																									LC	Fw
*Macrognathus ara l*Hamilton, 1822	Mastacembelidae	Synbranchiformes																									LC	Fw

Macrognathus pancalus Hamilton, 1822	Mastacembelidae	Synbranchiformes	LC	Fw
Mastacembelus armatus (Lacepede, 1800)	Mastacembelidae	Synbranchiformes	LC	Fw
Megarasbora elanga (Hamilton, 1822)	Danionidae	Cypriniformes	LC	Fw
Minimugil cascasia (Hamilton, 1822)	Mugilidae	Mugiliformes	LC	Fw
Monopterus cuchia Hamilton, 1822	Synbranchidae	Synbranchiformes	LC	Fw
Muraenesox bagio (Hamilton, 1822)	Muraenesocidae	Anguilliformes	NE	Bw; Fw
Mystus bleekeri (Day, 1877)	Bagridae	Siluriformes	NE	Fw
Mystus cavasius (Hamilton, 1822)	Bagridae	Siluriformes	LC	Fw
Mystus gulio (Hamilton, 1822)	Bagridae	Siluriformes	LC	Bw
Mystus tengara (Hamilton, 1822)	Bagridae	Siluriformes	LC	Fw
Mystus vittatus (Bloch, 1794	Bagridae	Siluriformes	LC	Fw
Nandus nandus (Hamilton, 1822)	Nandidae	Anabantiformes	LC	Fw
Nemacheilus corica (Hamilton, 1822)	Nemacheilidae	Cypriniformes	LC	Fw
Nemapteryx caelata (Valenciennes, 1840)	Ariidae	Siluriformes	LC	Bw
Notopterus notopterus (Pallas, 1769)	Notopteridae	Osteoglossiformes	LC	Fw
Nuchequula blochii (Valenciennes, 1835)	Leiognathidae	Acanthuriformes	NE	Bw; Fw
Odontamblyopus rubicundus (Hamilton, 1822)	Gobiidae	Gobiiformes	LC	Fw
Ompok bimaculatus (Hamilton, 1822)	Siluridae	Siluriformes	NT	Fw
Ompok pabda (Hamilton, 1822)	Siluridae	Siluriformes	NT	Fw
Ophisternon bengalense McClelland, 1844	Synbranchidae	Synbranchiformes	LC	Bw; Fw
Opsarius barna (Hamilton, 1822)	Danionidae	Cypriniformes	LC	Fw
Oreichthys cosuatis (Hamilton, 1822)	Cyprinidae	Cypriniformes	LC	Fw
Oreochromis niloticus (Linnaeus, 1758)	Cichlidae	Perciformes	LC	Fw
Osteobrama cotio (Hamilton, 1822)	Danionidae	Cypriniformes	LC	Fw
Otolithoides pama (Hamilton, 1822)	Sciaenidae	Perciformes	DD	Bw; Fw
Pampus argenteus (Bloch, 1795)	Stromateidae	Scombiformes	NE	Bw; Fw

Pangasius pangasius (Hamilton, 1822)	Panagasiidae	Siluriformes																									LC	Bw; Fw
Pangio pangia (Hamilton, 1822)	Cobitidae	Cypriniformes																									LC	Fw
Panna microdon (Hamilton, 1822)	Sciaenidae	Perciformes																									NE	Bw
Parambassis ranga (Hamilton, 1822)	Ambassidae	Perciformes																									NE	Fw
Parambassis lala (Hamilton, 1822)	Ambassidae	Perciformes																									NT	Fw
Paraplagusia bilineata (Bloch, 1787)	Cynoglossidae	Pleuronectiformes																									LC	Bw; Fw
Parastromateus niger (Bloch, 1795)	Carangidae	Carangiformes																									NE	Bw
Pellona ditchela (Valenciennes, 1847)	Pristigasteridae	Clupeiformes																									NE	Bw; Fw
Pethia conchonius (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Pethia gelius (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Pethia ticto (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Pisodonophis cancrivorus (Richardson, 1848)	Ohicthidae	Anguilliformes																									NE	Bw; Fw
Pisodonophis boro (Hamilton, 1822)	Ohicthidae	Anguilliformes																									LC	Bw; Fw
Planiliza parsia (Hamilton, 1822)	Mugilidae	Mugiliformes																									NE	Bw; Fw
Platycephalus indicus (Linnaeus, 1758)	Platycephalidae	Perciformes																									DD	Bw,Fw
Planiliza tade (Fabricius, 1775)	Mugilidae	Mugiliformes																									DD	Bw; Fw
Polynemus paradiseus (Linnaeus, 1758)	Polynemidae	Perciformes																									LC	Bw; Fw
Pseudambassis baculis (Hamilton, 1822)	Ambassidae	Perciformes																									LC	Fw
Pseudapocryptes elongatus (Cuvier, 1816)	Oxudercidae	Perciformes																									LC	Bw; Fw
Pseudotropius atherinoides (Bloch, 1794)	Scheilbidae	Siluriformes																									LC	Fw
Psilorhynchus balitora (Hamilton, 1822)	Psilorhynchidae	Cypriniformes																									LC	Fw
Pterygoplichthys disjunctivus (Weber, 1991)	Loricariidae	Siluriformes																									NE	Fw
Puntius phutunio(Hamilton, 1823	Cyprinidae	Cypriniformes																									LC	Fw
Puntius sophore (Hamilton, 1822	Cyprinidae	Cypriniformes																									LC	Fw
Puntius terio (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw

Puntius chola (Hamilton, 1822)	Cyprinidae	Cypriniformes																									LC	Fw
Raiamas bola (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Rasbora daniconius (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Rhinomugil corsula (Hamilton, 1822)	Mugilidae	Mugiliformes																									LC	Bw; Fw
Rita rita (Hamilton, 1822)	Bagridae	Siluriformes																									LC	Fw
Salmo trutta Linnaeus, 1758	Salmonidae	salmoniformes																									LC	Fw
Salmostoma acinaces (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Salmostoma bacaila (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Salmostoma phulo (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Scatophagus argus (Linnaeus, 1766)	Scatophagidae	Acanthuriformes																									LC	Bw; Fw
Schizothorax plagiostomus(Heckel, 1838)	Cyprinidae	Cypriniformes																									NE	Fw
Schizothorax progastus (McClelland, 1839)	Cyprinidae	Cypriniformes																									LC	Fw
Schizothorax richardsonii (Gray 1832)	Cyprinidae	Cypriniformes																									VU	Fw
Schizothorax esocinus (Heckel, 1838)	Cyprinidae	Cypriniformes																									NE	Fw
Securicula gora (Hamilton, 1822)	Danionidae	Cypriniformes																									LC	Fw
Setipinna brevifilis (Hamilton, 1822)	Engraulidae	Clupeiformes																									DD	Fw
Setipinna phasa (Hamilton, 1822)	Engraulidae	Clupeiformes																									LC	Fw
Setipinna tenuifilis (Hamilton, 1822)	Engraulidae	Clupeiformes																									DD	Fw
Sillaginopsis panijus (Hamilton, 1822)	Sillaginidae	Perciformes																									NE	Bw; Fw
Sillago sihama (Forsskål, 1775)	Sillaginidae	Perciformes																									LC	Bw; Fw
Silonia silondia (Hamilton, 1822)	Scheilbidae	Siluriformes																									LC	Bw; Fw
Sisor rabdophorus (Hamilton, 1822)	Sisoridae	Siluriformes																									LC	Fw
Sperata aor (Hamilton, 1822)	Bagridae	Siluriformes																									LC	Fw
Sperata seenghala (Sykes, 1839)	Bagridae	Siluriformes																									LC	Fw
Stolephorus indicus (van Hasselt, 1823)	Engraulidae	Clupeiformes																									LC	Bw; Fw
Systomus sarana (Hamilton, 1822)	Cyprinidae	Cypriniformes																									NE	Fw

Tenualosa ilisha (Hamilton, 1822)	Clupeidae	Clupeiformes	LC	Bw; Fw
Terapon jarbua (Forsskål, 1775)	Terapontidae	Centrarchiformes	LC	Bw; Fw
Tor putitora (Hamilton, 1822)	Cyprinidae	Cypriniformes	EN	Fw
Tor tor (Hamilton, 1822)	Cyprinidae	Cypriniformes	DD	Fw
Trichogaster fasciata (Bloch & Schneider, 1801)	Osphronemidae	Perciformes	LC	Fw
Trichogaster lalius (Bloch& Schneider, 1801)	Osphronemidae	Perciformes	LC	Fw
Trichogaster chuna (Hamilton, 1822)	Osphronemidae	Perciformes	LC	Fw
Trichurus lepturus (Linnaeus, 1758)	Trichiuridae	Scombriformes	LC	Fw
Wallago attu (Bloch & Schneider, 1801)	Siluridae	Siluriformes	VU	Fw
Xenentodon cancila (Hamilton, 1822	Belonidae	Beloniformes	LC	Fw

Abbreviation (LC-Least Concern, VU-Vulnerable, EN-Endangered, DD-Data Deficient, NE-Not Evaluated, NT-Near Threatened, Fw- Freshwater, Bw- Brackishwater)

Fig. 67. Assesment of fish biodiversity data in different sites of river Ganga

4.3 Crustacean diversity of river Ganga

River Ganga has been home to several freshwater and brackish water prawns and crabs (Fig. 68). Prawn species belonging to the genus *Macrobrachium*, like *Macrobrachium rosenbergii*, *M. malcolmsonii*, etc., are broadly distributed all over the Gangetic River system and are commercially valuable. Besides important fish species, they form a significant source of income and livelihood for several fishermen residing around the bank of the river. The giant river prawns are widely available during monsoon months in the upper and lower Ganga plains. Jhingran and Ghosh (1978) have pointed out the limited distribution of this giant freshwater prawn in the middle stretch of the river. They also elucidated the declining trend of production of these species along the middle stretch of the Ganga. Prasad et al. (2012) have reported a total production of 5.87 tons of giant freshwater prawn from the river Ganga at Patna. As per the findings, the composition of *M. gangeticum* was observed to be dominant in all the months and seasons. Adult specimens were found throughout the lower, middle, and northern portions of the Ganga River system with a size group of 65-215 mm, revealing that both *M. malcolmsonii* and *M. gangeticum* migrate over 800 kilometers from the estuary (Kanaujia et al., 2000). At the beginning of the final week of May, berried females are observed. The number of individuals reached its peak in the middle of the monsoon season in August and September. The rise and fall of floodwater in the river stretch was found to be closely associated with the occurrence of mature males and berried females (Prasad and Kanaujia, 2006).

The estuarine part of the river also harbors a rich source of commercially important prawn species like *Penaeus monodon*, *Fenneropenaeus indicus*, *Nematopalaemon tenuipes*, etc. The swampy, intricate network of mangrove channels in the lower estuary attracts a huge number of shellfish to sustain the critical phase of their life cycle. The estuary serves as an important breeding and nursery ground. The three most important commercial prawn groups are Peneaidae, Palaemonidae, and Seregestidae. The collection of prawn seeds, especially those of *Penaeus monodon*, in the lower Gangetic estuary serves as an important source of livelihood. To date, eight different prawn species and three different crabs have been identified in the river. However, the findings are still underway under the project.

Gangetic River Prawn (Freshwater)
Macrobrachium gangeticum

Giant River Prawn (Freshwater)
Macrobrachium rosenbergii

The Monsoon River prawn (Freshwater)
Macrobrachium malcolmsonii H. Milne Edwards, 1844

Giant Tiger Prawn (Brackishwater)
(*Penaeus monodon* Fabricius, 1798)

Rainbow Shrimp (Brackishwater)
(*Parapenaeopsis sculptilis* Heller, 1862)

Indian White Shrimp (Brackishwater)
(*Fenneropenaeus indicus* De Man, 1892)

Spider prawn (Brackishwater)
(*Nematopalaemon tenuipes* Henderson, 1893)

Giant mud crab (Brackishwater)
(*Scylla serrata* Forskål, 1775)

Flower Moon Crab (Brackishwater)
(*Matuta planipes* Fabricius, 1798)

Charybdis orientalis Dana, 1852
(Brackishwater)

Fig. 68. Prawns and Crabs recorded from river Ganga

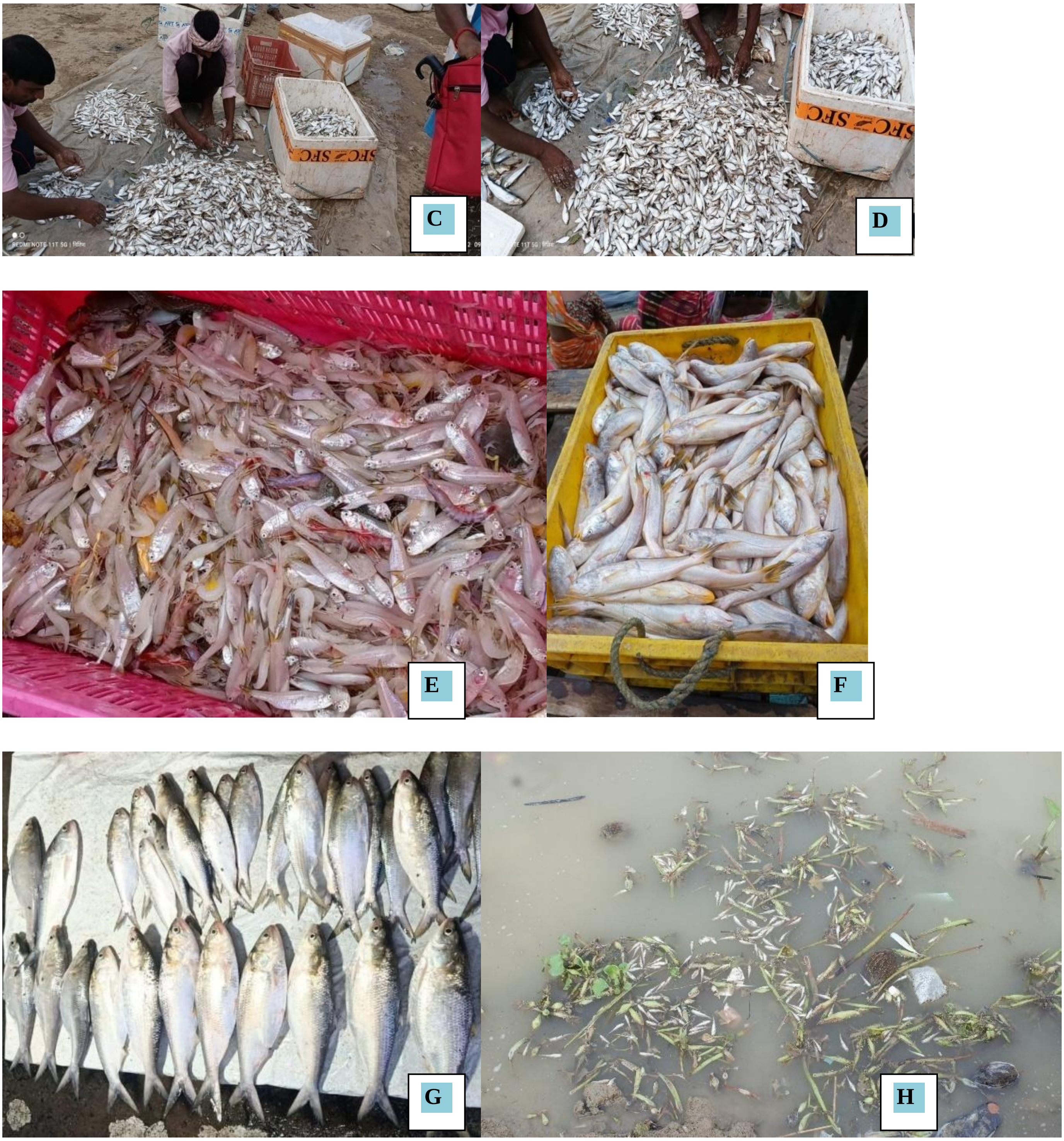

Fig. 69. A-B: Assorted catch from river Ganga; C-D: Landing of *G. chapra* at Buxar, Bihar; E-G: Landing of fishes at an estuarine stretch of the river, H: Mass mortality of fishes at Varanasi Ghat, UP

4.4.Exotic fish intervention

The Ganga River harbors a rich fish biodiversity, and an updated list of 190 fish species has been reported as per a recent study. However, proper and systematic evaluation of the exotic fish species is a prerequisite for undertaking any conservation and management plan and sustainable fisheries. As per the reports, over 300 different exotic fish species were introduced in India during the past few decades, particularly for various humanoid activities like sport fishing, mosquito regulation, and experimental aquaculture. The impact of such exotics on the indigenous fish species assemblage is yet to be evaluated vividly. Although it has helped in augmenting the fish diversity spectrum of the country, it is realized that the induction has certainly affected the native diversity in terms of food, space, and proliferation. In view of that, the ICAR-Central Inland Fisheries Research Institute under the Namami Gange project assessed the occurrence and distribution of such non-native fish species in a systematic way and recorded altogether nine different exotic fish species. These are grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmicthys molitrix*), big head carp (*Hypophthalmicthys nobilis*), scale carp (*Cyprinus carpio* var. communis), mirror carp (*Cyprinus carpio* var. specularis), tilapia (*Oreochromis niloticus*), African magur (*Clarias gariepinus),* brown trout (*Salmo trutta fario),* and crocodile/sailfin catfish (*Pterygopliicthys disjunctivus*). All the exotics are classified into seven genera, five families, and three orders, as identified by the freshwater stretch of the Ganga. These non-native fish are believed to have been introduced into the main channel of the river mainly due to escapements from nearby aquaculture farms and overflowing catchments during peak flooding seasons. The distribution index of all the species is presented in Fig. 70. Relatively, the highest distribution index of the exotic fishes was found for the species common carp (54%), and tilapia (38%), respectively. Common carp were found to be available at 13 different sites out of the 24 sampling sites covered. On the other side, tilapia was found to be available at nine different sites. Interestingly, grass carp (17%) and African magur (17%) are recorded from 8 different sites, while the range of extension for suckermouth catfish (13%) has increased from 2 to 4 different sites in the river Ganga. The year-wise availability of the exotics from the Ganga is illustrated below.

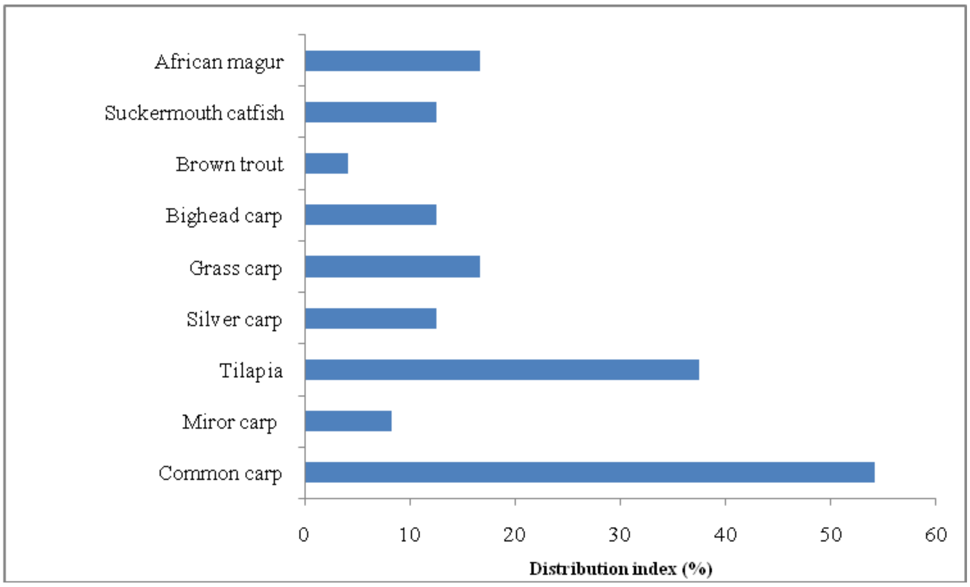

Fig. 70. Distribution (%) of different exotics in river Ganga during the period 2021- 2023

Period 2021-22

As observed during the period, *Cyprinus carpio* var. *communis* (common carp) is the most distributed exotic in the middle stretch of the Ganga, extending from Haridwar to Buxar, with a distribution index of 54%. Besides common carp, tilapia (*Oreochromis niloticus*) was also found to be the second most populous exotic species in the Ganges, with a distribution percentage of 38%. The population of tilapia was noticed to become rapid in sites like Varanasi and Gazipur. Being prolific breeders, tilapia and common carp could establish breeding territories in the middle stretch of the river Ganga pertaining to favorable ecological conditions like low flow, water depth, and organic load. Among other species, the distribution of grass carp and African carp was similar with 17%, followed by silver carp, big head carp, and grass carp with 13%. A minimum index value was recorded for mirror carp (8%) and brown trout (4%), showing their restricted distribution in the upper stretch during 2021–2022.

During the period of study (2021–2022), nine different exotic freshwater fish were recorded from the river Ganga. As observed, *Cyprinus carpio* var. *communis* (common carp) is the most distributed exotic in the middle stretch of the Ganga, extending from Haridwar to Buxar, with a size range of 80–213 mm. Besides common carp, tilapia (*Oreochromis niloticus*) was also found to be the second most populous exotic species in the Ganges, with a distribution percentage of 33%. Tilapia has been found to dominate in most of the catch, as the relative abundance of the species was observed at 3.45% in post-monsoon, 1.48% in pre-monsoon, and 0.99% in monsoon months. The population of tilapia was noticed to become rapid in sites like Varanasi and Gazipur. Being prolific breeders, tilapia and common carp could establish breeding territories in the middle stretch of the river Ganga pertaining to favorable ecological conditions like low flow, water depth, and organic load.

During the monsoon sampling (September 2022), a single specimen of *Pterygopliichthys disjunctivus* (Weber, 1991), having a total length of 212 mm and a weight of 177 g, was recorded from the river Ganga at Patna, Bihar (Fig. 72). After being reported from other areas of the Ganges, the species is reported for the first time at the site of Patna. The Loricaridae family of exotic catfish, including *P. disjunctivus*, are typically found in the Madeira River basin in South America. However, this is the first report of this species from the middle stretch of the Ganga; it had previously been discovered in the upper stretch. This species is a benthic forager that attaches to surfaces using its suctorial mouth to eat algae and debris. Das et al. (2020) reported the finding of exotic *P. disjunctivus* (Weber, 1991) in West Bengal, India's Bhagirathi-Hooghly River basin. The species has been found in the Ganga's Farakka and Balagarh regions, two places with different hydrological regimes. The collected species' average total length and weight were between 360 and 450 mm and 314-545 g, respectively. Due to feeding competition, the algivorous nature of the species feeding may be dangerous for native bottom-dwelling fish. Since the presence of this alien fish in the lower Ganga has been confirmed, management measures like determining the point of introduction will be taken to stop this invasive species from posing a threat to native river species in the future.

Fig. 71. Exotic *Salmo trutta fario* (Brown trout) caught at Harsil, Uttarakhand (December, 2021)

Fig. 72. Exotic *P. disjunctivus* caught at Patna, Bihar (September 2022)

Fig. 73. A haul of exotic common carp caught at Buxar, Bihar

Period 2022-23

During the period 2022–2023, particularly at the time of the post-monsoon, the relative abundance (%) of all the exotics was computed to be 2.8% out of all the major groups. Similarly, during the premonsoon phase, the abundance was found to be 3.1% higher than the postmonsoon.

Common carp were found to be the most abundant species among the exotics, with a size and length ranging from 42 to 308 mm and a distribution index value of 54%. During post-monsoon, the maximum was at Ballia (70%), followed by Mirzapur (7%), Gazipur (5%), Buxar (4%), Kanpur (4%), Prayagraj (4%), Chunar (2%), Farukhabad (2%), Varanasi (1%), Tehri (0.41%), Bijnor (0.08%), and Narora (0.04%), respectively. However, during the pre-monsoon period, Varanasi was recorded with the most abundant common carp (12%), followed by Ballia (10%), Mirzapur (8%), Buxar (6%), Farukhabad (6%), Prayagraj (5%), Kanpur (5%), Chunar (3%), Tehri (2%), Narora (0.03%), and Gazipur (0.02%), respectively. During a recent exploration in the river Ganga, *Cyprinus carpio* var. communis was reported for the first time from Farakka, particularly from the upstream of the Farakka barrage (Fig. 74.). Three fish specimens in the size range of 180–250 g were caught in a gill net of mesh size 45 mm operating in the area. The fish specimens have reportedly occurred due to the flooded condition of the river. Overflooding of the river results in the introduction of non-native fish species from nearby aquaculture ponds into the main channel.

Fig. 74. A fresh specimen of common carp caught from upstream of Farakka barrage in West Bengal (September 2023)

Tilapia with a size length of 58–168 mm was found to contribute the most at Chunar (2%) during the postmonsoon and Ballia (0.71%) during the premonsoon months. Lower abundances of tilapia were noticed in Varanasi (1%) and Mirzapur (0.02%) during the premonsoon and postmonsoon, respectively. African Magur (*Clarias gariepinus*) was not recorded from any of the sites during the period. Brown trout (*Salmo trutta*) was only observed in the Uttar Kashi-Harsil stretch during both seasons. By restricting their distribution and migration in high-altitude river basins, invasive brown trout pose a threat to the native Himalayan snow trout. These exotic trout are reported to dwell in cold freshwater rivers, lakes, and streams in Europe and were imported into India in the late 1890s during the British Raj. The species was observed to dwell in a low temperature regime (range: 2.3–13.5 ºC; average 6.9±1.31 ºC) in the Uttar Kashi-Harsil stretch of the river Ganga. Although the abundance of these exotic Chinese carps (grass carp, silver carp, and big head carp) remains below 1%, the distribution of these was reported, particularly from Farukhabad to the Bijor stretch of the Ganga, with a combined index value of 33%. At the time of the local survey, a gravid single female specimen of a loricariid exotic catfish, *P. disjunctivus*, was reported (total length: 285 mm; total weight: 110 g) for the first time from the Hooghly River at Barrackpore, West Bengal (Fig. 75). The effect of the monsoon and the overflowing condition of the river catchment areas might have caused the entry of exotic species into the river.

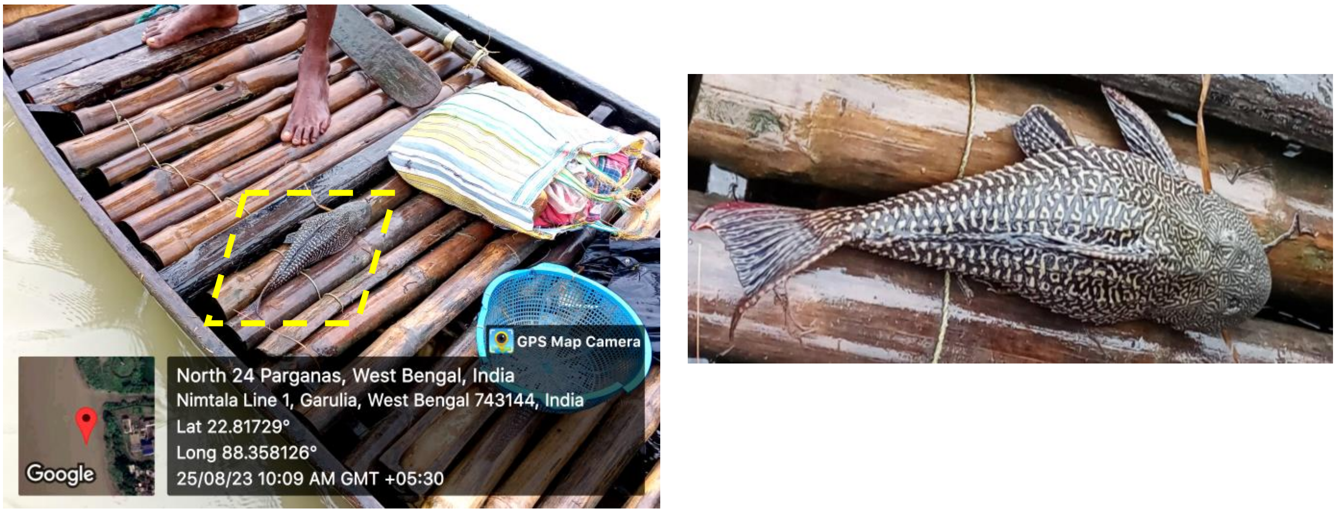

Fig. 75. A single specimen of Crocodile fish caught in gill net from Barrackpore sretch of river in West Bengal (August 2023)

Fig. 76. A haul of exotic Tilapia caught from river Ganga at Prayagraj, Uttar Pradesh

4.5. Shift and new record of fish species under the project

- *Megarasbora elanga* (Hamilton, 1822) (Bengala barb) (TL- 90.11 mm & TW-0.158 gm) was recorded from Bijnor. Even though is the species is kept under Least Concern (LC) as per IUCN Red list Status, *Megarasbora elanga* is a rare fish species in the river Ganga. It is a valued food fish and the population is believed to be declining due to overfishing and habitat destruction.

- *Nemacheilus corica* (Hamilton, 1822) Order- Cypriniformes, Family- Nemacheilidae was observed for the first time from the Bijnor stretch of the river Ganga. The IUCN status of the species has been placed under Least Concern (LC) category.

- *Salmo trutta fario* (Brown trout) (TL- 154 mm & TW- 40.35 gm) is reported for the first time, under the NMCG from Ganga River at Harshil (Latitude: 31^{0}02’15” N, Longitude: 78^0 45’ 49’’E), Uttrakhand. Brown trout is predatory in feeding nature; they feed mainly on aquatic and terrestrial insects and small fish. It is an exotic fish species in the upper stretches of the river Ganga. They prefer to dwell in fast-flowing, oxygen-rich, cool clear waters with gravel, or sandy riverbeds.

- *Garra gotyla* (Gray, 1830), was recorded from the Haridwar (Latitude: 29^{0}58’33” N, Longitude: 78^{0}11’13” E) stretch of the river Ganga.

- *Danio rerio* (Zebra danio) Zebrafish are indigenous to South Asia, and are broadly distributed across parts of India, Bangladesh, Nepal, Myanmar, and Pakistan. A survey was conducted on the investigation of fish diversity in the middle stretch of the river Ganga during April 2022 by CIFRI Prayagraj under NMCG Project. During the sampling period, the *Danio rerio* (TL-32.31mm & TW-0.381gm) was recorded for the first time under the project from Ganga River at Bijnor (Latitude: 29^0 22’ 48’’N, Longitude: 78^0 02’ 01’’E) Uttar Pradesh. *D. rerio* popularly known as Zebra danio and locally called as Zebrafish/Anju belongs to the order Cypriniformes and the family-Danionidae. The number of individuals retrieved during the present investigation was only one. The species was first described by Hamilton in 1822 and was reported from river Koshi in Uttar Pradesh. As per the IUCN status, the species is listed under Least Concern (LC) category. Zebrafish generally feed on a wide variety of benthic and planktonic crustaceans, in addition to worms and insect larvae. This species typically occurs in slow-moving to stagnant water bodies.

- An albinoid *Clarias magur* (Ham, 1822) is reported for the first time from river Ganges at Bhagalpur.

- *Schizothorax progastus* (McClelland, 1839) (Dinnawah snow trout) locally known as Snow trout (TL- 265 mm & TW- 170 gm) was recorded first time at Harshil (Latitude: 31002’15”N, Longitude: 780 45’ 49’’E) Uttarakhand.

- Four different marine inhabitant species (*Muraenesox bagio* Ham., 1822; *Pisodonophis cancrivorus*, Richardson, 1848; *Gymnothorax tile* Ham, 1822 and *Chelonodon patoca,* Ham., 1822) was recorded from brackishwater section of the river Ganga during monsoon sampling (2022) from Fraserganj, West Bengal. The species although reported earlier, was recorded for the first time under the project.

- *Leptomelanosoma indicum* (Shaw, 1804) commonly known as Indian Threadfin is a rare threadfin whose population is declining constantly. During a monsoon sampling of September 2022 in the lower estuarine stretch, a fresh specimen of 34 kg was recorded from Diamond Harbour, West Bengal.

- A single specimen of warm water Gangetic goby (*Glossogobius giuris*) was recorded from upstream of Tehri dam by CIFRI-NMCG team indicating a change in fish species distribution due to the shift in climate change.

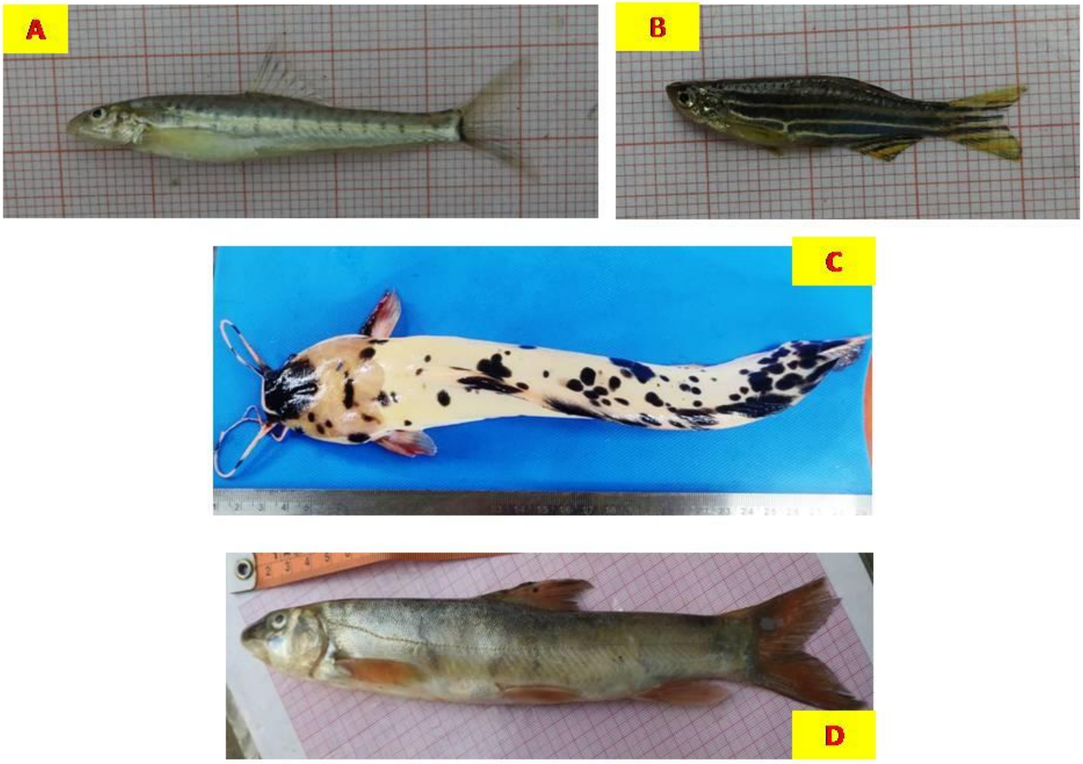

Fig. 77. (A-D) Photographs of newly distributed species **A.** *Nemacheilus corica*, **B**. *Danio rerio*, **C**. *C. magur* (Albinoid) **D.** *Schizothorax progastus*

Common pike conger (Brackishwater)

Long fin snake eel (Brackish water)

Fig. 78. (E-F) Photographs of newly recorded species **E**. *Muraenesox bagio* F. *Pisodonophis*

cancrivorus

Indian Threadfin

Milkspotted puffer fish

Fig. 79. (G-I) Photographs of newly recorded species **G**. *Gymnothorax tile, H. Leptomelanosoma indicum* **I**. *Chelonodon patoca*

Fig. 80. Single specimen of warm water tank goby recorded from Tehri Dam, Uttarakhand during May 2022

4.6. List of species not recorded from river Ganga during present study

The present investigation could not record 14 fish species reported by the earlier workers from the Ganga River (Talwar & Jhingran, 1991). Barring a few, the majority of them are considered trash fish. The non-available fish species in the present study are as follows:

Order: Cypriniformes

Family: Cyprinidae

1. *Labeo nandina* (Ham, 1822)
2. *Pethia guganio* (Ham, 1822)
3. *Puntius puntio* (Ham, 1822)
4. *Puntius vittatus* (Day, 1865)
5. *Tor mosal* (Ham, 1822)
6. *Amblypharyngodon microlepis* (Bleeker, 1853)

Family: Nemachelidae

7. *Schisturas caturigina* (McClelland, 1839)

Order: Siluriformes

Family: Bagridae

8. *Batasio tengana* (Ham, 1822)

Family: Aillidae

9. *Clupisoma montana* (Hora, 1937)

Family: Sisoridae

14. *Conta conta* (Ham, 1822)
15. *Erethistes jerdoni* (Day, 1870)
16. *Nangra nangra* (Ham, 1822)

Order: Perciformes

Family: Anabantidae

17. *Anabas cobojius* (Ham, 1822)

Family: Toxotidae

18. *Toxotes chatareus* (Ham, 1822)

4.7. Implication of climate change on river Ganga

The term "climate change" refers to changes in global weather patterns that last for a longer time, possibly decades or more, and the report on climate trends has revealed varying conditions in India's major river basins. For example, over the past few decades, temperatures in the Ganges River basin have risen by 0.20 to 0.47°C, while rainfall has decreased by 257 to 580 mm. The effects of global climate change are already apparent in a number of environmental factors, such as the melting of ice and the shrinkage of glaciers. The survival of numerous fish and animal species will be put at risk due to changes in the timing of precipitation and increasing levels of water pollution. Practically every ecosystem in the world is now impacted by climate change.

4.8. Impact of climate change on fisheries and ecology

From spawn to adulthood, almost all fish are obligatory poikilothermic and are affected by the water temperature in their environment. The Ganga River environment has seen an increase in air temperature, which has led to irregularities in the riverine ecosystems' heat budget. Almost every aspect of the of the life cycle of fish species, including its habitat, chances of surviving, growing, reproducing, and successfully hatching, as well as its metabolic needs, can be impacted by climate change.

Until 2050, an increasing trend in the Ganga River basin's mean annual temperature of 1-4 °C has been predicted by predictive climate models (Moors et al., 2011). The study has demonstrated how the combined effects of anthropogenic vulnerability and climate change affect biotic and abiotic communities in aquatic habitats.

Due to warmer and more variable temperature circumstances, changes in the plankton assemblage, composition, variety, and structure of fewer species have been recorded. Numerous kinds of plankton have evolved in direct or indirect reaction to the climatic signal. Seasonal differences were revealed in the effects of aberrations in the ecology and environment on small plankton (Sarkar and Das, 2021). Recent studies have shown that the entire Ganga basin's 133 districts have experienced a 56% decline in rainfall, mostly because of climate change (Bera, 2017). In reaction to recent climatic changes, freshwater fish have already undergone alterations in their range and habitat.

It has previously been stated that the Cyprinid fish family has benefited from climate change (Comte et al., 2013). The Ganga River System's natural recruitment of IMCs has been significantly impacted, which has led to a decline in fish spawning as a result of the effects of climate change. On the other hand, there has been a noticeable drop in the availability of fish seed, from 78.82% in the 1960s to 34.48% in 2004. (Vass et al., 2009).

The inland heat waves (HWs) have been observed globally and are expected to amplify in magnitude and frequency under anthropogenic climate variation. The first study by Sarkar and Das (2021) on the impact of heat waves in a stretch of the Ganga River and a wetland in West Bengal indicated the predominant and periodic occurrence of inland heat waves under the ‘caution’ category over these ecosystems during the summer months (April–July). The analysis revealed that IHI influenced pH, transparency, and water depth positively and TDS, salinity, and conductivity negatively, indicating that heat waves may affect the water quality, thereby affecting the sustainability and survival of aquatic life, and that IHI affects plankton concentration and diversity, thereby altering the food composition of the planktivorous fish in the ecosystem. In the past few decades, several fish species have shown extended breeding seasons (*Labeo catla, Labeo rohita, Cirrhinus mrigala, Liza parsia, Tor putitora, Oncorhynchus mykiss, Schizothorax richardsonii,* and *Puntius sophore*). A shift in breeding season was predicted for *Mystus tengara, M. cavasius, Eutropiichthys vacha, Mastacembelus armatus,* and *Ompok bimaculatus*. Modeling pre-spawning fitness and climate referendum towards fish is necessary to realize the impact of climate change on species level, including prediction in future scenarios, and to identify climate resilience and its possible impact on sensitive species.

4.9. Study on impact of climate on fish landing

The river Ganga is a vital aquatic ecosystem in India, supporting a diverse array of aquatic species, including major carp species such as the rohu (*Labeo rohita*), catla (*Catlacatla*), and mrigal (*Cirrhinus mrigala*). This scientific report explores the effect of temperature on the landing of major carp species in the Ganga. Water temperature is a critical factor influencing fish behavior, metabolism, and reproduction, and understanding its impact on major carp landings is essential for effective fisheries management and conservation. The study collected temperature data and landing records of major carp species over an extended period and utilized statistical analysis to assess the relationship between temperature and carp landing. Results indicated a significant correlation between temperature and carp landing, highlighting the need for temperature management in the conservation and sustainable management of major carp populations in the Ganga. Water temperature is a critical factor that affects the growth, reproduction, and survival of fish. IMCs are tropical fish that prefer water temperatures between 25 and 30 °C. When water temperatures rise above 30 °C, IMCs experience a decline in growth and reproduction. They may also become more susceptible to diseases.

Data Collection

Data were collected over a six-year period (2016–2023) at multiple sites along the river Ganga. Six years of data were analyzed to see how the local climate has changed over time. From the Indian Meteorological Department, we have collected daily mean air temperature and precipitation data for a period of six years, spanning from October 2016 through October 2023. Using the previous procedure, we were able to retrieve data from the grid representing the research area. The retrieved daily time series data was then used to calculate monthly time series averages for air temperature and rainfall. Finally, monthly averages were used to calculate the yearly mean air temperature and the total annual rainfall. The long-term trend was determined by a straightforward linear trend analysis. As a result, we were able to quantify shifts in seasonal rainfall composition by comparing pre-monsoon, monsoon, and post-monsoon totals.

Carp landing records: Landing records of major carp species, including rohu, catla, and mrigal, were obtained from local fishery authorities and cooperative societies. The records included species composition and landing quantities for each month.

Data Analysis: A statistical analysis was conducted to determine the relationship between water temperature and major carp landings. The following steps were taken: Data exploration: descriptive statistics and time series plots were generated to identify trends and patterns in water temperature and carp landing. Correlation analysis: Pearson correlation coefficients were calculated to assess the strength and direction of the relationship between temperature and carp landing.

Results

The analysis revealed a significant correlation between water temperature and major carp landings in the Ganga. The key findings include Temperature trends: The water temperature in the river Ganga exhibited seasonal variations, with higher temperatures during the summer months and lower temperatures during the winter months. Correlation with landing: Pearson correlation coefficients indicated a strong positive correlation between water temperature and carp landing ($r = 0.163$, $p < 0.05$). Warmer water temperatures were associated with increased carp landings. One study found that IMC landings in the middle stretch of the River Ganga declined by 50% between 1959 and 2004. This decline was attributed to a rise in water temperature of 1.5 °C.

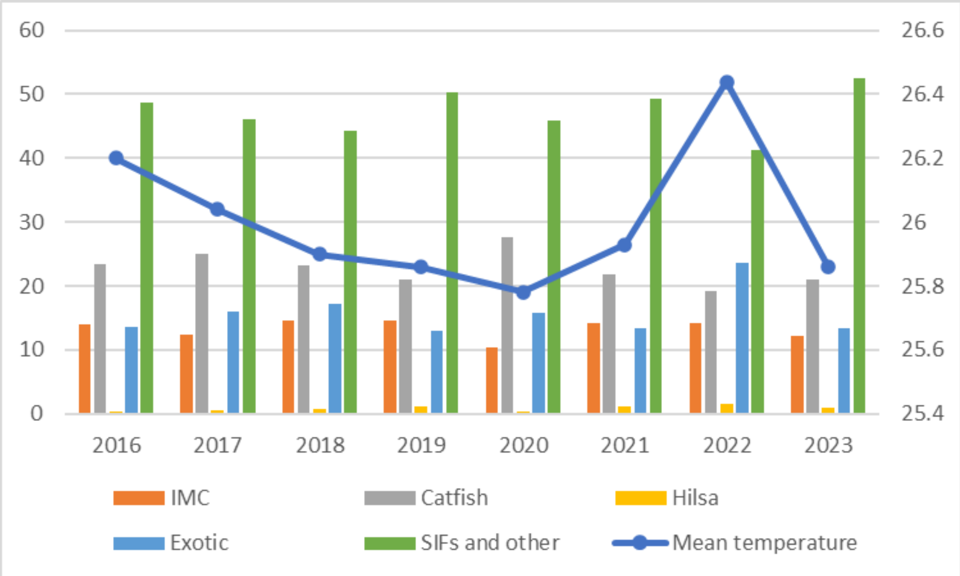

Fig. 81. Relationship between temperature and fish landing from 2016-2023

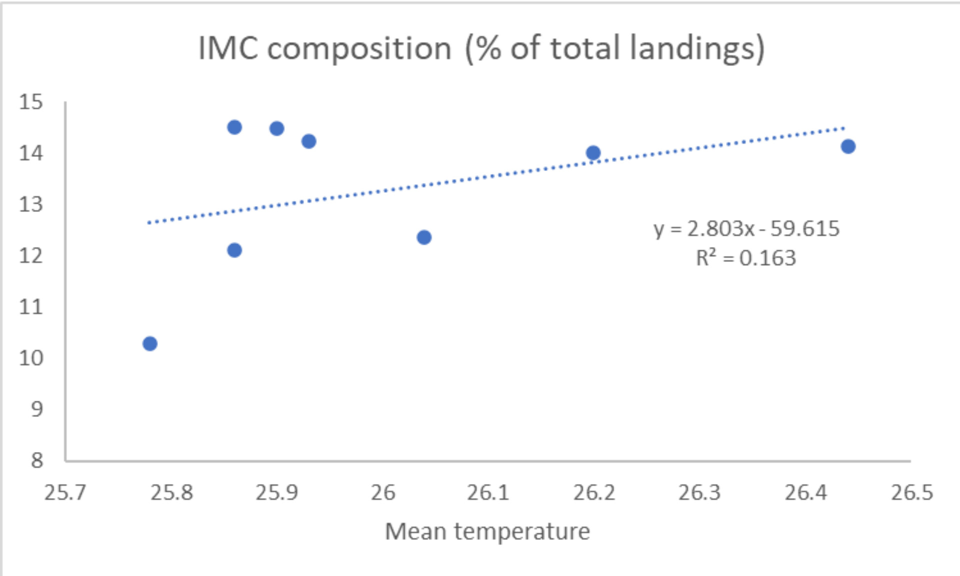

Fig. 82. Relationship between temperature and IMC landing from 2016-2023

Pearson correlation coefficients indicated a strong negative correlation between water temperature and catfish landing ($r = 0.2289$, $p < 0.05$). Warmer water temperatures were associated with decreased catfish landing emphasizing the importance of temperature management in fisheries conservation and sustainable management. Future research can further explore the specific mechanisms through which temperature affects catfish populations and develop targeted conservation strategies for these vital species in the river Ganga ecosystem.

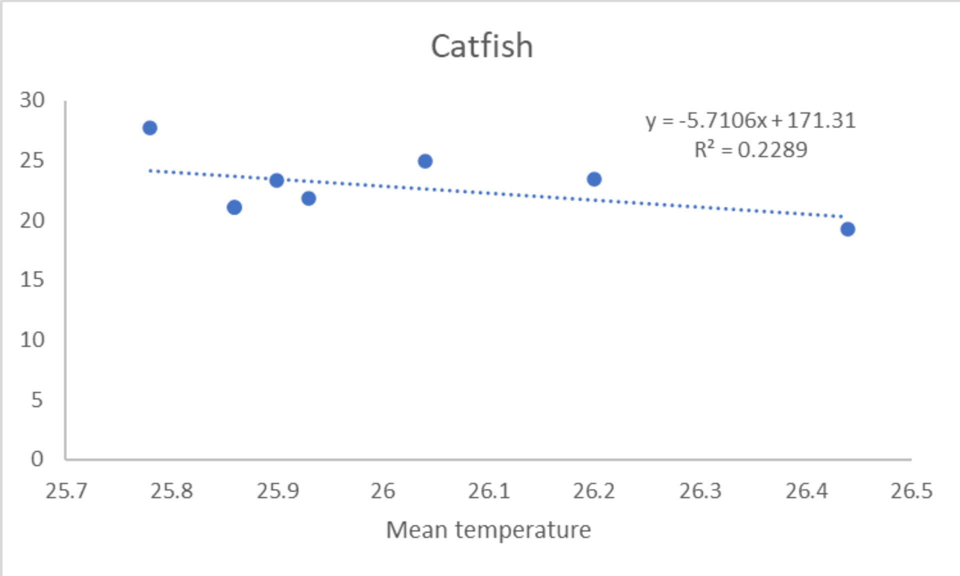

Fig. 83. Relationship between temperature and catfish landing from 2016-2023

The river Ganga, a pivotal waterway in India, is home to a diverse array of small indigenous fish species, which hold great ecological significance and are fundamental to the livelihoods of local communities. This scientific report investigates the impact of water temperature on the populations of small indigenous fish in the river Ganga. Water temperature is a critical abiotic factor that affects fish physiology, behavior, and reproduction. By collecting temperature data and fish landing records, this study employs statistical analyses to examine the connection between temperature and the presence of small indigenous fish. The results reveal a significant correlation between water temperature and the abundance of these fish, underscoring the importance of temperature management for the conservation and sustainable management of these species within the river Ganga ecosystem.

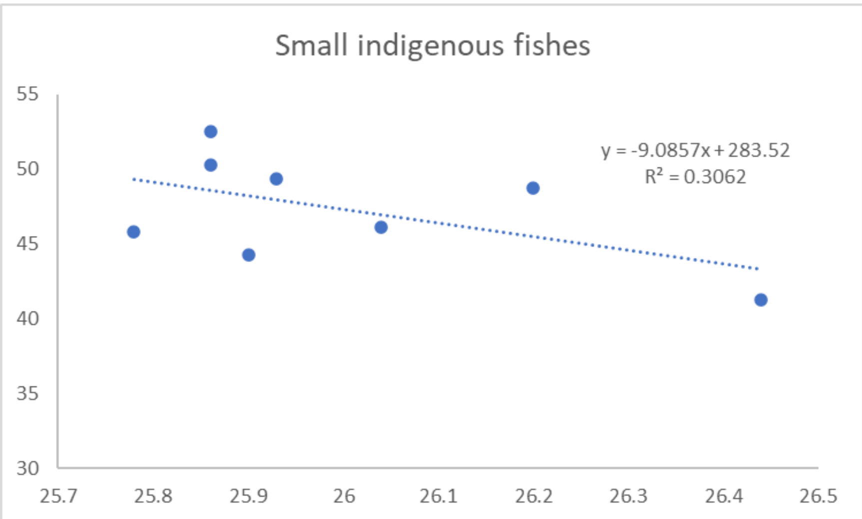

Fig. 84. Relationship between temperature and SIFs landing from 2016-2023

In the context of the river Ganga, an essential aquatic ecosystem in India, the influence of exotic fish species is steadily growing. These non-native species, often introduced by human activities, can have far-reaching ecological and economic repercussions. This scientific report delves into the interplay between water temperature and the presence of exotic fish species in the river Ganga. Water temperature, a fundamental abiotic factor, profoundly affects the behavior and distribution of aquatic organisms. To explore this relationship, the study collected temperature data and recorded instances of exotic fish landings. Utilizing statistical analyses, the research investigates how temperature influences the prevalence of non-native fish in this ecologically significant ecosystem. The findings provide valuable insights into the role of temperature in managing the challenges presented by invasive species in the River Ganga.

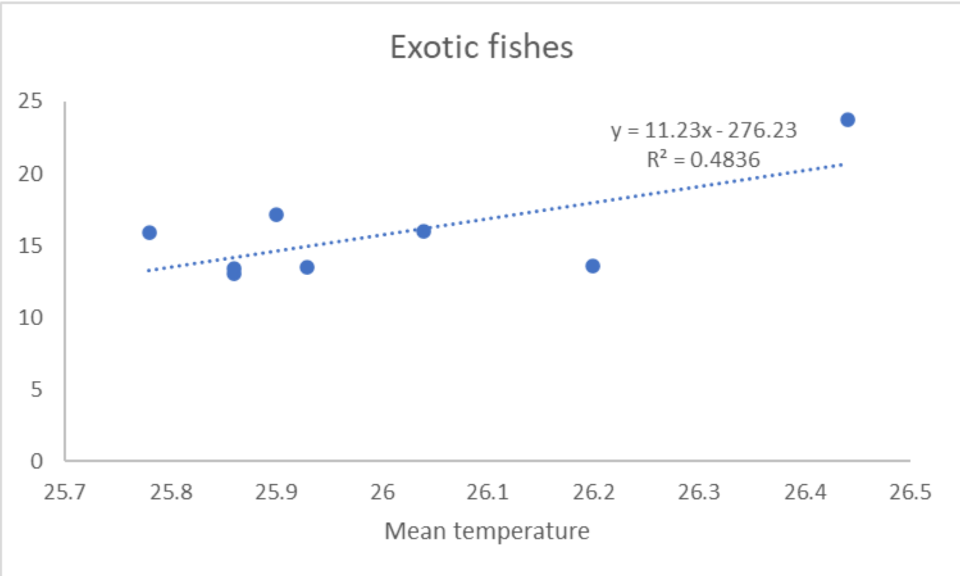

Fig. 85. Relationship between temperature and exotic fish landing from 2016-2023

4.10. Discussion

The results of this study highlight the significant impact of temperature on major carp landing in the River Ganga. Warmer water temperatures were found to be associated with increased carp and exotic fish landing whereas the reverse trend has been observed in the case of catfish and small indigenous fishes, suggesting that temperature is a critical factor influencing the behavior, metabolism, and reproduction of major carp and other species available in river Ganga. The findings have several implications for fisheries management and conservation:

Temperature management: Implementing strategies to regulate water temperature in the River Ganga may help sustain major carp and exotic species populations by providing optimal conditions for their growth and reproduction.

Seasonal planning: Fisheries management strategies should consider the seasonal variations in water temperature when planning for harvests.

Climate change adaptation: Understanding the temperature-related dynamics of major carp and exotic fish species is essential for adapting fisheries management to the effects of climate change.

Conclusion

This scientific report provides valuable insights into the relationship between temperature and the landing of major carp, catfishes, SIFs and exotic species in the River Ganga. The results indicate association between water temperature and fish landing, emphasizing the importance of temperature management in fisheries conservation and sustainable management. Future research can build upon this study to explore the specific mechanisms through which temperature affects major carp populations and develop targeted conservation strategies.

4.11. Cyclonic impact on fisheries and ecology of Ganga

Cyclonic interferences can adversely affect the riverine ecology and ecological niche of many aquatic organisms. A case study was conducted in cyclonic storm "Yaas," which affected the area of the lower stretch of the river Ganga in West Bengal. The study was focused on the impact of the tropical cyclone on different abiotic as well as biotic variables (plankton, fish, and benthos) of the river Ganga. In the study, it was observed that cyclones have affected the Water Quality Index, which was 70.52 during the period of Yaas and reduced to 52.8, while the observed value during the post-Yaas period was 68.2. The effect can also be noticed in the phytoplankton density of the waters, where the abundance varied from the pre-Yaas period (6284 cell^{-1}) to Yass (670 cell^{-1}) and finally during the post-Yaas period (196 cell^{-1}). Contrary to phytoplankton, zooplankton responded favorably as its density increased from the pre-Yaas period (196 cells/1) to the Yaas period (370 cells/1) and during the post-Yaas period (24 cells/1). The fish and 30 benthic organisms also showed similar responses to zooplankton.

4.12. Climate change impact on fish seed production

Previous reports on fish spawn availability from the river have indicated a decreasing trend of wild IMCs spawn (10%) during the period 2005–2009 in percent contribution compared to other fish stocks (90%). On the other hand, a considerable decline in fish seed availability has also been noticed, from 78.82% (1960's) to 34.48% (2004) (Vass et al., 2008). The number of fish spawns (approx.) varies greatly depending upon the time of commencement of the monsoon. Generally, the entire Ganga River basin receives heavy rainfall (80%) during the period from June to September, with an average of about 1200 mm. However, recent studies have indicated a decrease in rainfall by 56% over 133 districts along the entire Ganga basin, largely due to climate change. As a result, the river experiences several floods during the collection period, i.e., extending over a period of 30 days. The bulk appearance of the spawn is observed only during the first two floods during the peak season, while the remaining yield only shows traces of spawn. The first flood, which contributes the most to the spawn, commences very late nowadays owing to delayed monsoons. However, on the other side, the operation also reaches its peak when the river water appears reddish in color owing to the addition of water from the river Son from the north. It appears generally by the last week of July and remains until the 1st week of August. This is the probable reason behind the shorter span of collection time.

4.13. Assessment of Fish reproductive Biology

The most crucial aspect in determining the annual abundance levels of fish in the largest commercial fisheries is the reproductive success and recruitment of young fish into the exploitable population. The target of the present work under component I is to promote closer connections between basic and practical research on fisheries recruitment.

Due to overfishing, damaged natural habitats, or climate change, many wild fish populations are experiencing severe declines. The market demand for fish products for human consumption is also growing quickly and steadily. In this situation, it is imperative to manage vulnerable fish stocks effectively while also fostering the aquaculture sector's sustainable growth. Both the implementation of appropriate fishery regulatory measures and the successful introduction of new species in the aquaculture business depend on an understanding of fish reproductive biology. For the proper execution of fishery management laws, knowledge of reproductive features, including sexual maturity, reproductive cycles, spawning sites and behavior, spawning frequency, and fecundity, is essential.

Aquaculture needs the regulation of reproductive processes in captive broodstocks of either wild-caught or captivity-produced breeders to generate a variety of fish species for commercial purposes. However, a lot of fish raised in captivity have reproductive issues that prevent them from reliably and effectively reproducing. To address these reproductive dysfunctions utilizing both environmental and hormonal modifications, it is crucial to understand the gametogenesis, sexual maturity, reproductive cycles, and reproductive potential of wild and cultivated fish. The most crucial aspect in determining the annual abundance levels of fish in the largest commercial fisheries is the reproductive success and recruitment of young fish into the exploitable population. As a part of the present research work carried out, an assessment of the reproductive biology of different native Gangetic fishes is underway. The investigation regarding the present status of fecundity, sex ratio, and spawning periodicity of 9 fish species (*Polynemus paradiseus*, *Mystus cavasius*, *Puntius sophore*, *Amblypharyngodon mola*, *Heteropneustes fossilis*, *Cirrhunus reba*, *Ompok bimaculatus*, *Eleotris fusca*, and *Nandus nandus*) at different stages of development of this species in the water of Hooghly estuary.

Glossogobius giuris (Hamilton, 1822)

Puntius sophore (Hamilton, 1822)

Mystus vittatus (Bloch, 1794)

Mystus cavassius (Hamilton, 1822)

Heteropneustes fossilis (Bloch, 1794)

Pachypterus atherinoides (Bloch, 1794)

Fig. 86. Plates of gravid fish species assessed for studying reproductive parameters from different locations of river Ganga

4.14. Pool Barb (*Puntius sophore*)

Puntius sophore, commonly known as the Pool Barb, Spot Fin Barb, or Stigma Barb, is a nutritionally rich, indigenous small fish. It belongs to the family Cyprinidae and inhabits both fresh and brackish waters such as rivers, streams, ponds, beels, and floodplain regions (Singh et al., 2023). The fish are pelagic, herbivore, and shoaling in nature; their habitat spans throughout the Indian subcontinent, including India, Bangladesh, Bhutan, China, Nepal, Myanmar, and Pakistan (Hossain et al., 2012; Sarkar et al., 2019). Traditionally esteemed for its high nutritional value, protein content, and micronutrients, this species has recently gained recognition in the ornamental fish trade, finding its place as an indigenous ornamental fish exported from India. Presently, *P. sophore* in Indian rivers is facing a steady decline due to irregular overfishing, pollution, habitat destruction, the influence of climate, environmental changes, and other anthropogenic pressures (Rani et al., 2019; Sarkar et al., 2019) that threaten the Pool Barb, leading to its categorization as "near threatened" according to the CAMP report and "least concern" according to the IUCN Red List of threatened species (Choudhury et al., 2015; Gupta, 2015).

Results

The total length (L) of *P. sophore* exhibited a range between 4.46±0.61 cm and 9.88±0.74 cm, while the body weight (W) varied from 2.1±0.88 g to 19.99±5.42 g. Notably, the highest average values for total length and body weight were recorded in June, whereas the lowest values were observed in February. A comprehensive set of breeding biology parameters is shown in Table 7. In this study, *P. sophore* exhibited a maximum length of 11.20 cm and a weight peak of 27.50 g. The length and weight of the gonad range from 1.26±0.23 to 2.75±0.38 cm and 0.06±0.03 to 2.8±0.51 g, respectively.

Table 7. Month wise depiction in variation of fish gonad of *P.sophore*

Sampling month (2023)	Total length (cm)	Total body weight (g)	Length of gonad (cm)	Weight of gonad (g)
February	4.46±0.61	2.1±0.88	1.26±0.23	0.06±0.03
March	6.64±0.57	6.58±1.58	1.3±0.15	0.19±0.07
April	7.24±0.6	6.38±2.15	2.08±0.46	0.38±0.25
May	7.89±0.81	10.65±3.29	2.53±0.32	1.16±0.58
June	9.88±0.74	19.99±5.42	2.75±0.38	2.8±0.51
July	7.81±0.87	10.35±3.39	2.42±0.26	1.13±0.67
August	7.9±0.8	7.42±1.48	1.8±0.65	0.55±0.26

The Gonadosomatic Index (GSI) serves as a primary indicator for gauging the gonadal development and maturity stages of fish specimens (Parween et al., 1993). Remarkably, a surge in gonadal activity occurs during the monsoon season, with the peak spawning season consistently observed in June. Negligible GSI was found in February and March, while a peak was found in June. The relationship between ova diameter and GSI is shown in Fig. 87. Ova diameter varied between 18.27±0.65 µm and 18.27±0.65 µm. An increase in GSI corresponds to an increase in ova diameter and vice versa, thus suggesting that the two parameters were proportional.

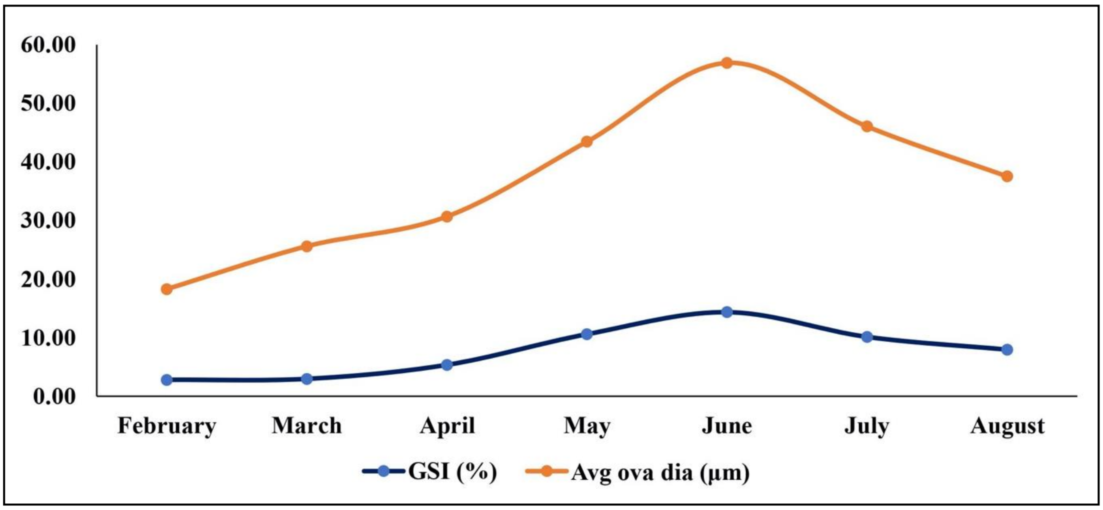

Fig. 87. Relationship between ova diameter and GSI of *Puntius sophore*

The result showed the highest fecundity was observed in June (6721±1134) with a length of 9.88±0.74 cm. The lowest fecundity was found in February (311±106), having a length of 4.46±0.61 cm. The relative fecundity of *P. sophore* ranged from 160±44/g to 447±166/g. The mean total fecundity was 3016±2228, ranging from 216 eggs (for the smallest mature with a body length and weight of 3.95 cm and 1.25 g, respectively) to 8260 eggs (female with a body length and weight of 11.2 cm and 27.50 g, respectively). Total length, body weight, and weight of the gonad showed positive correlation with the fecundity, and relationships are displayed in Fig. 3. Fig. 4 and Fig. 5 have r^2 values of 0.63, 0.68, and 0.66, respectively.

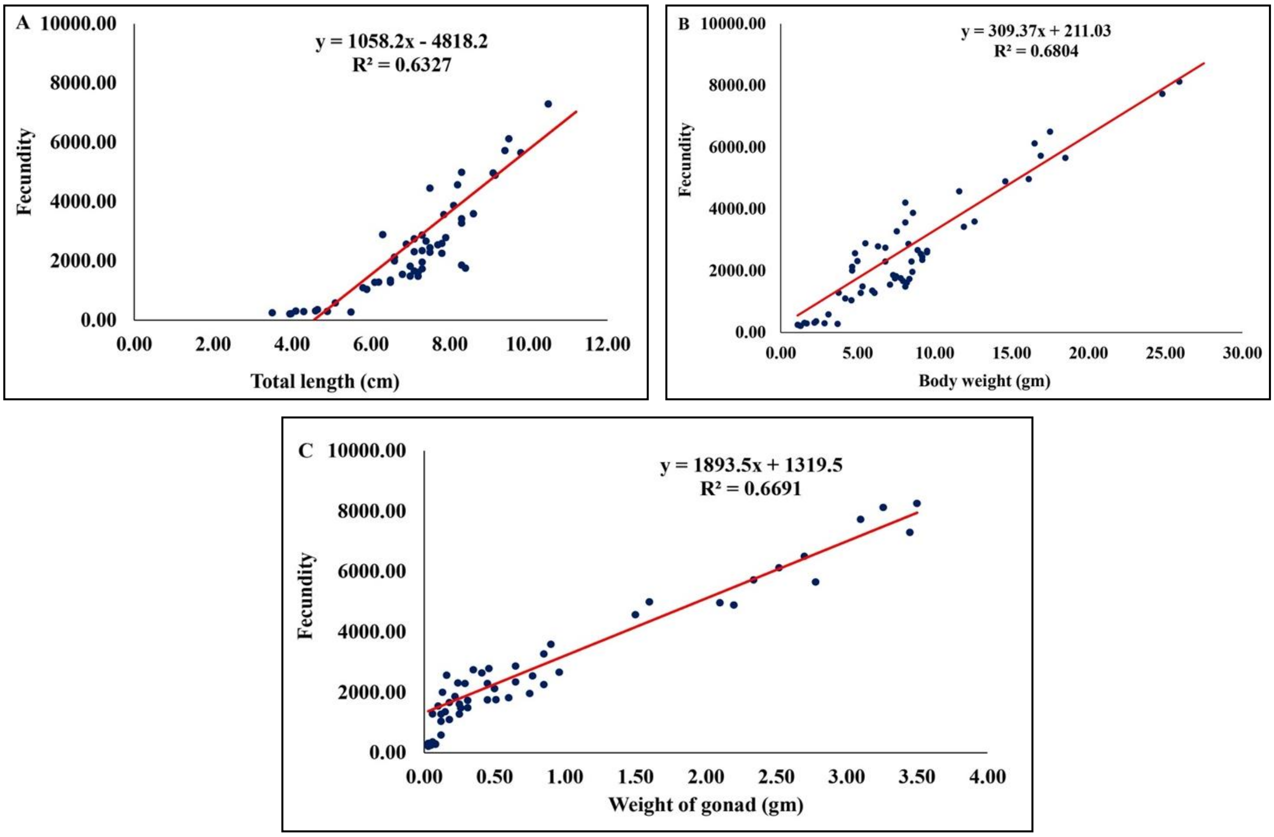

Fig. 88. Relationships of fecundity with between total length (A), Body weight (B) and weight of gonad (C) of *P. sophore*

4.15. Paradise threadfin (*Polynemus paradiseus*)

The paradise threadfin (*Polynemus paradiseus*) is a catadromous ray-finned fish species and a member of the Polynemidae threadfin family. It is a medium-sized threadfin species, growing up to 30 cm in length. The paradise threadfin lives in estuaries and offshore seas down to depths of 27 meters where there are sand substrates. Because it breeds in freshwater, it must frequently move into rivers. It is a carnivorous species that consumes benthic invertebrates, tiny fish, and crustaceans. This species has distinct sexes, and hermaphroditism is absent. At Hooghly River, paradise threadfins are believed to spawn from April to September, and the majority of the females that were sampled in October were presumed to be spent.

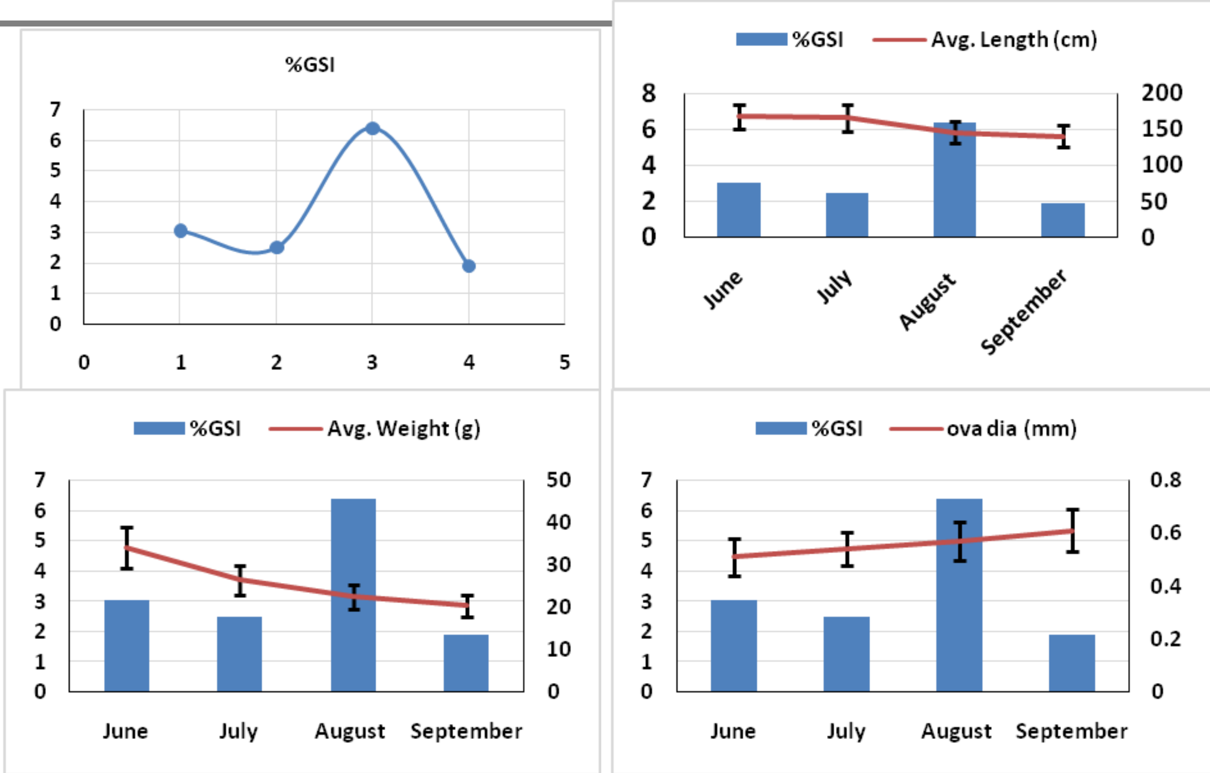

Fig. 89. Gonadosomatic index of *P.paradiseus* with different body size (A), GSI vs. average length (B), GSI vs. average body weight (C) and GSI vs. ova diameter (D) has been calculated from the month of June to September 2022 in wild-caught *Polynemus paradiseus*. Values are represented as mean ± SEM, n=25/day/month.

4.16. Gangetic mystus (*Mystus cavasius*)

Mystus cavasius is a freshwater catfish that belongs to the family Bagridae of the order Siluriformes. It is a common food fish on the Indian subcontinent and has a high market value. It is frequently referred to as Gangetic Mystus and has been found in India and other tropical nations. Externally, it is distinguishable by the genital papilla, which is only found in males. During the breeding season, the papilla is quite noticeable.

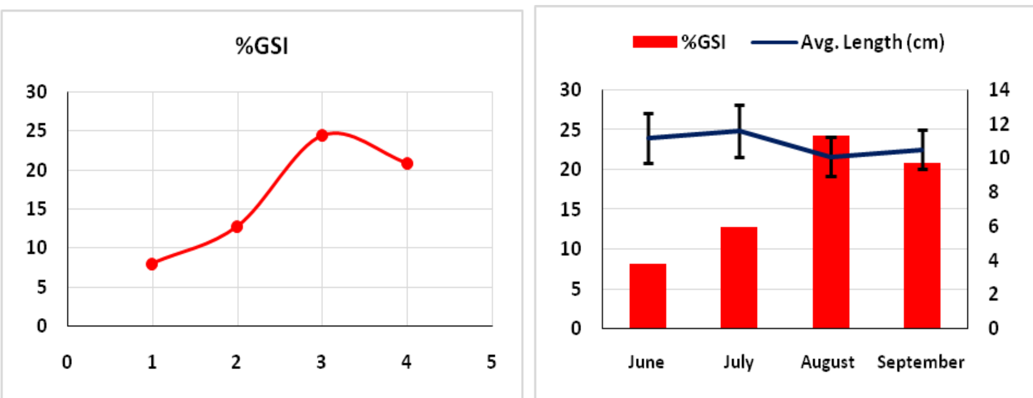

Fig. 90. Gonado-somatic index of *M. cavassius* (A), GSI vs. average length (B), Values are represented as mean ± SEM, n=31/day/month.

4.17. Detection of river pollution based on plasticizers and endocrine-disrupting chemicals and their effect on aquatic ecosystem

India's main source of fresh water is the Ganga. The river has recently been shown to contain several developing organic contaminants. It is crucial to look at plasticizers and bisphenol A in the Ganga River from its source to its end due to the widespread usage of additives and plasticizers in plastic items. Since more than 50 years ago, manufacturers have utilized the phenolic chemical bisphenol A (BPA) to create polycarbonate plastics, epoxy resins, thermal paper, and as a polymerization inhibitor in the creation of various polyvinyl chloride polymers. Products like compact discs, auto parts, infant bottles, plastic dinnerware, eyeglass lenses, toys, and impact-resistant safety gear are all made with polycarbonates. Some canning container protection linings, wine vat linings, epoxy resin-based paints, flooring, and some dental composites all use BPA-containing epoxy resins. Therefore, we started looking at the level of BPA in various components of the river Ganga, starting with river water and other biotic and abiotic components of the riverine ecosystem.

BPA has been known to induce alterations in gene expression, which are designated as epigenetic modifications, including DNA methylation, histone modification, and the expression of non-coding microRNAs. BPA and phthalates are epigenetically harmful substances. Epigenetics is a crucial mechanism by which environmental chemicals can affect health and disease. We therefore designed a work plan (Fig. 91), and research work is underway to explore the role of BPA in the riverine ecosystem.

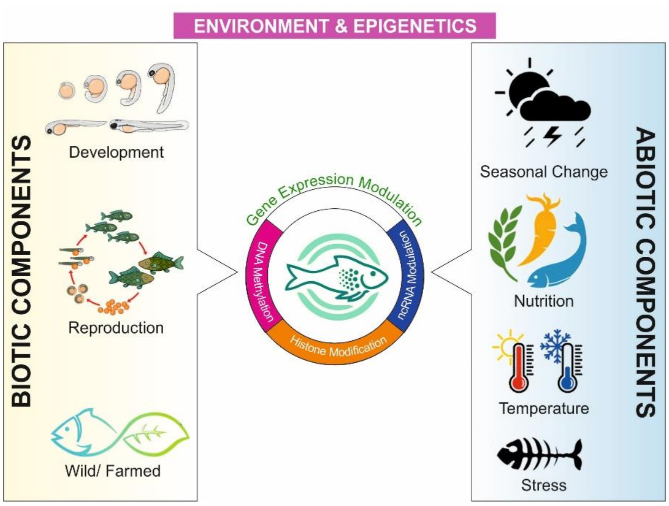

Fig. 91. Effect of biotic and abiotic components of the environment on gene expression modulation

4.18. Objectives of the work:

Role of BPA on fish reproduction via epigenetic modulation

Steroid hormone analysis with an emphasis on BPA exposure and its role in modulating the reproductive biology of aquatic animals, especially fish.

The study of the epigenome in eco-toxicologically relevant fish species is of great importance because it is evident that there are vast differences between higher and lower vertebrates.

Epigenetic study of lower aquatic flora and fauna (plankton, invertebrates, aquatic plants) connected with the fishery.

4.19. Experiment-1

To understand the dynamics and concentration of BPA in the water of River Ganga and its associated wetlands.

Sampling procedure:

- Ganga river water was collected during monthly sampling from sampling points Farakka, Jangipore, Berhampore, Triveni, Balagarh, Barrackpore, Godakhali, Diamond Harbour, and Frasergunj.
- Water samples of open and closed wetlands were collected quarterly.
- ELISA method was used to detect the presence of BPA levels in the water sample.

Fig. 92. Plastic pollution on the banks of river Ganga (Photo taken at Swarupganj Ghat, Nabadwip, Nadia, West Bengal).

4.20. BPA extraction method:

On a vacuum manifold, C18 cartridges were put in position. To remove any remaining bonding agents, the cartridges were treated with 40 ml of deionized water and 25 ml of methanol, which were both pulled through the cartridges at a low vacuum. Then, 500 ml river water samples from each sampling station were separately loaded onto the appropriate cartridges and pumped through them while being slightly vacuumed (mean flow rate: 60 ml/min). The target compounds were transferred from the aqueous samples onto the SPE cartridges during the sample loading stage. The adsorbed analytes were then extracted from the cartridges in 10 ml vials using 5 ml methanol flowing at a rate of 5 ml/min. Either BSTFA with 1% TMCS or MSTFA with 1% TMCS was used to derivatize the dry residues. After that, the vials were sealed and heated to 65 °C for 25 minutes. Test samples (100 g/l) were derivatized in triplicate at reaction durations of 10, 20, 25, 30, 35, and 40 min.

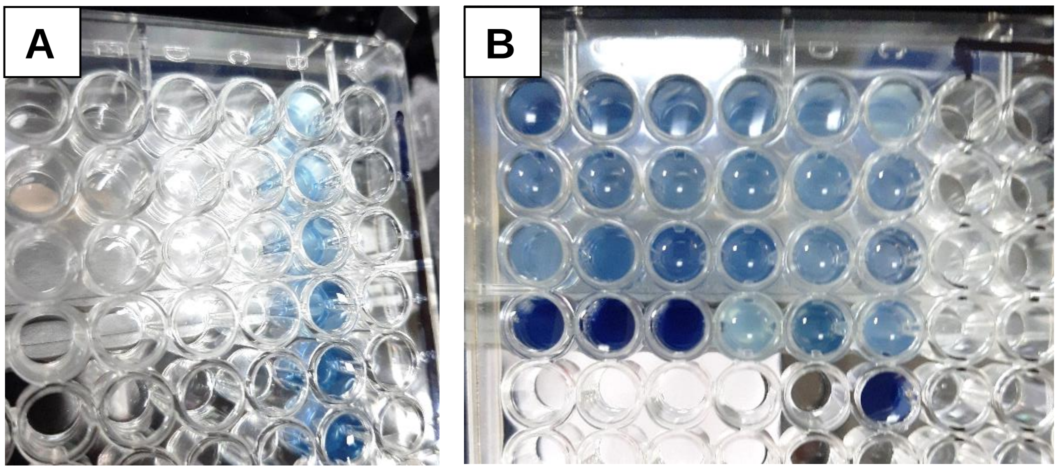

Fig. 93. ELISA plates after final colour development of BPA. A. Plate with standards and B. Plate with experimental samples after analysis

ELISA method

Sandwich-ELISA kit from 'My Biosource Inc. (San Diego, CA)' which is highly specific and sensitive for aqueous samples was used for the detection. For the standard curve, 1.0 ml of standard diluent was added to the lyophilized standard vial and was kept for 30 minutes after proper mixing. After the standard has completely dissolved, standard serial dilutions were used to achieve the standard curve from 200 to 3.12 ng/ mL.100 µL of standards and samples, were loaded to assigned ab-coated wells including blank to their corresponding wells. The wells were sealed and incubated at 37 ºC for 90 minutes. After incubation, the wells were washed and 100 µL of biotinylated Ab was added. The wells were sealed and incubated again. The wells were washed and 100 µL of enzyme conjugate was added to each well. After the incubation period is over, wells were washed and 100µL of the prepared color reagent was added to individual wells and incubated. After incubation, 100µL of the color reagent C was added to individual wells, mixed, and OD was read at 450 nm using a microplate reader.

4.21. Experiment-2

Effect of dissolved BPA in freshwater gastropods of river Ganga

Targeted species:

1. *Filopaludina bengalensis*
2. *Melanoides tuberculata*
3. *Assiminea francesiae*
4. *Thiara granifera*

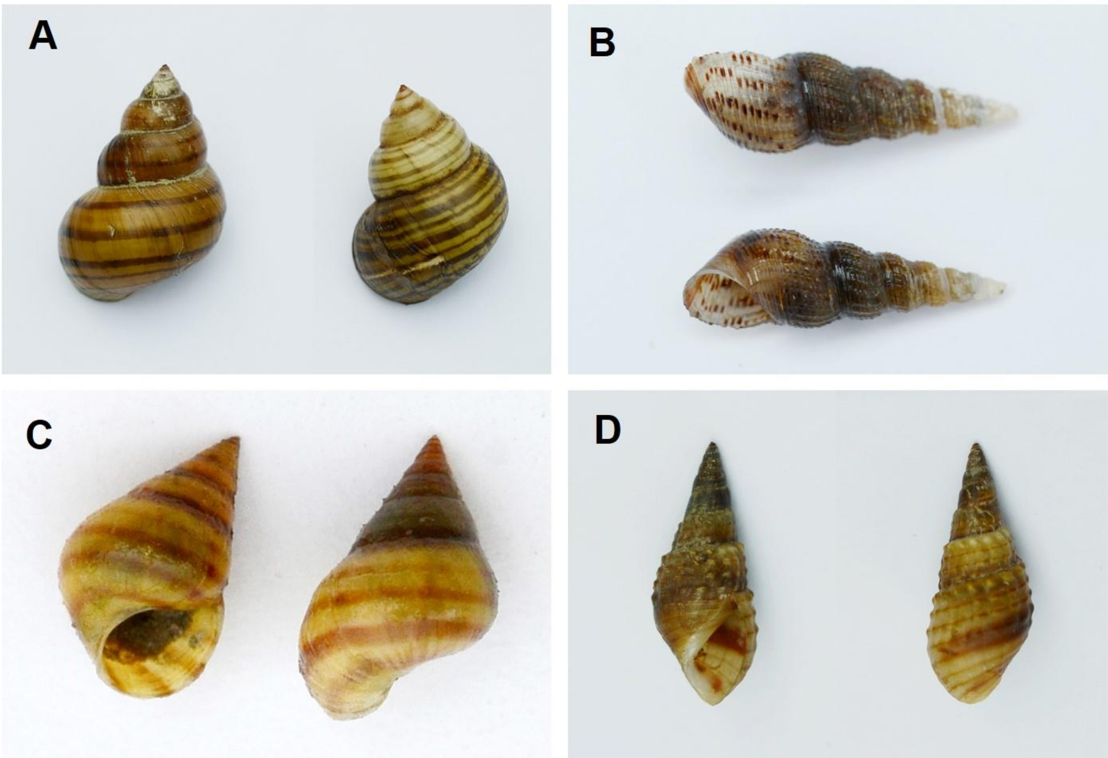

Fig. 94. Targeted benthos species available in river Ganga for BPA (A. *Filopaludina bengalensis*, B. *Melanoides tuberculata*, C. *Assiminea francesiae*, D. *Thiara granifera*)

Sampling procedure:

- Benthos samples were collected monthly from Farakka, Jangipore, Berhampore, Triveni, Balagarh, Barrackpore, Godakhali, Diamond Harbour, and Frasergunj depending on their availability.

- Aspartate Aminotransferase (Metabolic Enzyme); Gamma GT; Alkaline Phosphate; Total Protein; Triglyceride; Creatinine; Albumin; Vitellogenesis; Urea and Uric Acid will be analyzed.

Objective: Gastropods are one of the important ecological factors in the Ganga, whose depletion in number or abnormalities in behavior can change the ecological aspects of the riverine system. The parameters are analyzed because of their reproductive behavior, imposex due to pollutants, hormonal imbalance, incomplete hatching, reduction of sperm count in males and females (increase in ‘X ‘chromosomes), ecological behavior, temperature causing behavioral change, and increase in cannibalism.

An analysis of bisphenol A in two freshwater benthic organisms was carried out. The samples were collected from Buxar to Tribeni (lower stretch). The accumulation of BPA was observed more in bivalve species than in gastropods (Fig. 95).

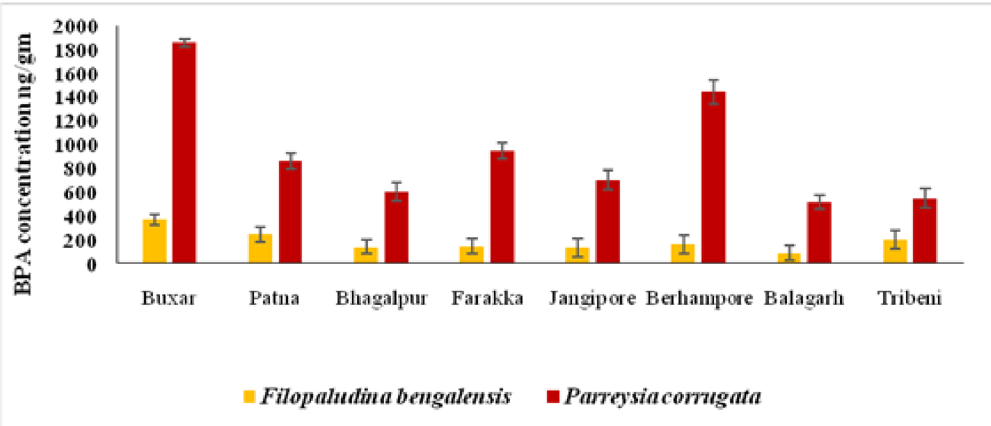

Fig. 95. Accumulation of BPA was observed in two Gangetic benthic species

4.22. Experiment-3

Effect of dissolved BPA in freshwater fishes of river Ganga

<u>Targeted species:</u>

1. *Labeo rohita*
2. *Labeo catla*
3. *Cirrhinus mrigala*

<u>Sampling procedure:</u>

- Fish samples were collected monthly from Farakka, Jangipore, Berhampore, Triveni, Balagarh, Barrackpore, Godakhali, Diamond Harbour, and Frasergunj depending on their availability.

- The following parameters like complete blood count, WBC, RBC, hemoglobin, HCT, MCV, MCH, MCHC, PLT along with serum-related tests like liver function test, kidney function test, heart function test, stress hormones (cortisol, etc.), oxidative enzymes/ ROS parameters (CuSOD, MnSOD, TNFα, VEGF, Hif1α), superoxide dismutase (SOD, catalase) will be analyzed.

4.23. Experiment-4

Effect of BPA in freshwater fishes of river Ganga in captive condition

<u>Targeted species:</u>

1. *Labeo rohita*
2. *Mystus vittatus*
3. *Pangasianodon hypopthalmus*

<u>Sampling procedure:</u>

- Fingerlings of the targeted species will be grouped into 4 groups and will be divided into glass aquariums. Each glass tank will contain 20 fish. The BPA treatment will continue for 60 days at desired concentration (after calculating the LC50) and samples will be harvested every 15 days post-treatment.
- Water quality parameters will be checked every day till the experiment lasts.
- The following parameters like complete blood count, WBC, RBC, hemoglobin, HCT, MCV, MCH, MCHC, PLT along with serum-related tests like liver function test, kidney function test, heart function test, stress hormones (cortisol, etc.), oxidative enzymes/ rosparameters (CuSOD, MnSOD, TNFα, VEGF, Hif1α), superoxide dismutase (SOD, catalase) will be analyzed.
- BPA content in the kidney, muscle, liver, brain, etc. will be analyzed using the ELISA method described earlier.

Along with these, the epigenetic mark will be detected by analyzing global DNA methylation, gene expression of multiple DNMT gene families, histone deacetylases and miRNA profiling. To state briefly:

4.24. Genomic DNA isolation from fish gonad

A glass Dounce homogenizer was used to homogenise 20 mg of minced fish ovarian tissue, which was then suspended in 500 μl of lysis buffer. The mixture was then kept overnight at 55 °C in a shaking incubator. The dissolved liquid was combined with an equal volume of phenol, chloroform, and isoamyl alcohol and centrifuged at 14000 rpm for 5 minutes. An equivalent volume of pre-chilled isopropanol was added to the upper aqueous layer in a fresh microcentrifuge, which was then centrifuged once more at 8000 rpm for 15 minutes. The remaining particle was cleaned with 70% ethanol after the isopropanol removal. The extracted DNA pellet was resuspended in nuclease-free water and kept at -80 °C for later usage after being air-dried in a laminar hood. Bisulfite conversion of the samples (250 ng) was executed with the EZ DNA Methylation-Lightning Kit.

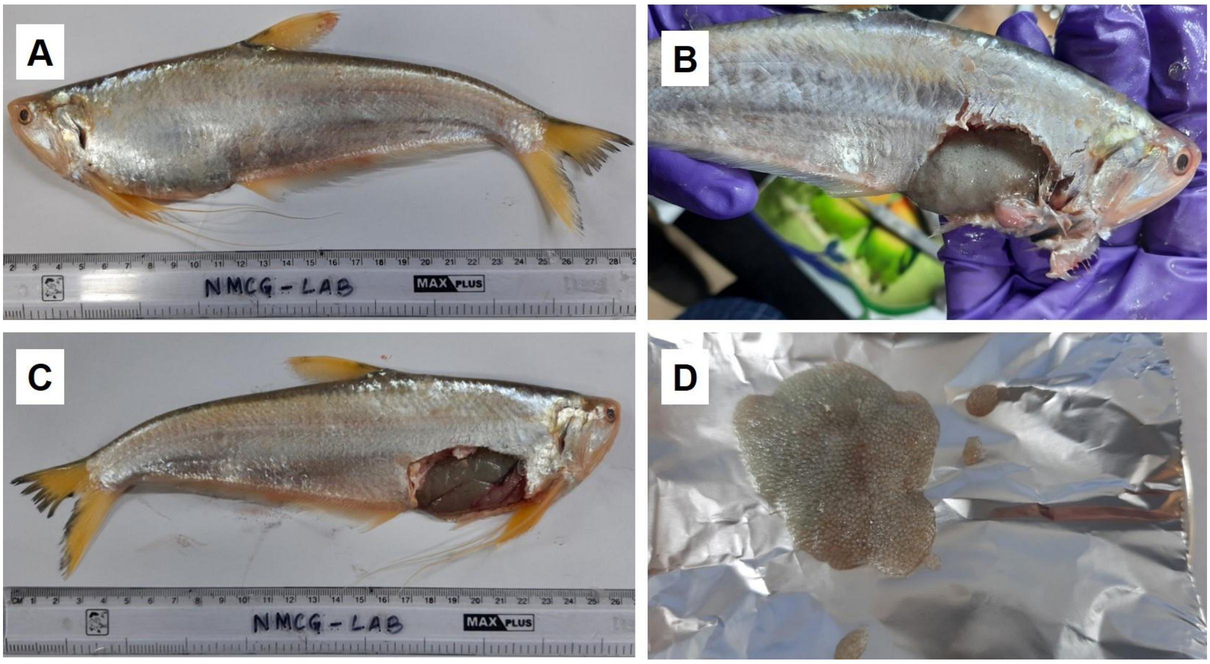

Fig. 95 Isolation of gonad from mature adult female Gangetic hairfin anchovy (*Setipinna phasa*). A. Mature wild-caught female fish from river Ganga, B. Location of ovary, C. Ovary length in comparison with body length and D. ovary dissected out from mature female for genomic DNA isolation.

4.25. Global DNA methylation quantification

To measure levels of global methylation, the amount of 5-methylcytosine (5-mC) was determined using Imprint ® methylated DNA quantification ELISA kit. Briefly, DNA samples were diluted in DNA binding solution and 30 µl of sample was added to sample wells using DNA binding solution as blank. The wells were incubated at 37 °C for 60 minutes. After incubation, 150 µl of block solution was added to each well and incubated again at 37 °C for 30 minutes. The samples were then discarded and washed thrice with 150 µl of working wash buffer. For methylated DNA capture, capture Ab was diluted in working wash buffer at a ratio of 1:1000 and 50 µl of the capture Ab was added to each well. The wells were covered and incubated at RT for 60 minutes. After incubation, capture Ab was discarded and wells were washed with 150 µl of working wash buffer, four times. 50 µl of diluted detection Ab was added to the wells and incubated for 30 minutes at RT. Wells were washed with 150 µl of working wash buffer after discarding the detection Ab. 100 µl of developing solution was added to the wells and incubated at RT in dark. During this period, a blue colour appeared in the wells. To stop the reaction, 50 μl of stop solution was added to each well which turned the colour to yellow. The absorbance was read at 450 nm using EPOCH2 microplate reader.

4.26. Detection of methylation index

To determine the index of methylation, SAM and SAH levels in fish gonadal tissue have been analyzed using a SAM and SAH combo sandwich-ELISA kit specific for samples from aquatic sources. Approximately 100 mg of fish ovarian tissue was homogenized in 500 μl ice-cold PBS and centrifuged at 10000 x g for 15 minutes at RT. Fifty μl of sample as well as standards were added to the respective conjugate-coated plate and incubated inside an orbital shaker for 10 min. 50 μl of anti-SAM or anti-SAH Ab was added to each well and incubated using an orbital shaker for 60 min at RT. The wells were washed with wash buffer solution, 100 μl of diluted secondary Ab HRP conjugate was added and incubated again. Wells were washed and 100 μl of substrate solution was added immediately. The incubation period for this step varied from 2 to 30 minutes at RT. The reaction was stopped using a stop solution and the absorbance was read at 450 nm wavelength.

4.27. RT-PCR analysis of genes related to reproduction and DNA methylation

For RT-PCR analysis, *cyp19a1*-, *20β-HSD*-, *FSHR*-, *DNMT1*- and *DNMT3A*-specific oligonucleotide primers were designed with optimum annealing temperature, 53 to 57 °C, based on the available ovary-specific cDNA sequences of *Oncorhynchus mykiss*, *Carassius auratus*, and *Danio rerio*, belonging to the family Actinopterygii, available in GenBank at NCBI (https://www.ncbi.nlm.nih.gov/). After testing all the available primer sets using standard nucleotide BLAST (https://www.blast.ncbi.nlm.nih.gov/), one pair of the best-fit primer was selected for further gene expression experiments. The housekeeping gene selected for this work was GAPDH. In a total volume of 50 μl, PCR was carried out by adding 2.5 U Taq DNA polymerase to a master mix that contained 20 M of each deoxy-NTP, 20 pmol of each primer, and 20 M of each reaction buffer (50 mM KCl, 10 mM Tris-HCl [pH 8.3], 0.1 percent Triton X-100). 35 cycles of amplification at 94 °C for 30 s (5 min in the first cycle), a predetermined temperature (55 °C) for each pair of primers for 30 s, and extension at 72 °C for 30 s were carried out after the initial 5 min denaturing step at 94 °C (10 min in the last cycle). The expression analysis used RT-PCR products made with primers.

4.28. Framing fish reproductive biology

4.28.1. Estimation of fecundity, GSI and spawning periodicity

The estimation was carried out by recording the total length and body weight of each collected fish specimen to the nearest 0.01 cm and 0.01 g, respectively. The individuals were dissected to record the ovary length (OVL) and ovary weight (OW) nearest to the 0.00001g by a sensitive electric balance. Simultaneously, the shape and colour of the ovary were also recorded by visual observation. The ripe mature ovary was taken out and preserved in Bouin's fluid solution. The gravimetric method was followed for estimating fecundity where three sets of sub-samples were taken out from each region of the ovary (anterior, middle and posterior). Likewise, the Relative fecundity of the species was achieved by dividing absolute fecundity with the total weight of fish. Monthly Gonado Somatic Index (GSI) was evaluated following the equation i.e., GSI= (Weight of the gonad)/ (Total body weight) × 100. To evaluate spawning periodicity, methods were followed outlined by Clark (1934) from the preserved ovaries.

Fig. 96. Photomicrograph of Tengra fish (*Mystus vittatus*) caught from river Ganga. Inset: Mature ovary dissected out from the mature female of *M. vittatus*.

4.28.2. Estimation of ovarian steroid hormone

The assay was carried out using multiple ELISA kits specific for fish 11-keto testosterone, FSH, GnRH, and 17β-estradiol. Briefly, 50 µl each of steroid standard (concentrations vary among steroids as per manufacturer) were transferred to the standard well containing a biotinylated antibody. In the sample wells, 40 µL of samples were added with a 10 µL anti-steroid antibody provided with the kit. The immunoreactions were started by adding 50 µl of streptavidin-HRP conjugate solution into each standard and sample well, sealed with a sealer followed by incubation at 37 °C for 1 h on a plate shaker. After the incubation, the content from each plate was removed and washed. The Wash buffer was completely drained out from each well by blotting the plate onto paper towels. Next, 50 µl of solution A was dispensed into each well followed by the addition of 50 µl of second solution B. The plate was again sealed with a sealer and incubated at 37 °C for 10 min in dark. Color development was stopped by adding 50 µL of stop solution. Absorbance was recorded at 450 nM using a microplate spectrophotometer.

4.29. Protein content analysis in plankton and benthos samples

Freshwater plankton and benthos species were extensively studied for their toxicity profiles using biochemical measures; however, information on their protein profiles is sparse. Protein electrophoresis has been proven to be a reliable method for identifying intra- and inter-specific variation among species. Fish health was assessed thoroughly using protein profiles. With this in mind, we used SDS-PAGE as a molecular biomarker for protein profile analysis in support of biochemical parameters to investigate the impact of hazardous chemicals on freshwater plankton and benthic ecosystem.

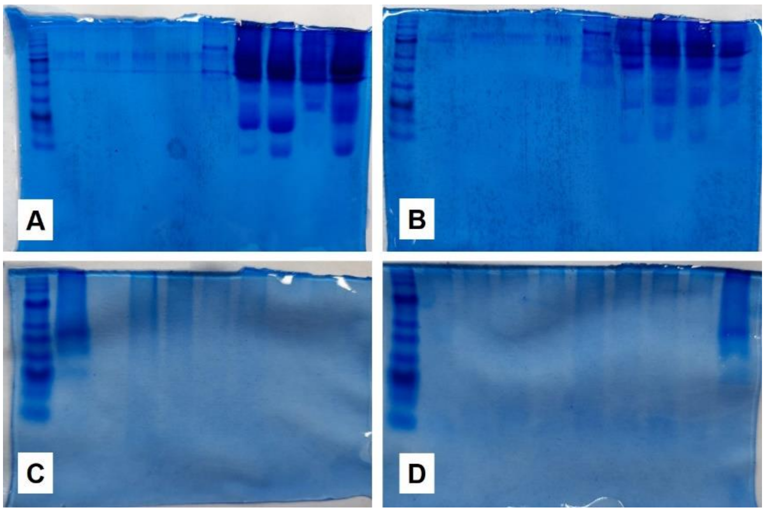

Fig. 97. Photomicrograph of SDS-PAGE showing the preliminary protein profile obtained from benthos (A, B) and plankton samples (C, D)

4.30. BPA treatment and its effect on fish with a note on the ecological importance of fish muscle related to human consumption

BPA has undergone extensive aquatic toxicity research in recent years due to its impact on wildlife. This is because the aquatic environment may be exposed to BPA through discharges from production, processing, and sewage treatment plant effluents. Fish serves as a highly effective bio-monitor for assessing the possible risks of endocrine disruption in humans, as both species are exposed to comparable chemical substances. If the process of bioaccumulation of contaminants in fish leads to adverse consequences, it might be anticipated that the communities reliant on fish consumption will experience severe repercussions.

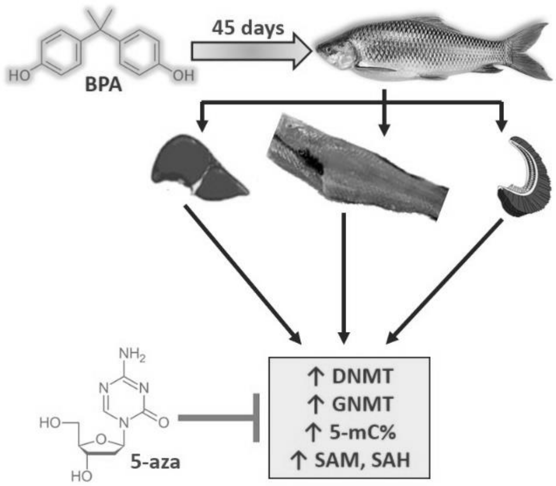

Fig. 98. Treatment of BPA treatment in *L. rohita* stimulated the expression of DNA methyl transferases, glycine-N-methyl transferases, global DNA methylation, and SAM/SAH content in tissues. Treatment with 5-aza restoredthe causative effects of BPA.

Treatment with BPA:

A standard technique was used to conduct acute toxicity studies on *Labeo rohita* fingerlings to determine the toxicity of BPA. A total of 250 fingerlings were subdividedinto 5 sub-groups, each consisting of 50 fingerlings, and placed in separate glass aquaria with 50 L of tap water. The fingerling groups (3 sub-groups) were subjected to varying amounts of BPA (3.0mg/L, 4.5 mg/L and 6mg/L). Replica acute toxicity tests were conducted for each dosage tested. The dosage of BPA was formulated using ethanol. The control group was likewise exposed to the highest level of ethanol used to dilute the dosage concentrations. The toxicant solution was replenished on alternative days, with each replacement occurring every 48 hours.

Treatment with DNMT inhibitor:

One sub-group of fishes exposed to BPA for 30 days has been treated with5-aza-2'-deoxycytidine, a potent DNMT inhibitor till the completion of the experiment.

Outcomes

1. The concentration of BPA varied from 14.57 to 27.33 ng/g-dw in the liver, whereas higher dosages of BPA in muscle samples produced a value range of 16.2-31.52 ng/g-dw. In contrast, the gill tissue showed a significant drop in BPA content (9.4-22.58 ng/g-dw) after 30 days of treatment in comparison to other tissues. Both within the dosage groups and in comparison, to the control, there were significant ($p<0.05$) differences in the BPA concentrations.
2. Muscle had the greatest level of DNMT1 expression (~31.52) at a BPA dosage of 4.5 g/L. At a dosage of 3.0 g/L BPA, the gill tissue showed the lowest expression (~9.4). Comparing the tissue DNMT1 expression in each treatment group to the control values (liver-2.42, muscle-3.91, and gills-4.67), a significant change was observed.
3. The liver had the highest expression of DNMT3A (21.56 at a BPA dose of 4.5 g/L), while the gills had the lowest expression (10.33 at a dosage of 3.0 g/L). Similar to DNMT1, 5-aza drastically decreased the expression of DNMT3A in the 3.0 and 4.5 g/L BPA treatment groups, but no discernible alterations were seen in the 6.0 g/L BPA treatment group.

   Graded BPA dosages markedly increased the expression of the DNMT3B gene, whereas 5-aza therapy reversed the expression of DNMT3B for 3.0 and 4.5 g/L BPA treatment ($P < 0.05$).
4. At a dosage of 4.5 g/L BPA, the muscle had the highest expression of GNMT (30.29), whereas the liver tissue (9.44) had the lowest expression at a dose of 3.0 g/L BPA. Similar to DNMTs, only the first two BPA dosages showed a substantial ($p<0.05$) down-regulation of GNMT expression following 5-aza administration.
5. It was discovered that the fish treated with 6.0 g/L BPA had the greatest levels of DNA hypermethylation. In comparison to control values, the data showed a 2.39-fold rise in values in the liver at dosage 3.0 g/L BPA, followed by a 2.79-fold increase at dose 3.0 g/L BPA and a 2.98-fold increase at dose 3.0 g/L BPA. Tissues from muscles and gills exhibited comparable patterns.
6. The tissue samples of *Labeo* fingerlings showed a significant increase in SAM and SAH levels and a decrease in the SAM/SAH ratio ($p<0.05$) with increasing amounts of BPA

exposure.The fold changes in SAM, SAH, and SAM/SAH ratio following treatment with 5-aza and exposure to escalating BPA levels were also recorded.

Importance of fish muscle tissue in ecology and human consumption

Fish muscle tissue, often referred to as fillet or flesh, plays a pivotal role in both ecological systems and human consumption. Its significance spans various aspects, from ecosystem dynamics to global food security, making it a critical component in the study of aquatic environments and the sustenance of human populations.

Ecological Significance:

a) **Predator-Prey Relationships**: Fish muscle tissue serves as a primary energy source within aquatic food webs. Predatory species, such as larger fish and aquatic birds, heavily rely on smaller fish as a food source. Fish muscle tissue provides essential nutrients and energy, facilitating the transfer of energy through trophic levels.

b) **Biodiversity**: The diversity of fish species within an ecosystem contributes to its overall health and resilience. Different species of fish occupy various ecological niches, and their muscle tissue composition can vary significantly. This diversity influences the structure and functioning of aquatic communities.

c) **Nutrient Cycling**: Fish excrete nutrients, including nitrogen and phosphorus, into aquatic environments. These nutrients play a vital role in nutrient cycling and can influence water quality, primary production, and the overall health of aquatic ecosystems.

d) **Indicator Species**: Changes in the health and quality of fish muscle tissue can serve as indicators of environmental stressors, such as pollution and habitat degradation. Monitoring fish muscle health can provide early warnings of ecosystem disturbances.

Human Consumption:

a) **Protein and Nutrition**: Fish muscle tissue is a rich source of high-quality protein, essential amino acids, and important nutrients like omega-3 fatty acids, vitamin D, and various minerals. These nutrients are critical for maintaining human health and are associated with reduced risk of cardiovascular diseases.

b) **Global Food Security**: Fish is a vital source of animal protein for millions of people worldwide, especially in coastal communities and regions with limited access to other protein sources. Sustainable fishery practices ensure a steady supply of fish muscle tissue, contributing to global food security.

c) **Cultural Significance**: Fish has cultural and culinary importance in many societies. It is often a staple in traditional diets and is integral to cultural celebrations and rituals in various regions.

d) **Economic Value**: The fishing industry, including capture fisheries and aquaculture, generates substantial economic value and employment opportunities globally. The sale of fish muscle tissue contributes to the livelihoods of millions of people.

e) **Dietary Preferences**: Due to its versatility, fish muscle tissue caters to a wide range of dietary preferences, including pescetarian and flexitarian diets. Its culinary adaptability makes it a sought-after choice in various cuisines.

4.31. Major Observations

4.31.1 Mass landing of Indian River Shad in middle stretch

The catch during monsoon particularly at July, 2022 showed havoc landing of *Gudusia chapra* (Indian River Shad) in entire stretch from Prayagraj to Buxar of river Ganga. The approximated catch at Buxar was recorded around 0.2-0.3 tonnes per day with average size length of 9.04±1.49 cm. The captured fishes are reported to be sold at Rs. 20 per kilogram and transported to wholesale markets at populous cities like Kolkata and Ranchi fetching higher price. Similar catch records were also observed in Prayagraj where the catch has gone up to 0.3 - 0.4 tonnes per day. The sudden rise in catch trend of this particular species may be attributed due to breeding season which might have allowed the species to localise in the middle stretch.

Fig. 99. Mass landing of *G.chapra* from Buxar of river Ganga

4.31.2 Fish mortality at Varanasi Ghat, Uttar Pradesh

A large number of small-sized fish were found to have died and were found floating near the river bank of the Ganga on July 25, 2022, from Ramnagar to Sujabad, including Varuna Muhana, covering a stretch of 15 km on both sides of the Ganga River. The observed fish were mostly in the range of 6–10 cm in length, comprising fish species like *Gonialosa manmina, Gudusia chapra, Gogangra viridescens,* and *Johnius coitor*. The preliminary investigation observed that the dead fish were of a particular size; a group of juvenile-sized fish died, and the reported place was experiencing heavy rain from the last few days and had a flood-like situation. The possible cause of the mass mortality of fish in the region may be the asphyxiation of fish due to the sudden fall of dissolved oxygen in the water during the flood.

4.31.3 Rampant usage of toxic pesticide for fishing in lower Ganga

The rising use of synthetic chemicals in aquatic environments has created alterations and imbalances in fish composition and abundance. Rampant use of 'poisons' in natural water bodies, more specifically pesticides, is invariably used for quick fishing practices. These chemicals are persistent in the ecosystem, thus manifesting threats to the entire aquatic ecology. The practice of fish harvesting with synthetic pesticides enhances catch efficiency and overall quantity expeditiously. The mischievous practice of fishing with pesticides creates a large ecological as well as social risk. The information was gathered through conversations and discussions related to the fishing activity and their relevant information's with the fishermen who remain in day-to-day fishing activity in River Ganga. Information understood by the fishermen implies that continuous poaching with pesticides of the synthetic pyrethroid group is carried out in the lower and few parts of the upper Hooghly estuary, particularly in areas extending from Nabadwip to Balagarh in West Bengal, India.

The pattern of occurrence of this malpractice is between a gap of two weeks. Previously, endosulfan was rampantly used for this purpose, but due to its ban in India in 2011, nowadays synthetic pyrethroide groups of pesticides like cypermethrin and deltamethrin are commonly used under different brand names for fishing. As per the representation of the localities, the illegal intruders appear from the nearby areas, specifically from villages adjacent to the river. The target group of organisms remains mainly the lucrative freshwater prawn (*Macrobrachium* spp.), which commands high prices in the market. Besides this, small indigenous fish species like *Puntius* spp., *Gudusia chapra*, *Salmostoma bacaila*, *Cirrhinus reba*, and other small catfishes (*Heteropneustes fossilis*, *Eutropiicthys vacha*, and *C. garua*) are caught rampantly as the bye catch. The fisherman informs us that the illegal roguish mafias disperse the chemicals manually during the high tide when the water level rises. The fishing operation lasts for 4-5 hours on the banks of the river.

Fig. 100. Local branded pesticides used for illegal fishing

4.32. State wise status of fish production in river Ganga

4.32.1 Uttarakhand

- In the exteme upper sretch of Harsil, the exotic brown trout (*Salmo trutta*) has been the prime target for the catch. Since the fishing is less upstream of Harsil, continuous monitoring of the landing is a setback for the investigation. However, during the year 2023, the exotic fish landing in the Harsil stretch has been estimated to be 0.09 tons, with maximum abundance during the winter months of January (50%) and February (40%). A relatively low catch was also noticed during the month of May (10%).
- The estimated annual landing at *Dobra Chanti* stretches of Tehri, Uttarakhand, was estimated to be 13.62 tons during the period 2021–2023. Out of the total, the Mahseer (*Tor putitora*) species alone contributed a total of 8.61 metric tons, which is almost 63.21% of the total landing. The yearly landing of Mahseer showed an increasing trend. The annual landing, which was 0.215 metric tons in the year 2021, increased to 0.256 metric tons in 2022 and finally to 0.424 metric tons at present (2023) (Fig. 101). Seasonal variations in the Mahseer landing depicted an increased pattern in the premonsoon months (March–June) in all the years studied compared to the monsoon and postmonsoon months. This might be attributed to the fact the fact that Mahseer stocks are mostly harvested when concentrated in summer pools during the spawning migration.

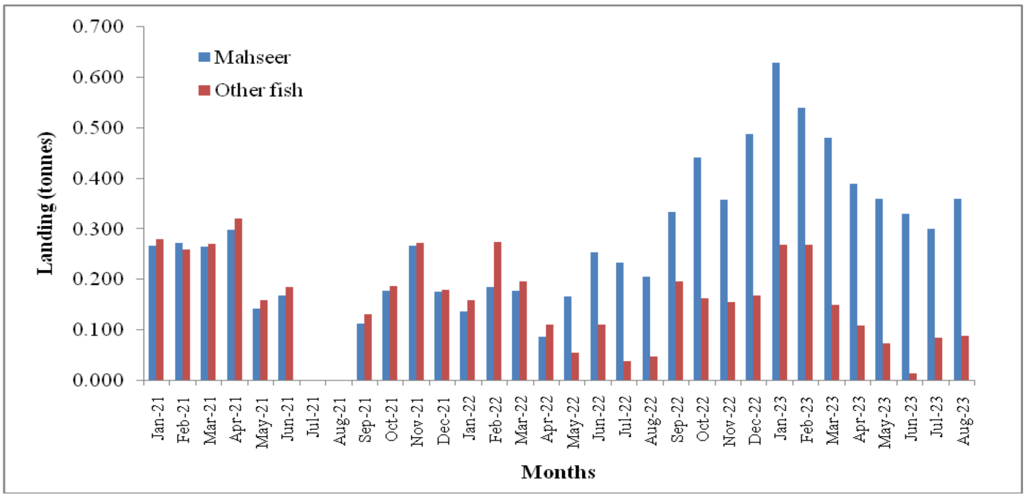

Fig. 101. Monthly fish landing from Tehri, Uttarakhand during the period 2021-2023

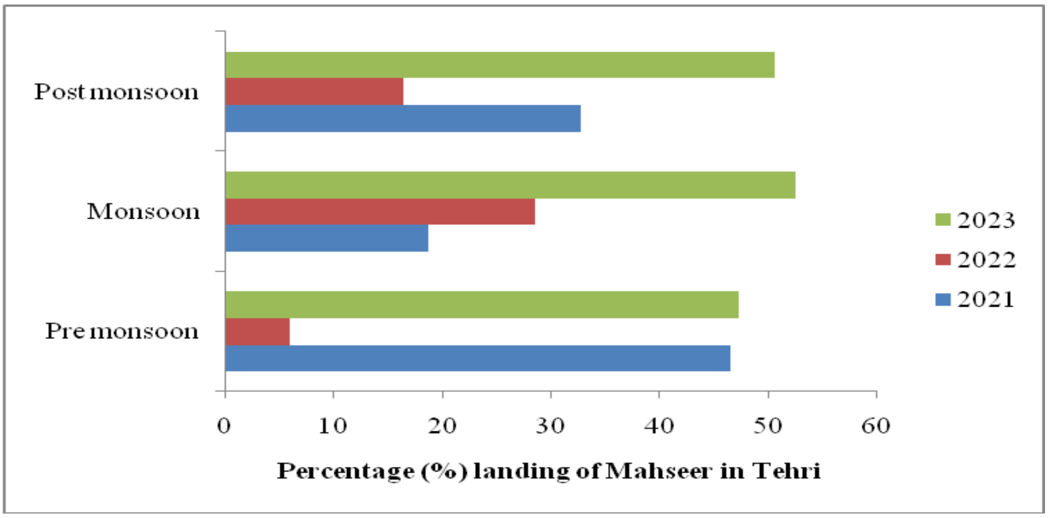

Fig. 102. Seasonal landing (%) of Mahser from Tehri, Uttarakhand during the period 2021-2023

- The estimated annual landing at Haridwar, Uttarakhand, was 9.45 tons during the period 2022–2023. Out of the total, the Mahseer (*Tor putitora*) species alone contributed a total of 2.06 metric tons, which is almost 22% of the production. The annual landing, which was 4.80 metric tons in 2022, slightly decreased to 4.64 metric tons at present (2023) (Fig. 103). The exotic fish comprising *Cyprinus carpio* (common carp) contributed an overall landing of 0.304 metric tons in the period, which was 3.22% of the total fish production. The landing of the exotic carp was observed to be much less during the year 2023 (2.97%) compared to the year 2022 (3.45%).

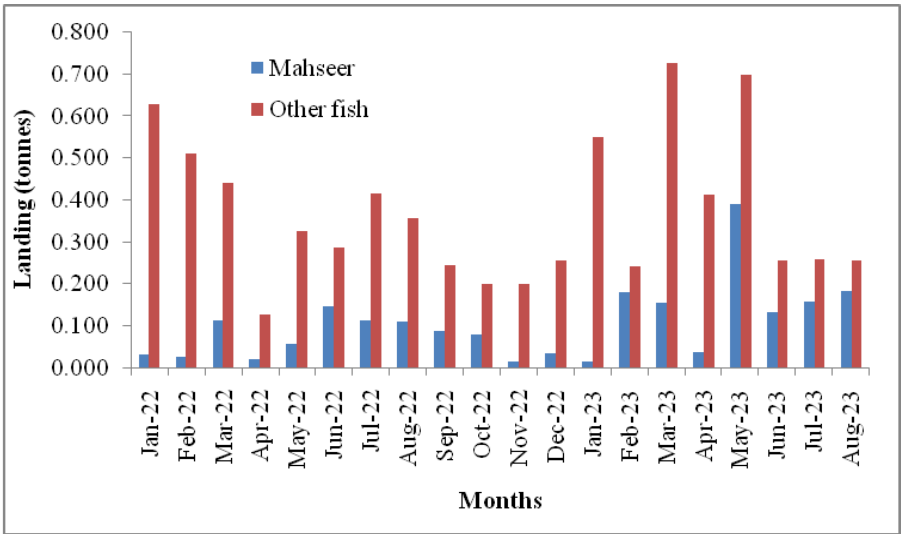

Fig. 103. Monthly fish landing from Haridwar, Uttarakhand during the period 2021-2023

4.32.2 Uttar Pradesh

- Site Bijnor in Uttar Pradesh was marked with a total landing of 77.63 tons at present. Both the miscellaneous group and catfish shared the majority of the fish landing at Bijnor, contributing about 36.80% and 34.60%, respectively. The landing of exotic fish and the IMC at Bijnor showed a similar trend, with 14.80% and 14.30%, respectively. Mahseer landing was recorded particularly during the winter months (January–February) at Bijnor, with a minimal contribution of 0.05%. Species *Labeo rohita* contributed a maximum 52% among the IMC, followed by *Cirrhunus mrigala* (32%), *Labeo calbasu* (9%), and *Labeo catla* (7%).
- At Narora, the estimated catch was recorded at 104.91 metric tons, with the highest contribution from the miscellaneous group (76%), followed by catfish (13%), IMC (10%), and exotic fish (1%).
- A total landing of 30.67 metric tons was estimated from the site in Farukhabad, with the highest contribution from the miscellaneous group (40%), followed by catfish (27%), exotic fish (18%), and IMC (15%).
- The fish landing (2023) from Kanpur was estimated to be 99.32 tons. A miscellanous group of fish comprising minnows, barbs, and minor carps contributed about 40% (39.82 metric tons) of the total catch. The catfishes and exotics were recorded to contribute 25% (24.70 metric tons) and 23% (23.30 metric tons), respectively, with the lowest (12%) from IMC (11.73 metric tons). *Rohita* was found to contribute the majority of the IMC landings (66%), followed by C. Mrigala (27%), *L. Calbasu* (4%) and *L. Catla* (3%).
- Total annual Indian Major Carp (IMC) landing from the Prayagraj landing site of the river Ganga during November 2020 to October 2021 has been estimated at 11.38 tons (Fig. 104). During the period 2021–2022, a total fish landing of 92.42 tons was recorded from the Ganga River at Prayagraj. Out of the total landing, the IMC at Sadiyapur, Prayagraj, Uttar Pradesh, was estimated to be 11.76 tons. The overall highest percentage was observed for the species *mrigala*, 30.84% (3.62 tonnes), followed by *L. catla*, 29.56% (3.47 tonnes), *L. rohita*, 25.40% (2.98 tonnes), and *L. calbasu*, 14.19% (1.66 tonnes). The period 2022–2023 marked a total production of 90.86 metric tons from the Prayagraj center. The contribution from misscelenous fishes (50.94 tonnes; 55.86%) was the highest, followed by IMC (14.59 tonnes; 16.6%), catfishes (13.97 tonnes; 15.32%), and exotic fishes (11.36 tonnes; 12.45%). Species-wise analysis of IMC revealed that *L. catla* 40.12% (5.84 metric tons)

contributed the most, followed by L. rohita (32.18%), *C. mrigala* (17.71%), and *L. calbasu* (9.99%), respectively. The overall highest percent of IMCs landing was contributed by *C. mrigala* (48.00%), followed by *L. rohita* (22.00%), *L. catla* (28.28%), and *L. calbasu* (11.00%). Timeseries data extracted from ICAR-CIFRI records show that the landing of IMC at Prayagraj increased by 24.70% when compared to 1959 (11.70 metric tons). (Fig. 105)

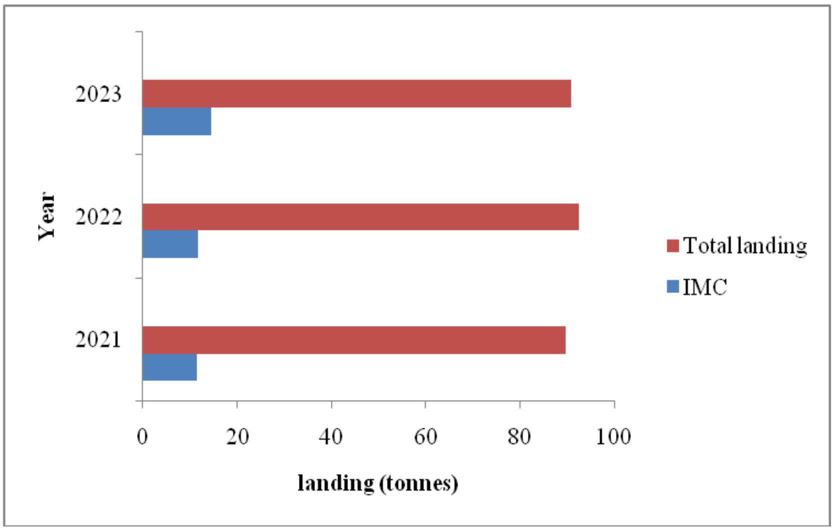

Fig. 104. Year wise landing of Indian Major Carp at Prayagraj, Uttar Pradesh during the period 2021-2023

• A

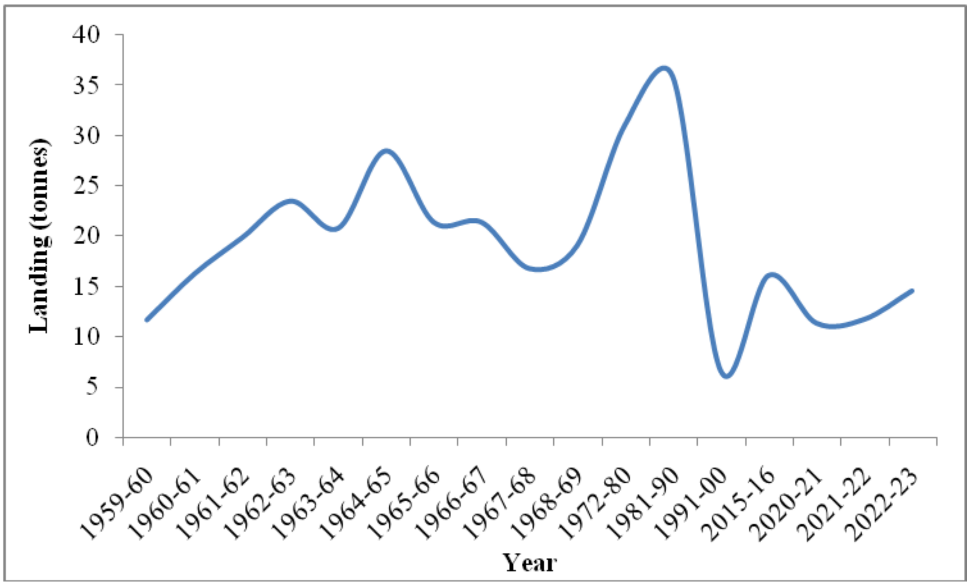

Fig. 105. Time scale landing of IMC from Prayagraj during the period 1959-2023

Fish landing of 42.84 tons was recorded in Varanasi during 2023. 48% of the total landing was shared by the miscellaneous group of fish, while catfish, exotic fish, and IMC shared 24%, 18%, and 10%, respectively. *C. mrigala* (36%) was observed to be the most dominant species in the landing among IMC, followed by *L. rohita* (30%), *L. catla* (20%), and *L. calbasu* (14%). Previous records of IMC landings from Varanasi from 1959–60 (2.90 metric tons) when compared with the present landings (4.09 metric tons) showed an increase trend of 41.03% (Fig. 106). However, data after 1968–1969 was not reported by ICAR-CIFRI in earlier records.

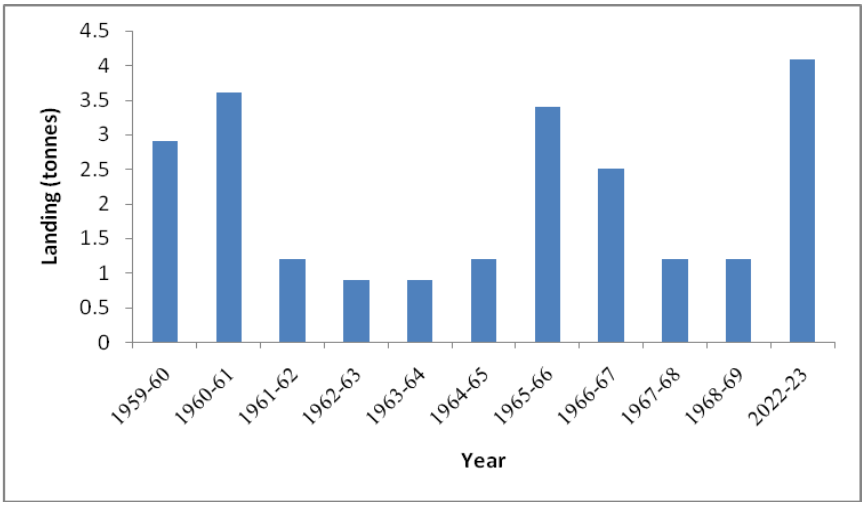

Fig. 106. Timescale landing of IMC from Varanasi during the period 1959-2023

- A similar trend of landing was also observed at the site Mirzapur, where, out of the total landing of 80.82 tons, a miscellaneous group of fish shared the majority (61%). The dominance of exotic fish like tilapia and common carp can also be noticed in all seasons, contributing around 19% more than catfish (14%), and IMC (6%). From all the above sites, the species dominance of IMC showed that catla (37%) was the highest among other major carps like *L. rohita* (29%), *C. mrigala* (19%), and *L. calbasu* (16%).
- Sites like Chunar, Gazipur, and Ballia were also assessed for fish landings. Landing of Gangetic fish was found to be the highest at Gazipur (65.70 metric tons) among the three sites, followed by Ballia (18.63 metric tons) and Chunar (11.43 metric tons). In all the sites, a miscellaneous group of fish comprising minnows, barbs, and minor carps contributed the most. The dominance of exotic fishes was observed in Ballia (28%), followed by Gazipur (21%), and Chunar (20%). Besides exotic, IMC was also recorded to be highest at Ballia (10%), Gazipur (7%), and Chunar (7%).

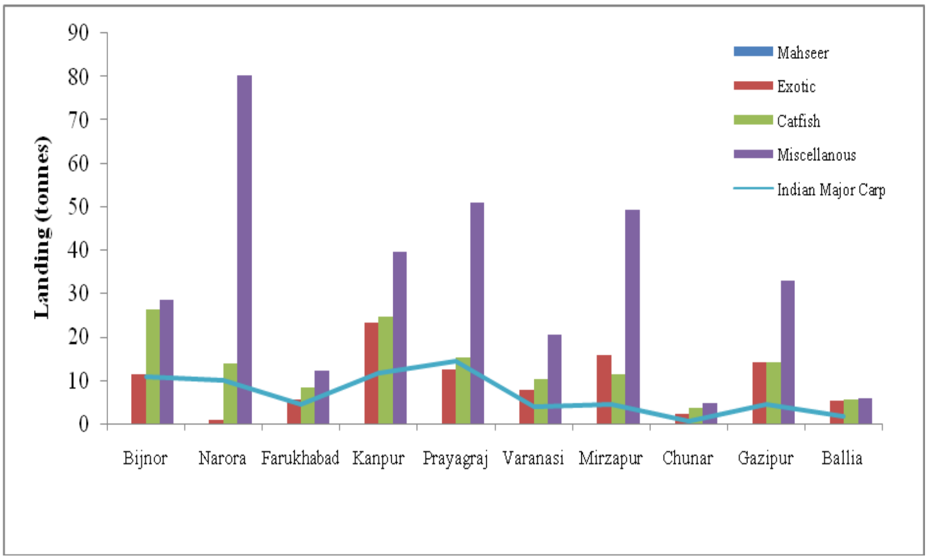

Fig. 107. Annual fish landing (t) in the Uttar Pradesh stretch of river Ganga during the period 2022-2023

4.32.3 Bihar

- The total fish production from the Patna stretch of the Ganga River System from December 2020 to November 2021 was estimated to be 5.42 metric tons. The contribution IMC was recorded to be 0.38 metric tons. Among the major carps, the percentage share of *mrigala* was recorded to be highest (0.156 t; 2.89%), followed by *L. rohita* (0.149 t; 2.74%) and *L. catla* (0.08 t; 1.49%). Species like *L. calbasu* contributed the most with 0.15 tons, followed by *C. reba* (0.10 tons). The total catfish landing was estimated to be 4.33 tonnes, out of which minor catfish comprising *Eutropiicthys vacha*, *Clupisoma garua*, *Mystus* sp., *Ailia coila*, *Ompok* sp., and *Heteropneustes fossilis* contributed 71% (3.04 tonnes), while large catfish such as *Sperata* sp., *Wallago attu*, *Bagarius bagarius*, and *Rita rita* contributed 29% (1.28 tonnes). The mean length of *Sperata* sp. was recorded at 322.7 mm, while that of *Rita rita* was recorded at 155.7 mm. Likewise, the miscellaneous fish group comprising *Mastacembelus armatus*, *Notopterus notopterus*, *Chitala chitala*, *Gudusia chapra*, *Cabdio morar*, *Setipinna phasa*, and *Glossogobius giuris* was estimated to be 0.79 tonnes. During November 2021 to October 2022 the landing was estimated to be 15.99 tonnes. The highest landing was observed during pre monsoon months extending from March to June 2022 (7.81 tonnes) followed by winter (4.61 tonnes), monsoon (2.14 tonnes) and post-monsoon (1.42 tonnes). The contribution of Indian Major Carp was recorded to be 3.06 tonnes. Among the major carps, the percentage share of *L. catla* was recorded to be highest (1.95 metric tons; 63.89%) throughout the year, followed by *L. rohita* (0.848 metric tons; 27.74%), *L. calbasu* (0.15 metric tons; 4.92%), and *C. mrigala* (0.105 metric tons; 3.44%). In comparison to the previous year's landing records of 2021 (5.42 metric tons), a sharp increase in production was noticed. Moreover, the rise in production of IMC from the previous year was also recorded. The total catfish landing was estimated to be 7.23 tonnes, out of which minor catfish comprising *E. vacha*, *C. garua*, *Mystus* sp., *A. coila*, *Ompok* sp., and *Heteropneustes fossilis* contributed 2.67 tonnes, while large catfish such as *Sperata* sp., *W. attu*, *B. bagarius*, and *R. rita* contributed 4.56 tonnes. Likewise, the estimated landing at Patna in 2023 was 6.83 tons. IMC contributed 0.49 tons. The total catfish landing was estimated to be 2.94 metric tons, with minor catfish contributing 1.68 metric tons and large catfish *Sperata* sp., *W. attu*, *B. bagarius*, and *R. rita* contributing 1.26 metric tons. The miscellaneous fish groups were recorded with a share of 3.40 metric tons during the period Fig. 108. A gradual decline in the landing of IMC was noticed from the year 1989 onwards to 2016. When compared with the previous landing of IMC at Patna, a decrease of 74% was recorded when compared to 1959 (12.70 metric tons) (Fig. 109).

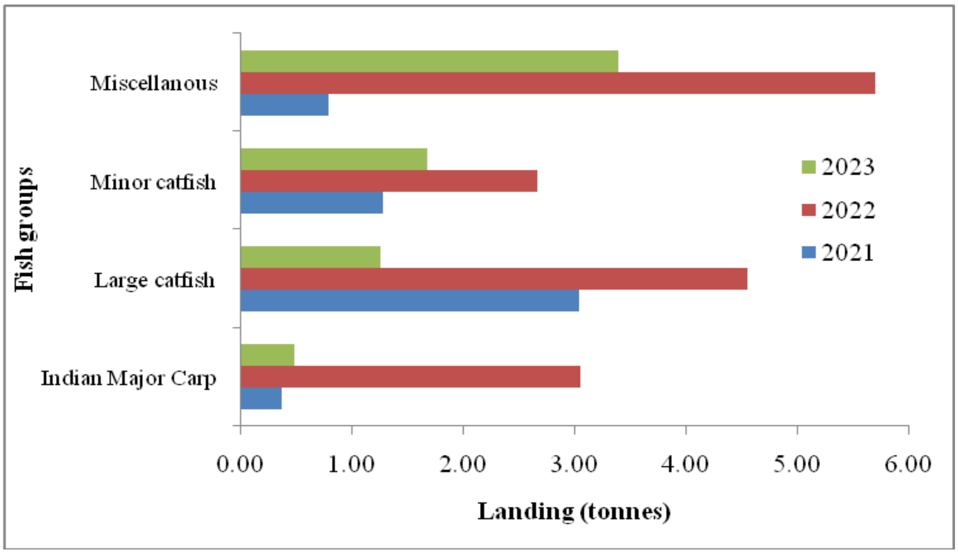

Fig. 108. Group wise annual fish landing (t) from Patna, Bihar during the period 2021-2023

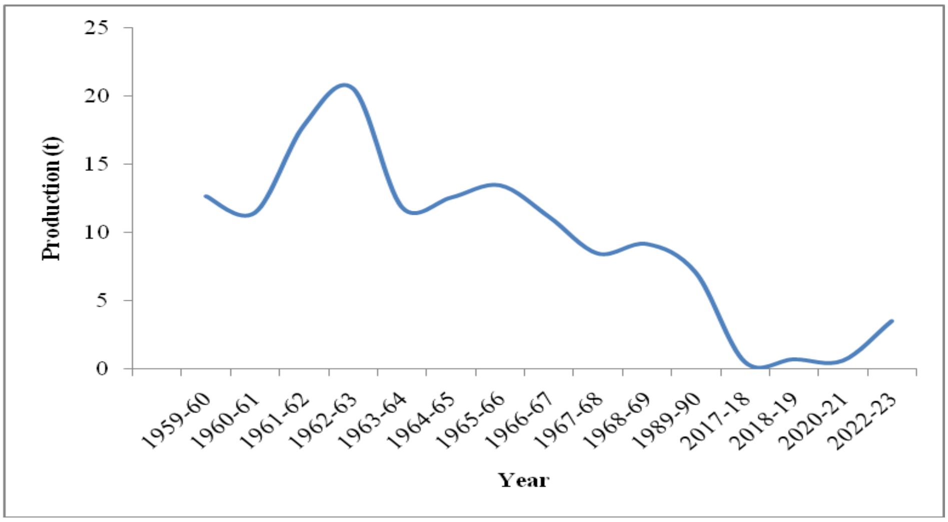

Fig. 109. Timescale landing of IMCs from Patna during the period 1959-2023

- During the period of December 2021 to October 2022 the total fish landing from Bhagalpur, Bihar was 5.55 tonnes. The highest landing of fishes was recorded during winter months extending from December'2021 to February' 2022 (3.62 tonnes) followed by pre-monsoon (1.22 tonnes), monsoon (0.11 tonnes) and post-monsoon (0.60 tonnes). The lowered production during monsoon months may be attributed due to rise in water level resulting in less fishing in the areas. The contribution of IMC was recorded to be 1.16 tonnes. Among the major carps, the percentage share of *L. rohita* was recorded to be highest (0.58 t; 50%) followed by *L. catla* (0.44 t; 37.93 %), *L. calbasu* (0.08 t; 6.89%) and *C. mrigala* (0.06 t; 5.17%). During the period November 2022- August 2023, the overall landing was recorded to be 6.66 tonnes. The contribution of IMC was noted as

0.13 tonnes. Among the principal carps, *L. catla* had the highest percentage share (0.82 tonnes; 62%), followed by *L. rohita* (0.37 tonnes; 28%), and *C. mrigala* (0.012 tonnes; 9%).

4.32.4 West Bengal

- The annual fish landing for the period 2021–2022, from the river Ganges at Farakka, West Bengal, was recorded to be 32.48 tons. The winter month of the year showed a minimum landing production of 6.86 tons. However, the pre-monsoon months extending from March to June 2022 resulted in a maximum landing (13.95 metric tons), whereas the monsoon landing showed a slightly declining trend with 11.60 metric tons. Likewise, the overall fish landing for the period 2022–2023 was estimated to be 42.07 metric tons, an increase of 29.52% from the previous year. The prized species Hilsa (*Tenualosa ilisha*) solely contributed 6.14 metric tons, which was 14.59% of the total production. Premonsoon months extending from March to June recorded maximum landings of Hilsa (2.54 metric tons) compared to monsoon (1.10 metric tons), postmonsoon (0.89 metric tons), and winter (1.59 metric tons).
- The total evaluated fish landing at Balagarh, West Bengal, during the period 2021–2022, was 11.71 tons. As per the previous sites, the aggregated production of the winter month extending from November 2021 to February 2022 showed a maximum of 4.64 tons. However, the pre-monsoon months extending from March to June 2022 resulted in a maximum landing (13.95 metric tons), whereas the monsoon landing showed a slightly declining trend with 11.60 metric tons. The combined annual landing of Indian Major Carps in the stretch was recorded to be 1.16 tons. Species-wise landing showed Catla to be the most dominant among the major carps (0.46 t), followed by *L. rohita* (0.40 t), *L. calbasu* (0.132 t), and *C. mrigala* (0.209 t), respectively. Among others, *T. ilisha* was found to be the leading fish species among all with 3.30 metric tons. The average size range of hilsa was observed to be 0.3–1.5 kg. Apart from this, prawns like *Macrobrachium* spp. form the most lucrative target species in the area, with an annual landing of 0.744 metric tons. Catfish such as *Pangasius pangasius*, *R. rita*, *Sperata* spp., *E. vacha*, *Mystus cavasius*, and *Wallago attu* were found throughout the year. The estimated share of catfish was 2.47 metric tons. Species like *Salmostoma bacaila* (0.470 metric tons), *Apocryptes bato* (0.221 metric tons), and *Amblypharyngodon mola* (0.156 metric tons) contributed the most among the small indigenous fishes (SIF's). The present landing from the Balgarh area

of the Ganga (2022–2023) was 10.76 tons. Out of the total landing, the percent share of IMC was found to be 20% (2.15 metric tons). *T. ilisha* was found to be the major fish species targeted in the stretch, contributing around 2.53 metric tons.

- The site of Barrackpore is close to the metropolitan city of Kolkata. The river around Barackpore experiences a daily tidal regime, resulting in the induction of freshwater and partly brackish water fish species. The total fish production from the Barrackpore stretch of the Ganga River System during the years 2021–2022 has been estimated to be 0.29 metric tons. *Ilisha* was found to contribute the most, with 0.15 metric tons (52.73%) during the period. Among the large catfishes, *P. pangasius* shared the maximum with 0.067 t (21.04%), followed by *R. rita* (0.47 t; 16.30%). The total production of the miscellaneous fish group comprising *Rhinomugil corsula*, *Setipinna phasa*, *Cynoglossus cynoglossus*, etc. was estimated to be 0.013 metric tons only during the period. On the other hand, the landing of exotic silver carp (*Hypophthalmichthys molitrix*) was estimated to be 0.006 t, especially during monsoon season. The estimated fish landing at Barrackpore for the period November 2022–August 2023 was 1.27 tons, with *T. ilisha* solely contributing to 11% with a size range varying from 0.3–1.2 kg. Fish groups like IMC contributed around 24.0%, gangetic prawns (35%), and miscellaneous groups (30%).

Fig. 110. Photographs of few important fish species targeted from lower region of the river Ganga

4.33. Stock assessment of selected fishes of river Ganga

Fish stock assessment may be described as the determination of the exploitation level, which is necessary for the estimation of maximum sustainable yields from the fish resources. The study of stock assessment is necessary to understand the present level of exploitation or the status of exploited stock for the maintenance of yield at a sustainable level. Inland fisheries are often considered multispecies multigear fisheries, and most of the catches are categorized under small-scale fisheries.

Estimation of stock assessment of fish helps establish the best method for utilizing and managing aquatic life resources like fish and shrimp (Sparre, 1998). It employs a range of statistical and mathematical models to generate quantitative predictions about how fish populations will respond to different management approaches (Sparre, 1998). Understanding population dynamics rates requires the computation of growth, death, and recruitment patterns made achievable by the study of population dynamics in fin and shellfish (Chung et al., 1999; Bhakta et al., 2020).

Since these variables have an impact on population dynamics, they provide useful data on a variety of topics, including age at first maturity, spawning frequency, individual and stock responses to environmental changes, recruitment success, stock structure, etc. (Johnson et al., 2020). The primary goal of fish stock assessments is to provide information on the best ways to utilize aquatic living resources, such as fish and shrimp, as well as resource management (Sparre, 1998). The fisheries and population dynamics of Gangetic fishes were evaluated using length-frequency data collected monthly from the upper, middle, and lower stretch of the Ganga River from December 2020 to August 2023. Using the FiSAT-II software package (FAO-ICLARM Stock Assessment Tools), population parameters were evaluated and computed for the estimation data, which were grouped into different class intervals. During the CIFRI-NMCG phase II project, a total of 11 fish species were selected for assessment of population dynamics.

4.33.1 *Labeo rohita,* Hamilton, 1822

Fig. 111. A specimen of *Labeo rohita*

Local Name :	Rohu/Rui/Rehu
Family :	Cyprinidae
Order:	Cypriniformes
IUCN red list status:	Least Concern (LC)
Distribution:	Bijnor to Tribeni

Labeo rohita (Hamilton, 1822), commonly known as 'Roho labeo' and popularly known as 'Rohu, deserves higher economic importance due to customer preference. The species is inhabitant of river and is found in the upper and lower stretches of the Ganga. The species is predominately a column feeder, and adults prefer deeper waters for dwelling (Kumar *et al*., 2020). Egg-producing capacity is the highest in Rohu in comparison to all three major carps. The species is a highly esteemed food fish of the river, and it has wide acceptance among the fishermen and local buyers throughout the river stretch.

The fisheries and population dynamics of a prized Gangetic carp, *Labeo rohita* (Hamilton, 1822), were evaluated using length-frequency data collected monthly from the middle stretch of the Ganga River from April 2015 to December 2021. Using the FiSAT-II software package (FAO-ICLARM Stock Assessment Tools), population parameters were evaluated and computed for the estimation data, which were grouped into 60-mm class intervals. Total mortality (*Z*), natural mortality (*M*), and fishing mortality (*F*) mortality coefficients were calculated to be 1.28, 0.54, and 0.74, respectively. Using the length-converted catch curve approach, the estimated value of the exploitation ratio (*E*) was determined to be 0.58, somewhat higher than the ideal value (0.50). *L. rohita* has two unique recruitment seasons each year, one minor from February to March and the other significant from August to October, according to the Ganga River recruitment pattern. The current study's findings indicated that the middle stretches of the Ganga's *L. rohita* are already overfished. Management practices, including minimizing fishing pressure by limiting the number of boats or fishing hours, controlling mesh size to avoid overfishing of both recruitment and growth, and establishing breeding grounds and closed seasons, can all help revive fish stocks. To manage the *L. rohita* fisheries in the Ganga River systems effectively, research is also advised to understand the life-history traits of the species.

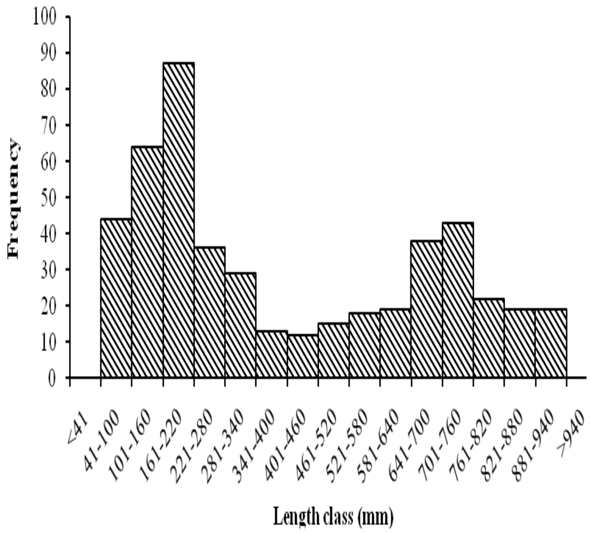

Fig. 112 A. Length- size composition of *L. rohita*

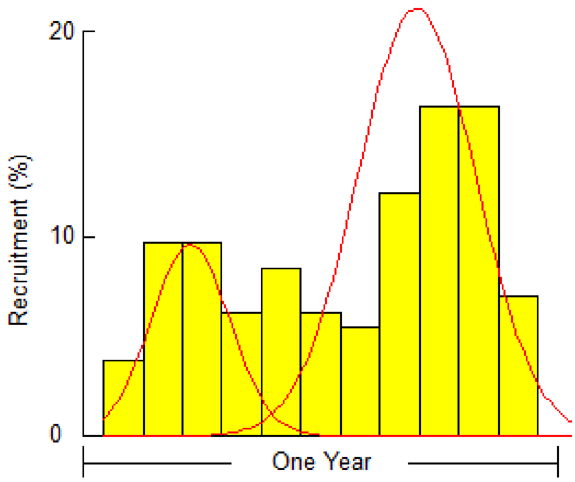

Fig. 112B. Estimated annual recruitment % of *L. rohita*

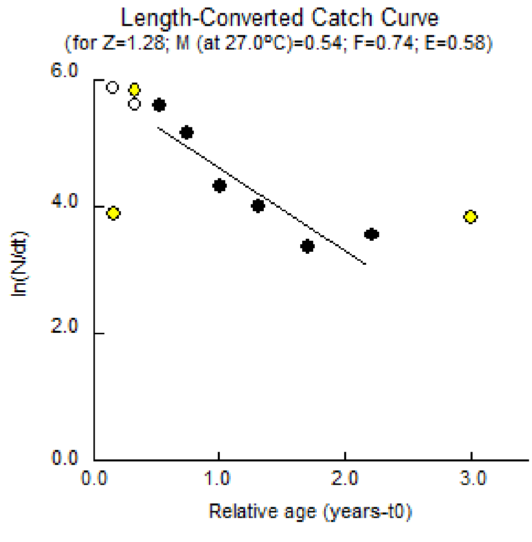

Fig. 112C. Estimated length converted catch curve of *L. rohita*

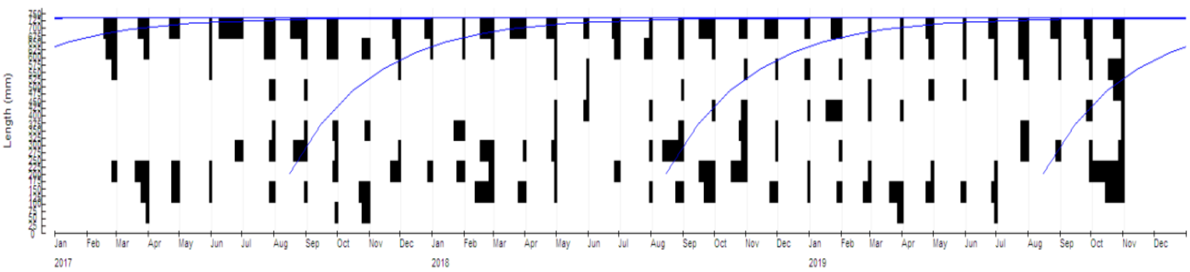

Fig. 112D. Estimated growth curve of *L. rohita*

Fig. 112 (A-D): Different population parameters of *L. rohita*

4.33.2 *Labeo catla* (Ham, 1822)

Fig 113. A specimen of *Labeo catla*

Local Name :	Katla/Bhakur
Family :	Cyprinidae
Order:	Cypriniformes
IUCN red list status:	Least Concern (LC)
Distribution:	Bijnor to Tribeni

Labeo catla (Hamilton, 1822), commonly known as Katla', is an important species out of three Indian major carps. The freshwater species tremendously support the commercial fishery of the upper and lower stretches of the Ganga. The species is predominately a column feeder, and adults prefer deeper waters for dwelling. The mature individuals breed in rivers. The species is a surface and mid-water feeder, mainly omnivorous, with juveniles feeding on aquatic and terrestrial insects, detritus, and phytoplankton. The average total length (min: 118 mm; max: 970 mm) and weight (min: 17.45 g; max: 18000 g) of *L. catla* were computed to be 504 mm (± 259.72). The present study indicated a dominant range of 101-200 mm, followed by 701–800 mm from the entire river stretch (Fig. 50). Khan et al. (2011) have reported a maximum length of 1450 mm from the Ganga river stretch. The growth parameters like asymptotic length (L_∞) and growth coefficient (K) of *L. catla* were analyzed as 879 mm and 0.96. Mortality rates as natural mortality (M), fishing mortality (F), and total mortality (Z) of *L. catla* were observed as 1.26 year^{-1}, 0.3 year^{-1}, and 1.56 year^{-1}, respectively. The growth performance index (ϕ) was obtained as 5.87. The length-weight relationship (W = 0.011, L = $^{3.08}$, R^2 = 0.952) calculated for the species indicated a somewhat isometric growth pattern from the river. A continuous recruitment pattern was observed for *L. catla* from the Ganga all over the year, with two major peaks in July (20.08%) and August (20.72%) (Fig.

51). The level of exploitation (*E*) was found to be 0.49 year^{-1} for *L. catla*, which was found to be almost at par with the exploited level (E_{opt} = 0.5) as per Gulland (1971). The Y'/R and B'/R curves (Fig. 52) for different exploitation rates were calculated in the case of *L. catla*. The value of E max was found to be 0.410 year^{-1}, while the values obtained for E_{10} and E_{50} were 0.305 year^{-1} and 0.267 year^{-1}, respectively.

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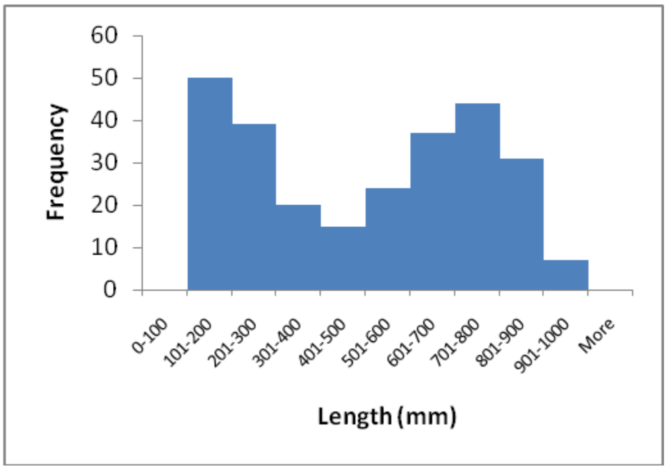


Fig. 114A. Length frequency histogram of L. catla obtained from river Ganga

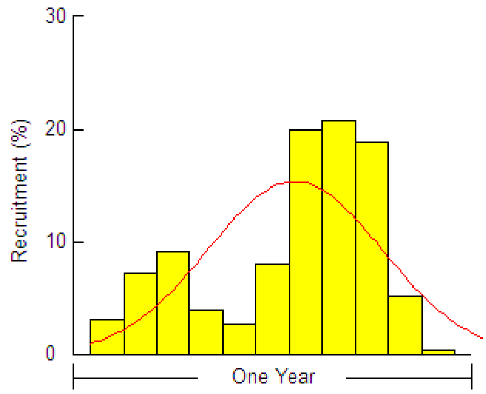


Fig. 114B. Annual recruitment pattern of L.catla in river Ganga

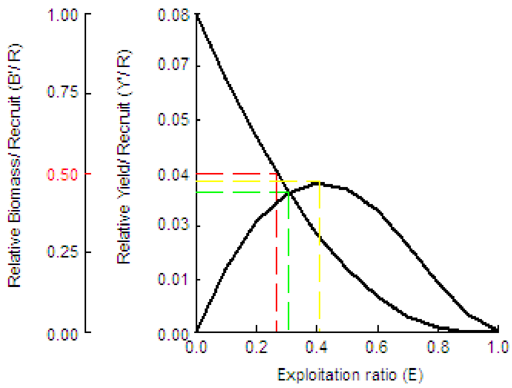


Fig. 114C. Relative biomass recruitment of L. catla in river Ganga

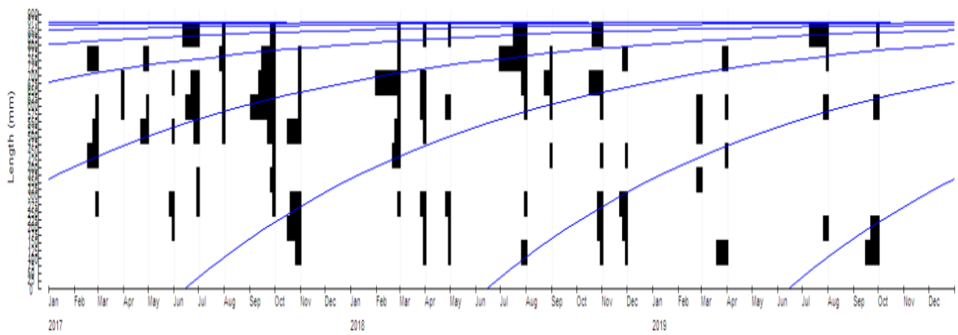


Fig. 114D. Growth curve of *Labeo catla* over three years (2017-19) from river Ganga

Fig. 114(A-D): Different population parameters of *L.catla*

4.33.3 *Cirrhinus mrigala* (Ham, 1822)

Fig. 115. A specimen of *Cirrhinus mrigala*

Local Name :	Mrigal/Naini/Mirka
Family :	Cyprinidae
Order:	Cypriniformes
IUCN red list status:	Least Concern (LC)
Distribution:	Bijnor to Tribeni

Widely known as Mrigala, the species *Cirrhinus mrigala* is an Indian major carp originally inhabitant of the Ganga River system in Northern India. The preferred niche of the species is the bottom layer of the water body, which is primarily a detritus feeder. The average total length (min: 42 mm; max: 1000 mm) and weight (min: 3.072 g; max: 1300 g) of *C. mrigala* were computed to be 458.89 mm (± 237.35) from the river Ganga. The present study indicated a dominant range of 401–460 mm, followed by 521–580 mm in the studied river stretch (Fig. 54). Jhingran (1959) estimated a maximum size of 1016 mm for both pooled sexes from the Ganga River at Buxar, Bihar. Similarly, Kamal (1969) described the maximum length of *C. mrigala* as being 960 mm from the Yamuna River (a tributary of the Ganga). The growth parameters like asymptotic length (L_∞) and growth coefficient (K) of *C. mrigala* were estimated to be 987 mm (TL) and 1.5 year-1, respectively, during the present study. The growth performance index (ϕ) for the species was found to be 6.61 during the present investigation. The annual mortality rates M, F, and Z of *C. mrigala* from the river Ganga were estimated to be 1.64, 3.35, and 1.71, respectively. The exploitation level (E) was computed to be 0.51 years. The length-weight relationship (W = 0.001, L = $^{3.14}$, R^2 = 0.955) calculated for the species indicated a positive allometric growth pattern in the river. A continuous recruitment pattern was observed all over the year, with two major peaks in July

(12.30%) and August (19.60%) (Fig. 55). The Y'/R and B'/R curves (Fig. 56) for different exploitation rates were calculated in the case of *C. mrigala*. The value of max E was found to be 0.420 year^{-1}, while the values obtained for E_{10} and E_{50} were 0.35 and 0.27, respectively.

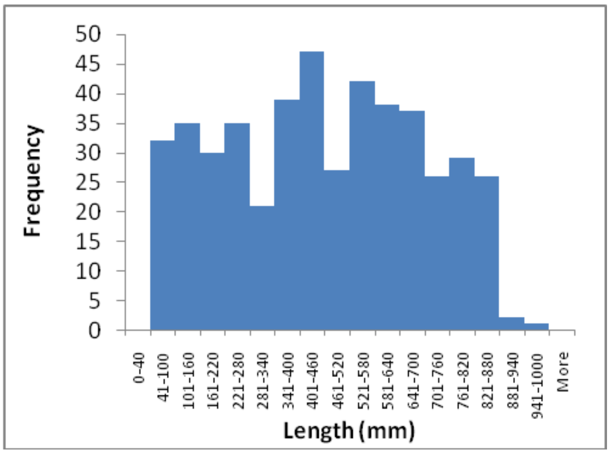


Fig. 116A. Length frequency histogram of *C. mrigala* obtained from river Ganga

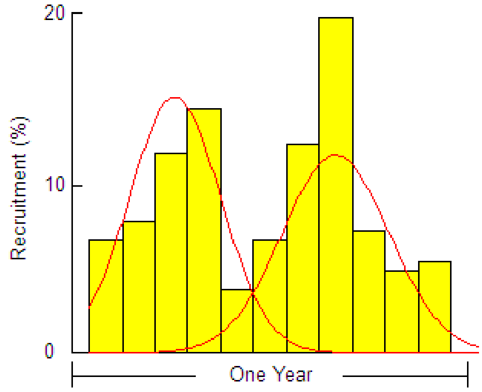


Fig. 116B. Annual recruitment pattern of *C. mrigala* in river Ganga

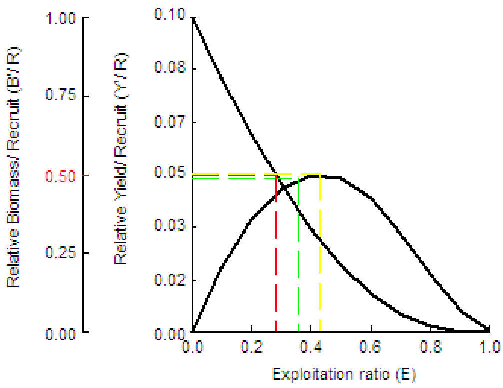


Fig. 116C. Relative biomass recruitment of *C. mrigala* in river Ganga

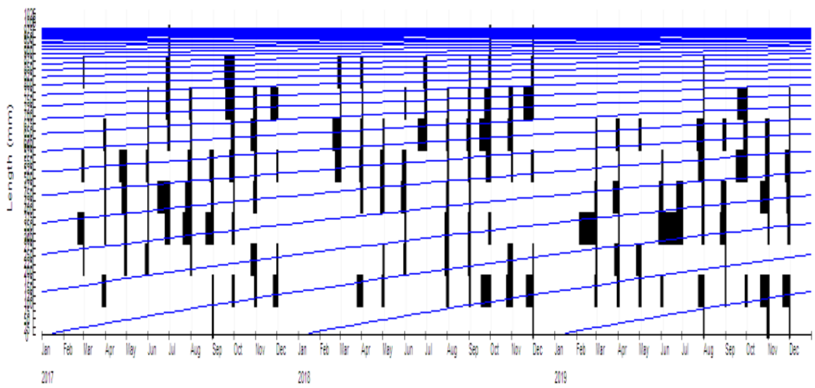


Fig. 116D. Growth curve of *C. mrigala* over three years (2017-19) from river Ganga
Fig 116 (A-D): Different population parameters of *C. mrigala*

4.33.4 *Cabdio morar,* Hamilton, 1822

Fig. 117. A specimen of *Cabdio morar* (Morari)

Local Name :	Harda chelwa/Piyali
Family :	Danionidae
Order:	Cypriniformes
IUCN red list status	Least Concern (LC)
Distribution	Bijnor to Tribeni

Cabdio morar, or Morari, is a freshwater benthopelagic species found abundantly in the Ganga. The species falls under the category of small indigenous fish (SIF's) and contributes substantially to overall fish production. During the present study, the observed total length and total body weight for the species (pooled sex) ranged from 34-139 mm and 0.31-22.62 g, respectively. The top three length group percentages were 39.13, 22.22, and 18.84%, respectively, for the length classes 70-89, 50-69, and 110-129 mm. The computed length-weight relationship equation for the sample size was W = 0.005L3.11 (r^2 = 0.975, p<0.01), indicating positive allometric growth. The growth constants asymptotic length ($L\infty$) and Growth coefficient (K) values were estimated to be 157.5 mm and 1.3yr^{-1}, respectively. The population parameters such as total mortality rate (Z), natural mortality rate (M), and fishing mortality rate (F) were assessed to be 3.47 years, 1.32 years, and 2.15 years, respectively. The rate of exploitation (E) was found to be 0.62, suggesting a higher exposure of the species. Two recruitment peaks of the species were determined, with one major during July–September and a minor in February. The result of the virtual population analysis (VPA) of the species signifies maximum fishing mortality in the length group of 70–79 mm (F = 2.78 yr^{-1}) and minimum mortality at 30 mm (F = 0.57 yr^{-1}). The relative yield per recruit (Y/R) and biomass per recruit (B/R) calculated based on $Lc/L\infty$ and M/K were computed to be 0.22 and 1.02, respectively. Based on the knife-edge selection, the values of E10, E50, and Emax were 0.407, 0.303, and 0.479, respectively. The L_{25}, L_{50}, and L_{75} were determined to be 20.11, 35.11, and 50.15mm, respectively, based on the selection pattern. The length at first capture

(*Lc*), which was determined to be 50.15mm, can be considered to be the suitable harvestable size of the species.

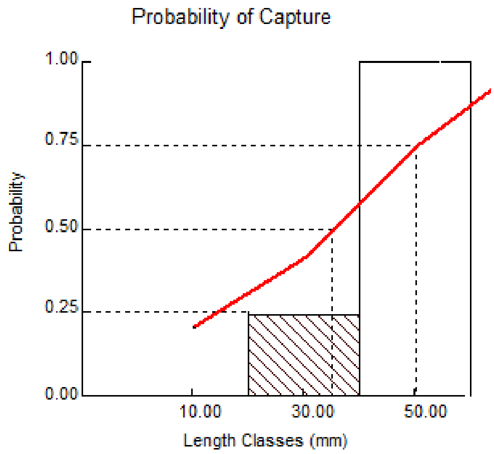


Fig. 118A. Estimated probability of capture of *C. morar*

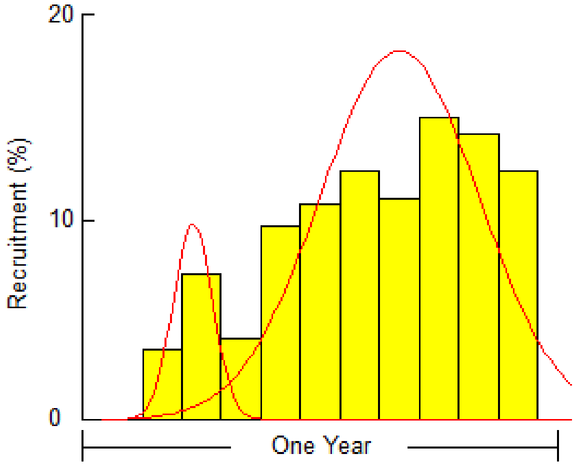


Fig. 118B. Estimated annual recruitment % of *C. morar*

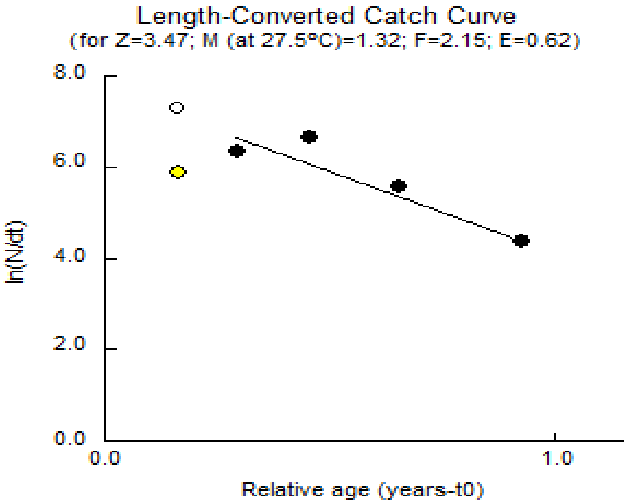


Fig. 118C. Estimated length converted catch curve of *C. morar*

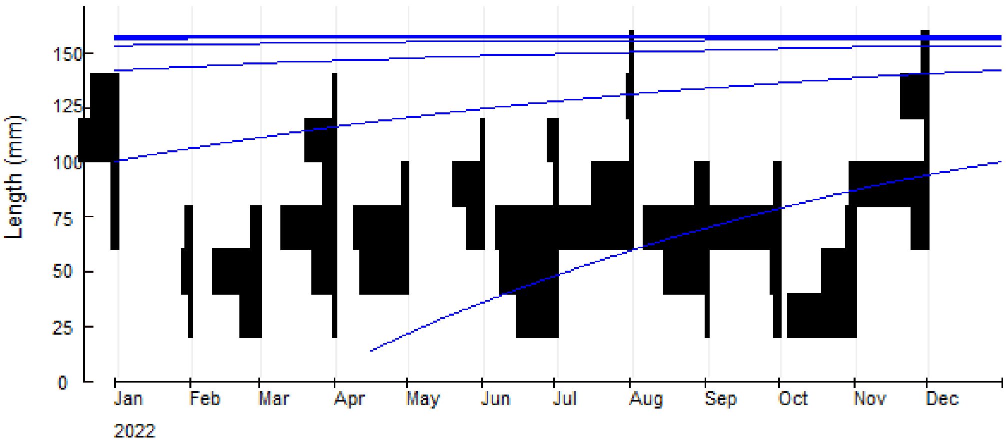


Fig. 118D. Estimated growth curve (VBGF plot) of *C. morar*

Fig 118(A-D): Different population parameters of *C. morar*

4.33.5 *Johnius coitor*, Hamilton, 1822

Fig. 119. A specimen of *Johnius coitor* (Coitor croaker)

Local Name :	Bholua/Bhola
Family :	Sciaenidae
Order:	Perciformes
IUCN red list status	Least Concern (LC)
Distribution	Bijnor to Godakhali

Johnius coitor, commonly known as coitor croaker, is a pelago-demarsal species and is found almost throughout the year in the upper, middle, and lower stretches of the river. The species is an amphidromous fish species belonging to the family Sciaenidae under the order Perciformes, popularly known as Jew fish, croakers, or drums. During the present investigation, the total length of the species ranged from 24-168 mm, while its body weight ranged from 0.15–41.41 g. In the fish catch, the length frequency distribution between 80 and 109 mm was identified as the most dominant (27.10%). The length-weight relationship of the species from the data was found to be W = 0.007 L = $^{2.93}$ ($r^2 = 0.926$, $p<0.01$), suggesting the growth of fish is negative allometry. The results of the growth parameters, such as asymptotic length (L_∞) and growth coefficient (K), were found to be 173.2 mm and 0.880 yr^{-1}, respectively. Likewise, the values of other population parameters like total mortality rate (Z), natural mortality rate (M), and fishing mortality rate (F) were estimated to be 1.48 yr-1, 1.00 yr-1, and 0.48 yr-1, respectively. The value of the exploitation rate was 0.33. According to the results of a length-based virtual population analysis (VPA), fish with lengths between 105 mm and 145 mm are commonly targeted for commercial exploitation. It was observed that the calculated maximum yield exploitation rate of the species (E_{max}) was 0.50. The recruitment pulse of the species indicated two peaks annually, i.e., August (22%) and September (18%) months, respectively. The fishing rate at 10% increase (E_{10} yr^{-1}) and 50% stock reduction was found to be 0.415 and 0.310, respectively. The estimated length at which 50% of the stock (L_{50}) is vulnerable to capture was 48.02mm. Consequently, the predicted lengths at which 25% and 75% of the stock are collected are L_{25} = 40.29 cm and *L75* = 55.76mm.

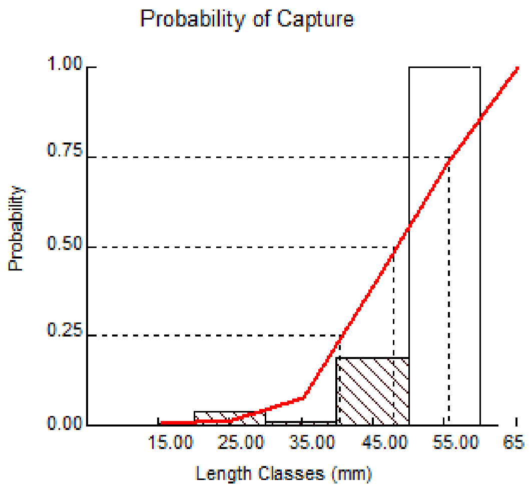


Fig. 120A. Estimated probability of capture of *J. coitor*

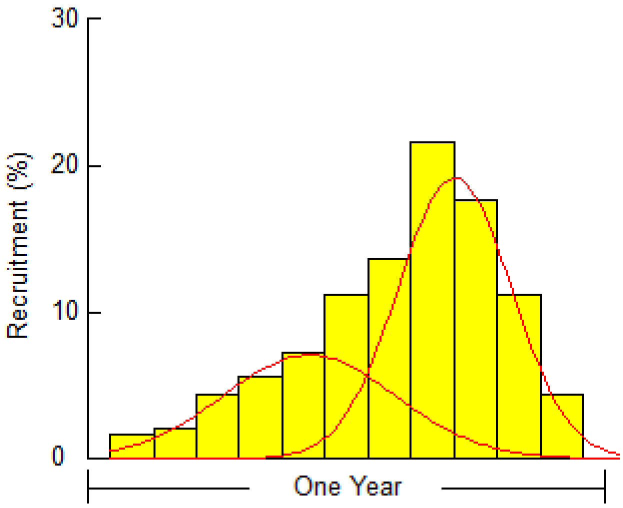


Fig 120B. Estimated annual recruitment % of *J. coitor*

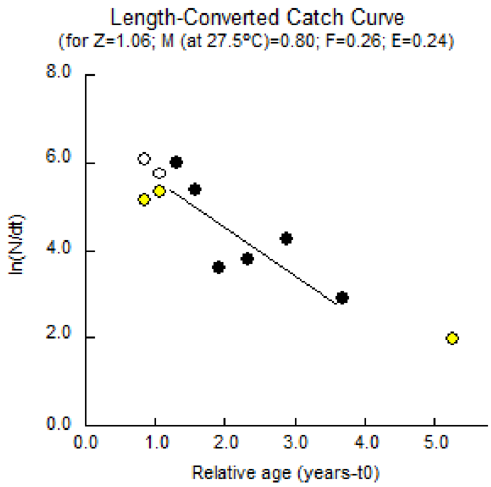


Fig. 120C. Estimated length converted catch curve of *J. coitor*

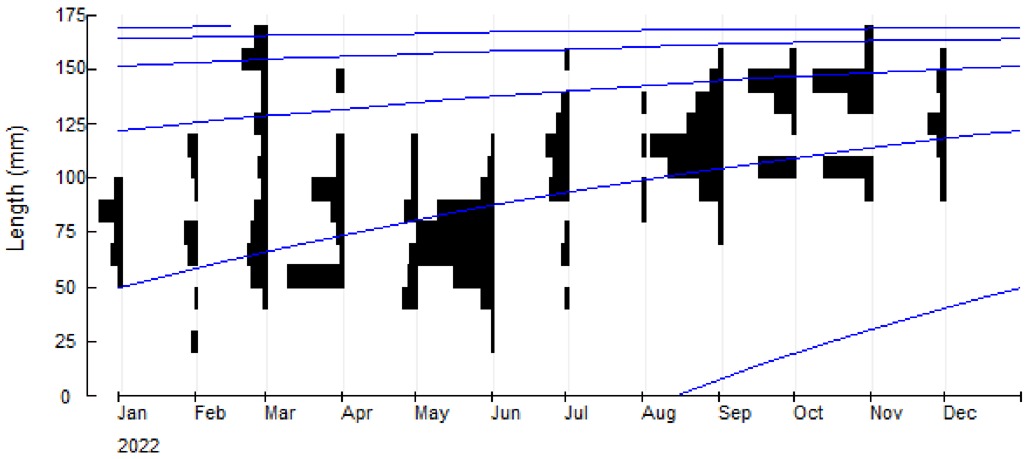


Fig. 120D. Estimated growth curve (VBGF plot) of *J. coitor*
Fig. 120 (A-D): Different population parameters of *J. coitor*

4.33.6 *Salmostoma bacaila*, Hamilton, 1822

Fig. 121. A specimen of *Salmostoma bacaila*

Local Name :	Chela/Chelwa
Family :	Danionidae
Order:	Cypriniformes
IUCN red list status	Least Concern (LC)
Distribution	Bijnor to Godakhali

Commonly known as the Large Razorbelly Minnow, *Salmostoma bacaila* is a freshwater benthopelagic species of the family Danionidae. People living around the Ganges prefer this species owing to its rich taste and nutritional qualities. This is a valued SIF and is also used as fish bait. During the present study, the observed TL and BW (pooled sex) varied from 50–134 mm and 1.11–18.30 g, respectively. The results for the top three (%) length groups were 28.69%, 23.47%, and 22.60%, which correspond to the length classes 60-69, 50-59, and 70-79 mm, respectively. The parameters for the length-weight relationship for the pooled sex were estimated to be W = 0.122L2.84 (r^2 = 0.904, p<0.01). The species' growth coefficient b value indicates that the fish grows in a negative allometric growth fashion. For the combined sexes, the estimated values of $L\infty$ and K for the combined sexes were determined to be 141.75 mm and 0.58 yr -1, respectively. Natural mortality (M) was calculated to be 0.80 yr^{-1} for both sexes combined. Similarly, the value of fishing mortality (F = 0.26 yr^{-1}) was obtained by subtracting the natural mortality total annual mortality rate (Z = 1.06 yr^{-1}). An exploitation ratio (E) of 0.24 was achieved for the species. The computed E10, E50, and Emax values were 0.506, 0.339, and 0.625, respectively. The length-structured Virtual Population Analysis (VPA) revealed maximum fishing mortality at length classes at 75 mm and above 115 mm, while catches were found to be more prevalent in length groups between 75 and 95 mm. The results of L_{25}, L_{50}, and L_{75} were found to be 50.26 mm, 59.37 mm, and 68.14 mm, respectively. It is determined that when the fish reaches a total length of 59.37 mm, according to the predicted L_{50} or Lc value, it becomes susceptible to fishing gear.

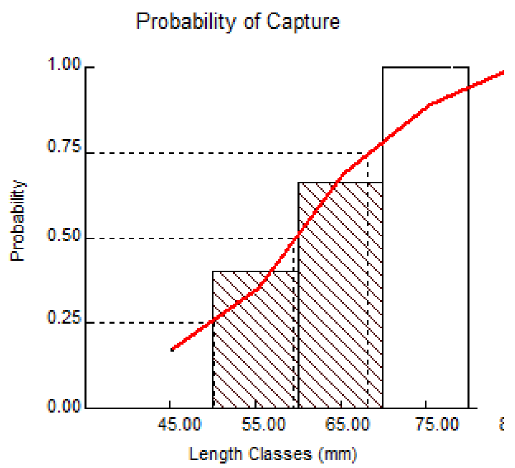


Fig. 122A. Estimated probability of capture of *S. bacaila*

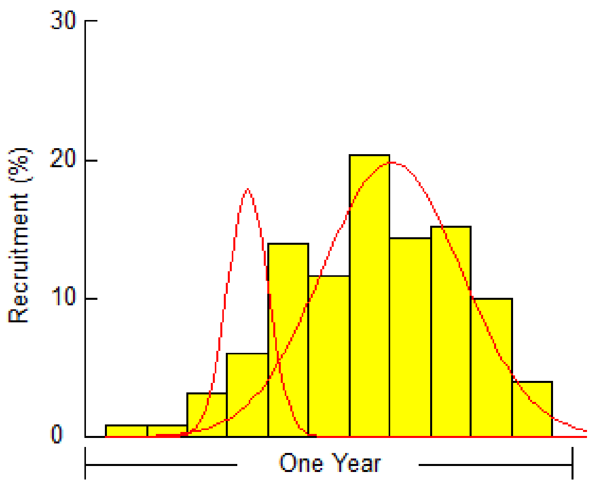


Fig. 122B. Estimated annual recruitment % of *S. bacaila*

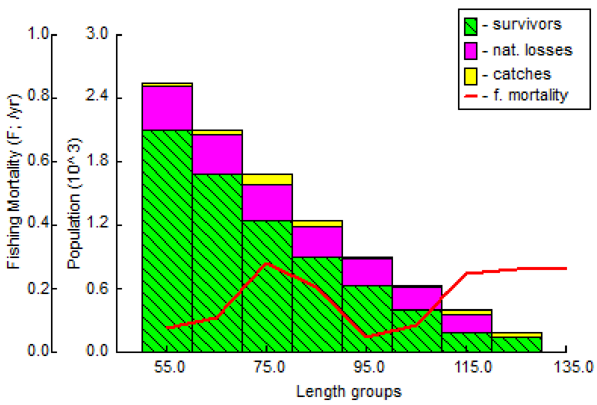


Fig. 122C. Estimated annual recruitment % of *S. bacaila*

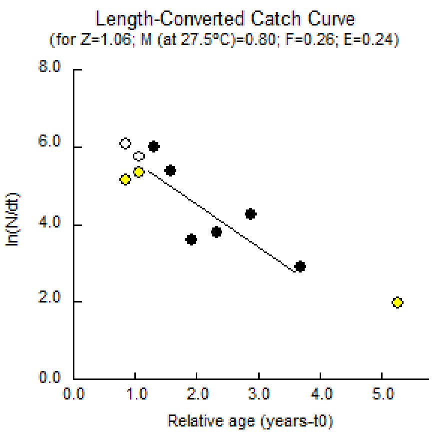


Fig 122D. Length converted atch curve of *S. bacaila*

Fig. 122(A-D): Different population parameters of *S. bacaila*

4.33.7 *Tor putitora*, Hamilton, 1822

Fig. 123. A specimen of *Tor putitora* (Mahseer)

Local Name :	Mahseer
Family :	Cyprinidae
Order:	Cypriniformes
IUCN red list status	Endangered (EN)
Distribution	Tehri to Bijnor

Tor putitora, commonly known as Golden Mahseer or 'Anglers delight', is an outstanding game fish, and it is the Sivalik Himalaya's primary fishery. This rheophilic species is potamodromous in nature and inhabits rivers with a large volume of water and areas with sand, silt, and small pebbles (Bhatt and Pandit, 2015). However, in the Himalayan stretch of Ganga, exploitation as well as other factors (Nautiyal, 1984, 1989, 1990, and 1994) have contributed to a drop in the population of the species. As estimated from the present study, the total length of the sampled fish ranged from 260 to 490 mm, while their corresponding weight ranged from 193 to 529 gm. The popular species attains a large body size, as indicated by Banarescu and Code (1991), who recorded a maximum size length of 2750 mm from Eurasian waters. The fish can reach lengths of up to 275 cm and weights of up to 54 kg in Indian waters (Everard and Kataria, 2011; Nautiyal et al., 2008). Nautiyal et al. (2008) have reported the maximum size of an individual specimen to be 1370 mm from the uplands of the Alaknanda River. Nautiyal et al. (2008) described Von Bertalanffy's (1938) equation for growth in length for this species (VBGF) was L_∞ = 272 mm and K = 0.035 yr^{-1}, respectively. The instantaneous rate of the total mortality coefficient (Z) was estimated to be 1.36 yr^{-1}. Similarly, the natural mortality coefficient (M) estimates were 0.37 yr^{-1}. The fishing mortality (F) estimated was 0.99 yr^{-1}. The estimated exploitation ratio (E) was 0.73.

Two peaks were observed for the annual recruitment patterns of *T. putitora*, which were found in March and July. The findings of length-based virtual population analysis (VPA) indicated that increased fishing mortality was observed from the length group of 339–419 mm onwards.

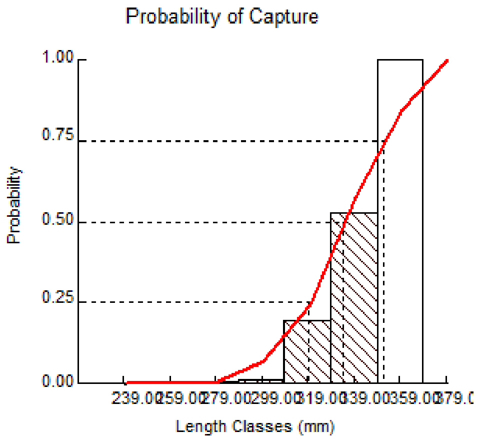


Fig. 124A. Estimated probability of capture of *T. putitora*

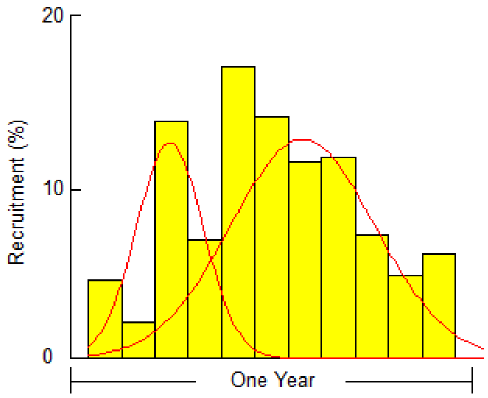


Fig. 124B. Estimated annual recruitment % of *T. putitora*

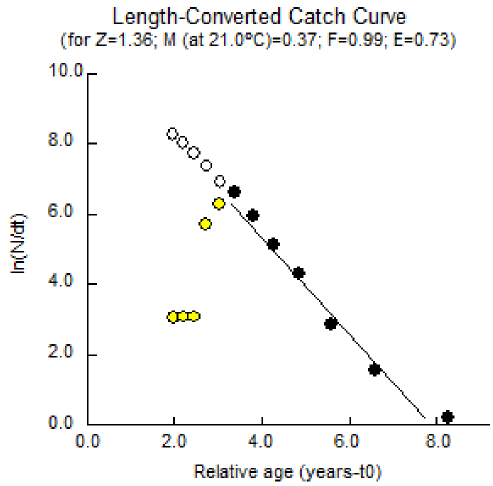


Fig. 124C. Estimated length converted catch curve of *T. putitora*

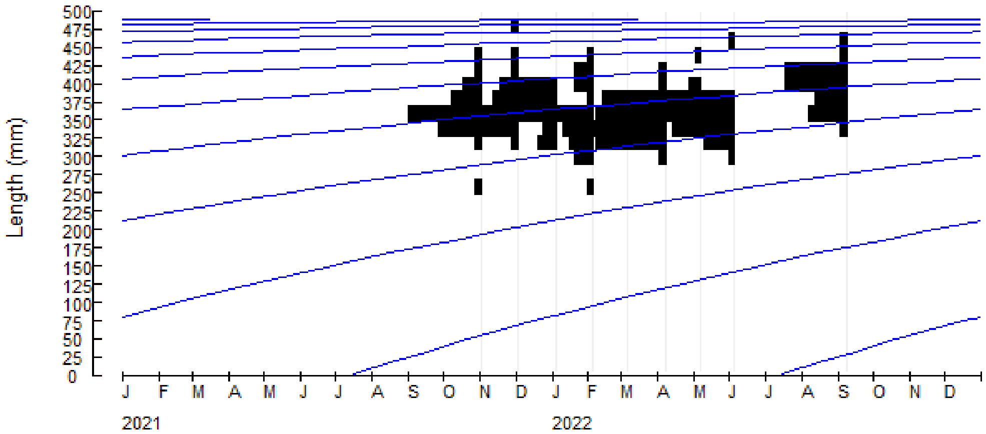


Fig. 124D. Estimated growth curve (VBGF plot) of *T. putitora*

Fig. 124 (A-D): Different population parameters of *T. putitora*

4.33.8. *Gudusia chapra* (Hamilton, 1822)

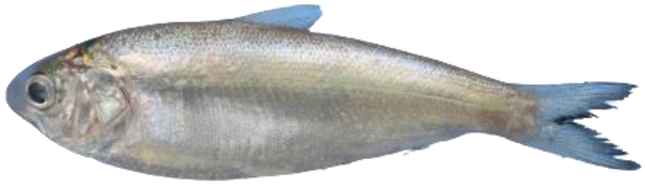


Fig. 125 A specimen of *Gudusia chapra*

Local Name :	Suia/Chapra/Khoira
Family :	Clupeidae
Order:	Clupeiformes
IUCN red list status	Least Concern (LC)
Distribution	Bijnor to Tribeni

The Indian river shad is one of the common small indigenous fish species (SIF) of the Ganga. It forms an important and valuable species, supporting livelihood along the Gangetic banks. The species is an important attribution to the catch of the river Ganga. As determined from the present study, the minimum and maximum total length of the species varied from 36 to 175 mm, and similarly, the weight ranged from 0.3 g to 38.02 g. The length range of 60–69 mm was observed to be the most dominant size group in the Ganga. Rahman (1989) described the maximum size length of 200 mm from Bangladesh waters. Hossain et al. (2019) have reported 13.0 cm as the maximum length from the Ganges River, whereas Gogoi et al. (2019) observed 16.10 cm from the Brahmaputra River. The value of the length-weight relationship yielded $W = 0.080\ L^{3.13}$ ($R^2 = 0.919$), where a = 0.080 and b = 3.13 showed positive allometric growth for the species in the river. The VBGF growth parameters for the species were estimated as L_∞ = 18.9 cm and K = 0.68 yr^{-1}, respectively. According to Pauly's length-converted catch curve method, the natural mortality (M) and total mortality (Z) were estimated at 0.81 yr^{-1} and 2.65 yr^{-1}, respectively. The analysis further revealed the rate of fishing mortality (F) as 1.84 yr^{-1} and the exploitation ratio (E) as 0.69, indicating exploitation of the stock above the optimum level. A growth coefficient (K) value of 0.87 yr^{-1} has been observed by Gogoi et al. (2021) from the river Brahmaputra, indicating a faster approach rate towards the asymptotic length. Likewise, the growth performance index (ϕ) was calculated to be 4.38. The species recruitment pattern suggested two peaks in June (17.07%) and August

(15.13%). Length-structured Virtual Population Analysis (VPA) of the species suggested steady natural loss from 6.0 to 10.0 cm. Subsequently, the highest value of fishing mortality (0.87 yr1) was observed parallel to the peak length at 12.0 cm.

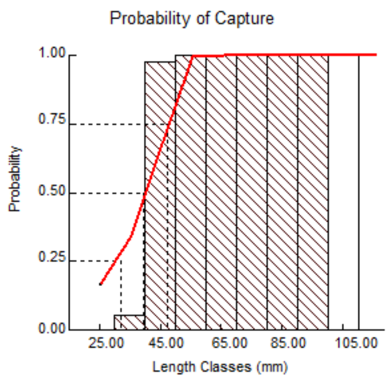


Fig. 126A. Estimated probability of capture of *G. chapra*

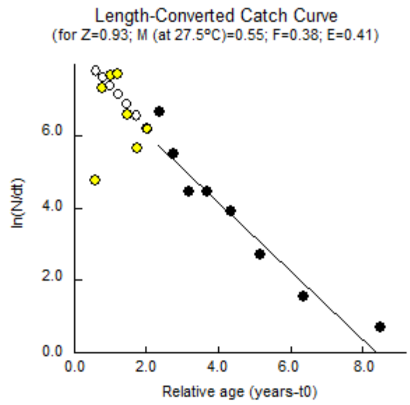


Fig. 126B. Estimated length converted catch curve of *G. chapra*

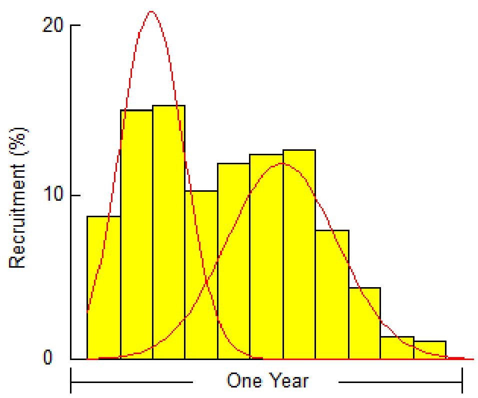


Fig. 126C. Estimated annual recruitment (%) of *G. chapra*

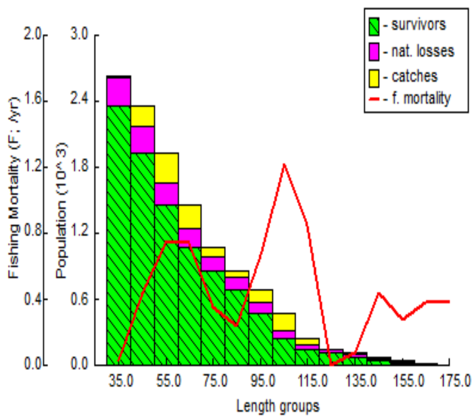


Fig. 126D. Estimated Virtual Population Analysis (VPA) plot of *G. chapra*

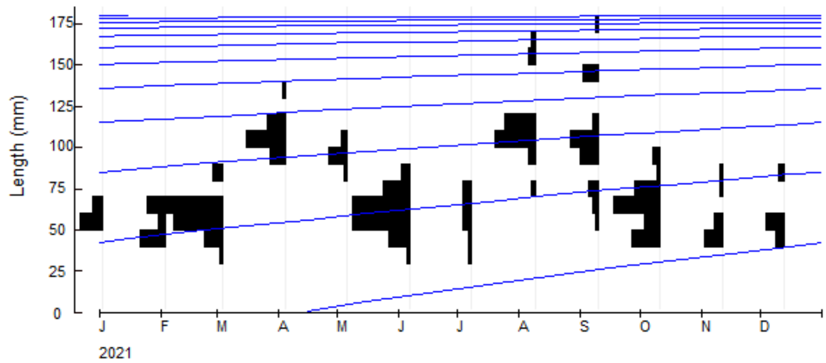


Fig. 126 E. Estimated growth curve (VBGF plot) of *G. chapra*

Fig 126 (A-E): Different population parameters of *G. chapra*

4.33.9 *Rita rita* (Hamilton, 1822)

Fig. 127. A fresh specimen of *Rita rita* (Ritah Catfish)

Local Name :	Ritah/Belgagra
Family :	Bagridae
Order:	Siluriformes
IUCN red list status	Least Concern (LC)
Distribution	Bijnor to Tribeni

A common rheophilic freshwater catfish, *Rita rita* is widely distributed in river Ganga and forms an important economically valuable fish. It is an important food fish of Gangetic belt with high nutritive value. In the present study, the total length of the species varied from 55 to 552 mm (average TL 166 mm), and the corresponding weight ranged from 2.49 g to 3000.44 g. The study revealed that fish in the length range of 100 to 149 mm dominated the catch. Fishes of TL 50 to 99 mm observed in the commercial landings indicated growth overfishing. Talwar and Jhingran (1991) reported a maximum length of 1500 mm for *Rita rita* from Indian waters. Similarly, Kumar et al. (2019) observed a maximum size length of 658 mm for this species from a middle stretch of the river Ganga (Haridwar to Kanpur). The current length-weight relationship (LWR) of the species.

The length-weight relationship determined for the species was $W = 0.010\ L = {}^{2.85}$ ($R^2 = 0.88$), suggesting the fish growth is satisfactory (negative allometric growth) for a definite length in the river. The estimates attained for 'b' value (2.85) in the present study pointed out a similar pattern with previous works by Baitha et al. (2018) and Kumar et al. (2019) from the river Ganga. The mean condition factor (K) for the species was estimated to be 2.23. The VBGF parameters L_∞ and K of *Rita rita* were estimated to be 551.25 mm (TL) and 0.44 yr^{-1}, respectively. The annual mortality rates M (natural mortality), Z (total mortality), and F (fishing mortality) of *R. rita* from the Ganga River were estimated to be 0.46, 1.10, and 0.64, respectively, at an average temperature of 28 ºC. Fishing mortality is a concern that remains much higher than the natural mortality rates in the river. A continuous pattern of recruitment was observed around the year, with one major peak in May to August, with more than >30% of the population found in mature conditions. The assessment of length-structured Virtual Population Analysis (VPA) revealed that *R. rita* is being harvested at a maximum length group of >75 mm with a higher rate of fishing mortality. The estimated exploitation ratio (E) was 0.58, which was higher than the optimum exploitation level (0.5) for sustainable fisheries..

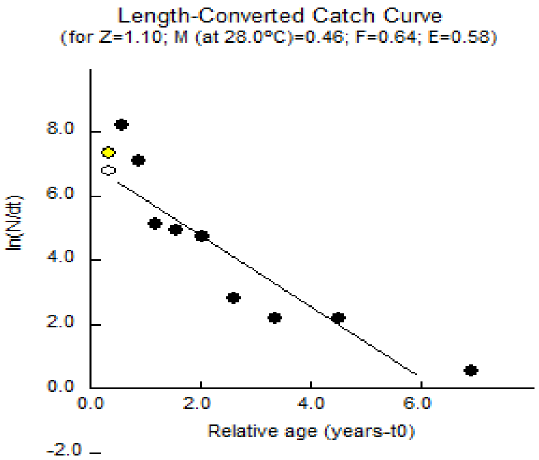


Fig. 128A. Estimated length convered catch curve of *R. rita*

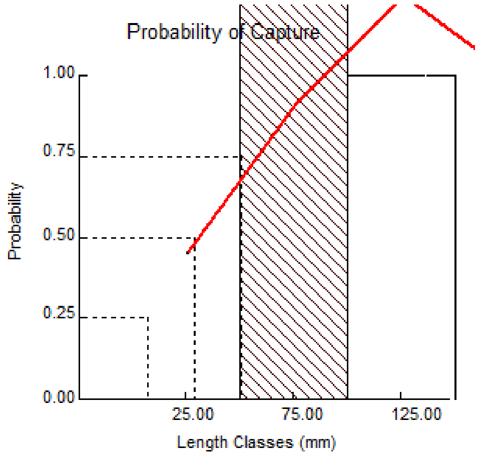


Fig. 128B. Estimated probability of capture of *R. rita*

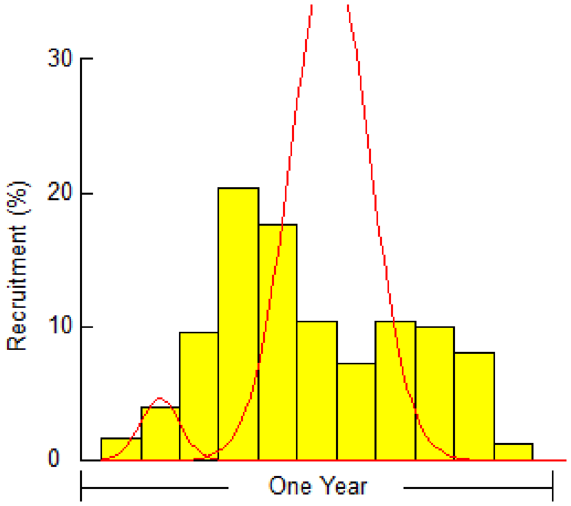


Fig. 128C. Estimated annual recruitment (%) of *R. rita*

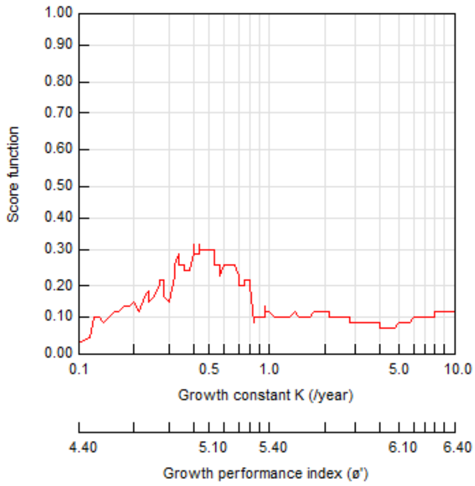


Fig. 128D. Estimated growth constant (K) of *R. rita*

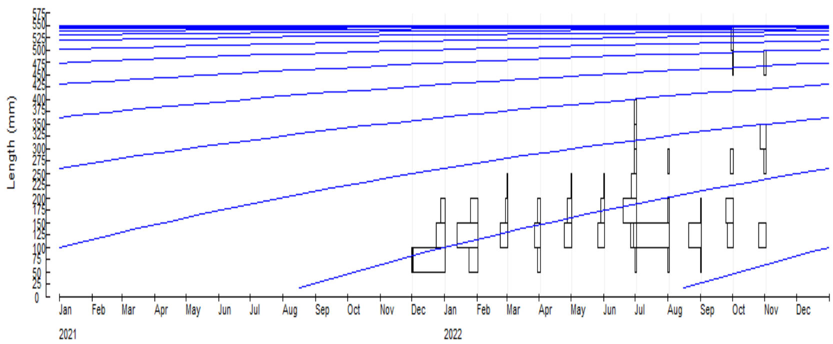


Fig. 128E. Estimated growth curve (VBGF plot) of *R. rita*
Fig. 128 (A-E): Different population parameters of *R. rita*

4.33.10 *Setipinna phasa* (Hamilton, 1822)

Fig. 129. A fresh specimen of *Setipinna phasa* (Gangetic hairfin anchovy)

Local Name :	Phasiya/Phasa
Family :	Engraulidae
Order:	Clupaiformes
IUCN red list status	Least Concern (LC)
Distribution	Bijnor to Tribeni

The Gangetic hairfin anchovy, *Setipinna phasa*, is a widely distributed freshwater and brackishwater fish. The fish support high economic demand in the Gangetic Belt, contributing immensely to the fish landing. The study revealed the total length of the species ranged from 40 to 246 mm (average TL 101.8 mm), with the corresponding weight extending from 0.36 g to 73.02 g. The study revealed that fish in the length range of 60 to 79 mm dominated most of the catch. Whitehead et al. (1988) reported a maximum size range of 400 mm for the species. Kamal et al. (1999) reported a maximum size length of 11.1 to 26.8 cm in males and 14.2 to 31.9 cm in females and a weight of 4.2 to 81.5 g in males and 11.6 to 180.6 g in females from Bangladesh waters. The estimated length-weight relationship determined for the species was $W = 0.004 L^{2.99}$ ($R^2 = 0.96$), suggesting the fish growth is satisfactory (negative allometric growth) in the river. However, Jhingran (1972) estimated the length-weight relationship in *S. phasa* from Indian rivers, attributing the total length only. He reported the value of 'n' at 3.07166, 2.86969, and 3.03549 for male, female, and combined male and female, respectively. The mean condition factor (K) for the species was estimated to be 0.48. The VBGF parameters L_∞ and K of *S. phasa* were estimated to be 283.50 mm (TL) and 0.49 yr-1, respectively. The annual mortality rate M (natural mortality), Z (total mortality) and F (fishing mortality) of *S. phasa* from the river Ganga were estimated to be 0.60, 1.63, and 1.03, respectively, at an average temperature of 28 ºC. Fishing mortality is a concern that remains much higher than the natural mortality rates in the river. A continuous pattern of recruitment was observed throughout the year, with one major peak in May to

August, with more than 30% of the population found in mature conditions. The assessment of length-structured Virtual Population Analysis (VPA) revealed that *S. phasa* is being harvested at a maximum length group of >50 mm with a higher rate of fishing mortality. The estimated exploitation ratio (E) was 0.63, which was higher than the optimum exploitation level (0.5) for sustainable fisheries.

4.33.11 *Rhinomugil corsula* (Hamilton, 1822)

Fig. 130. A fresh specimen of *Rhinomugil corsula* (Corsula)

Local Name :	Aduari/Khorsulah
Family :	Mugilidae
Order:	Mugiliformes
IUCN red list status	Least Concern (LC)
Distribution	Bijnor to Fraserganj

The grey mullet *Rhinomugil corsula* total length (TL) as determined from the present study was observed to be 40–194 mm. Similarly, the corresponding weight of the species was recorded to be 0.67–56.22 g. Menon (1999 recorded the maximum size and length of the species to be 450mm in Indian waters. Saini et al. (2010) have reported a maximum size range of 340 mm from the Gomti River (a tributary of the Ganga). The estimated length-weight relationship determined for the species was W = 0.012 L = $^{2.64}$ (R^2 = 0.94), suggesting the fish growth is satisfactory (negative allometric growth) in the river. However, Saini et al. (2010) from the river Gomti have estimated the length-weight relationship with values a = 0.0109 and b = 2.94, attributing the total length only. The VBGF parameters, L_∞ and K of *R. corsula,* were estimated to be 210 mm (TL) and 0.62 year-1, respectively. The annual mortality rates M (natural mortality), Z (total mortality), and F (fishing mortality) of *R. corsula* from the river Ganga were estimated to be 0.76, 1.90, and 1.14, respectively, at an average temperature of 28 ºC. Fishing mortality is a concern that remains much higher than the natural mortality rates in the river. Two peaks of recruitment were observed for the species in one year, with one major peak in July–August, suggesting it is mainly a monsoon breeder. The estimated exploitation ratio (E) was 0.60, which was found to be higher than the optimum exploitation level (0.5) for sustainable fisheries.

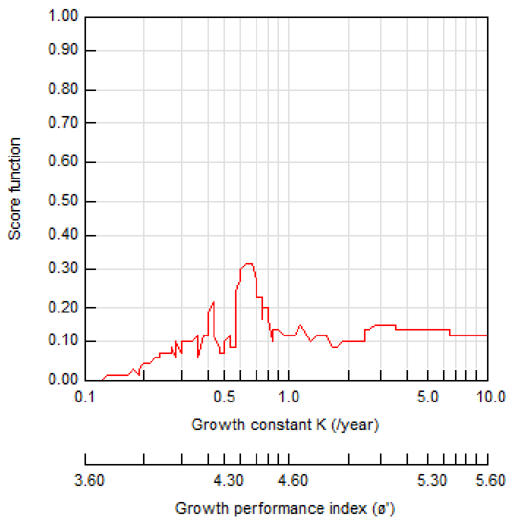


Fig. 131A. Estimated growth constant (K) of *R. corsula*

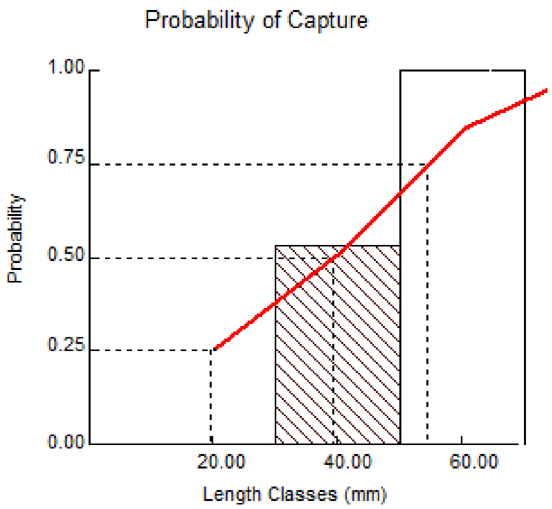


Fig. 131B. Estimated probability of capture of *R. corsula*

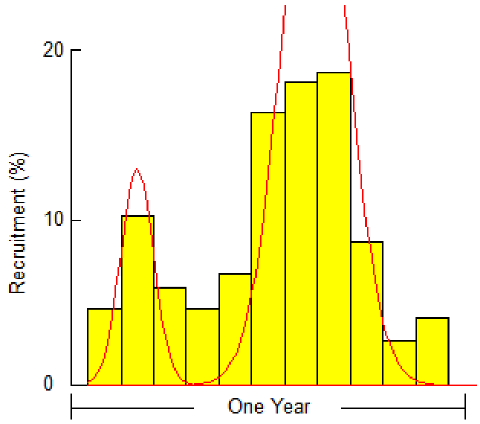


Fig. 131C. Estimated annual recruitment (%) of *R. corsula*

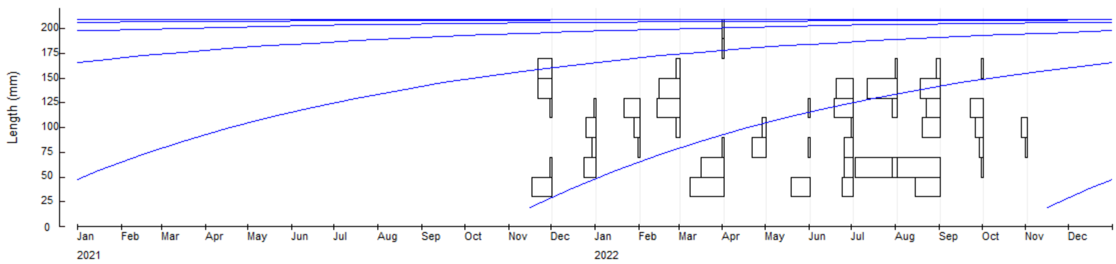


Fig. 131D Estimated growth curve (VBGF plot) of *R. corsula*

Fig 131 (A-D): Different population parameters of *R.corsula*

4.34. Annual Catch per unit Effort (CPUE) information of river Ganga

The river Ganga supports a unique diversity of life because it flows through three distinct bio-geographic regions-the Himalaya, the Gangetic Plain, and the Coastal Zone. The interactions between these species and between species and their habitats determine many ecosystem functions, including human survival. The diversity of freshwater organisms is, however, decreasing at a startling rate for a variety of reasons. Data on landings and catches from the river Ganga were evaluated using a multistage process that included landing centers, village-to-village, and market approaches. We have covered 2378 km^2 and 379 fishing villages in 45 districts of five states (Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal) (Fig. 132).

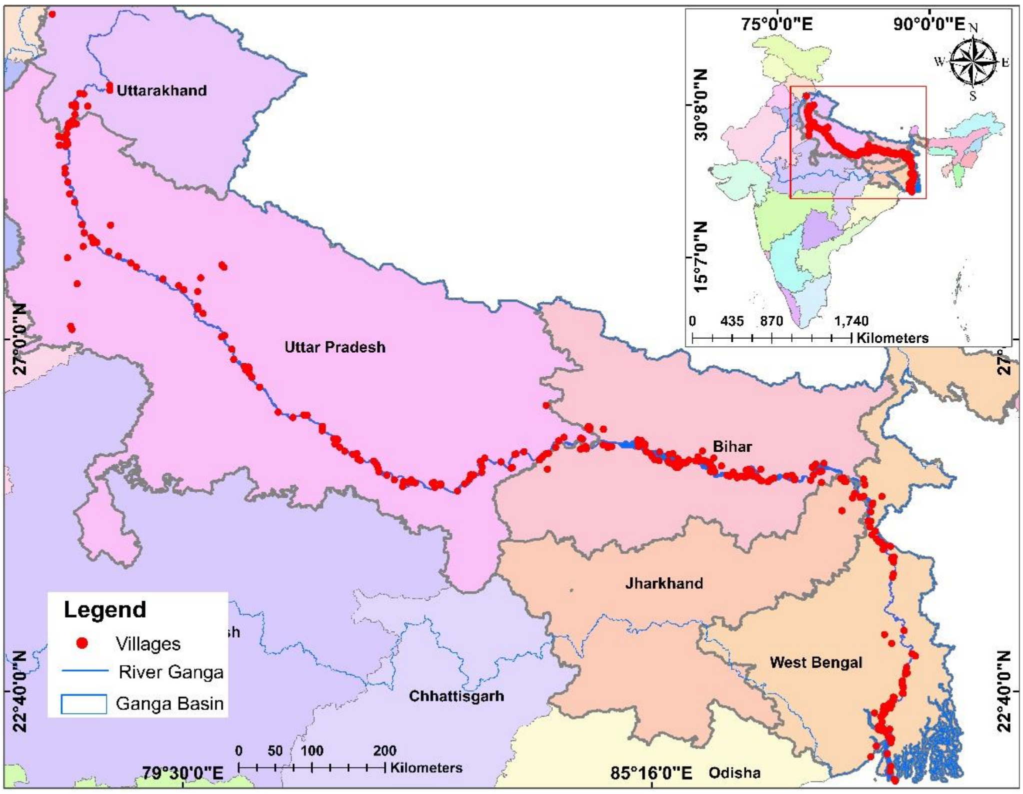


Fig. 132. Sampled villages along river Ganga for catch estimation

The district-wise annual fish catch landing ranged from 1.87 tons in Uttarkashi (Uttarakhand) to 7380.79 tons in Varanasi (Uttar Pradesh), and the total catch from the Ganga was 56387.24 tons per annum (Fig. 33). The study revealed that the middle and lower stretches are more productive than the upper stretch of the Ganga. The seasonal average catch landing during summer ranged from 1.67 tons in Uttarkashi to 5387.8 tons in Prayagraj, monsoon 0.11 tons in Uttarkashi to 1878.14 tons in Varanasi, and winter 0.09 tons in Uttarkashi to 2300.04 tons in Munger. The reason behind the low fish catch in Uttarkashi district may be attributed to fewer fishing practices and sporadic landings.

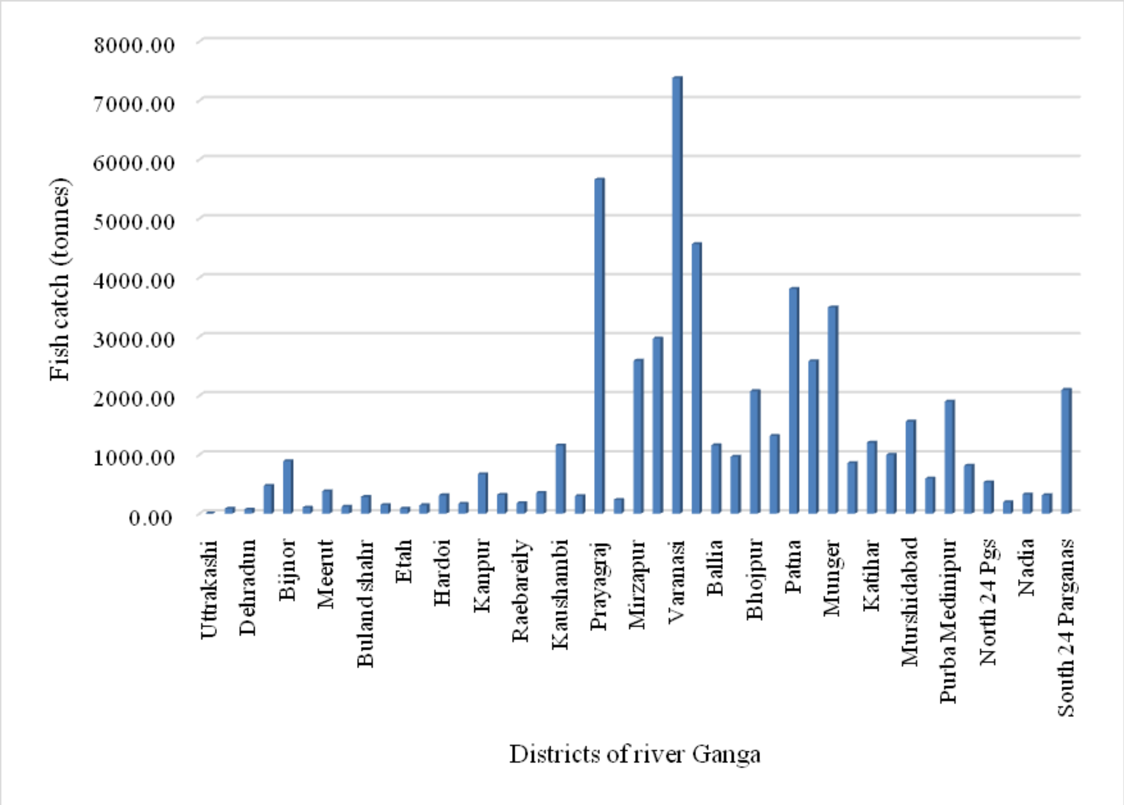


Fig. 133. District-wise annual fish catch landings of river Ganga

The average catch per unit effort (CPUE) from the Ganga varied from 0.48 kg/fisherman/day to 55.95 kg/fishermen/day during the summer, 0.65 kg/fishermen/day to 48.04 kg/fishermen/day in the monsoon, and 0.28 kg/fishermen/day to 53.57 kg/fishermen/day in the winter. The present study observed West Bengal (7.82 kg/fisher/day) as having the highest CPUE, followed by Uttar Pradesh (5.18 kg/fisher/day), Jharkhand (3.61 kg/fisher/day), Uttarakhand (3.21 kg/fisher/day), and Bihar (3.15 kg/fisher/day) (Fig. 134).

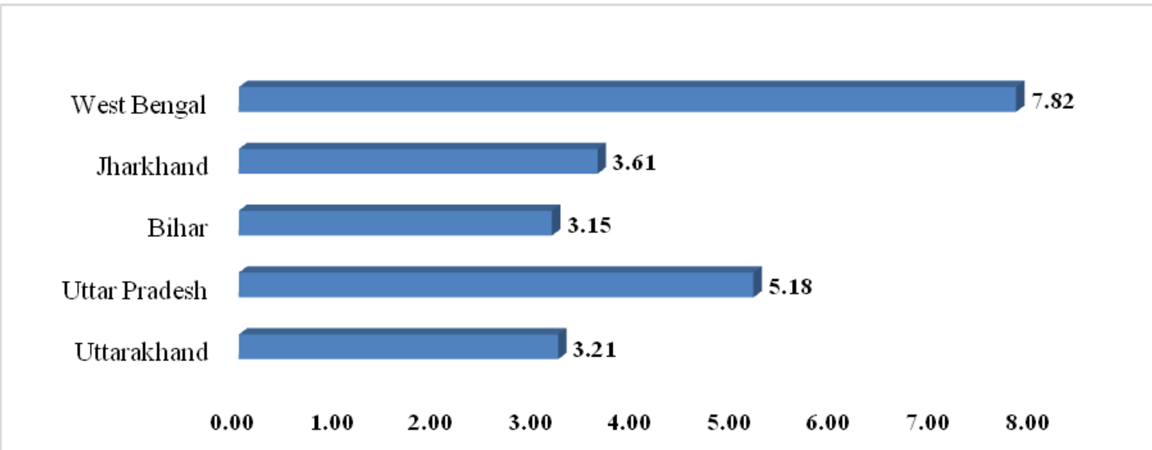


Fig. 134. State-wise CPUE (kg/fisher/day) of river Ganga

Fig. 135. Fishing in river Ganga at Godakhali of West Bengal

4.35. Physico-chemical characteristics of river Ganga

Assessment of ecological parameters in the river Ganga is very important, as the ecological habitat plays a significant role in determining the ecological niche of most of the fish organisms. Samplings were conducted at different sites in the upper, middle, and lower stretches of the Ganga River at 24 different sampling sites. Harshil-1, Tehri-2, Haridwar-3, Bijnor-4, Narora-5, Farrukhabad-6, Kanpur-7, Prayagraj-8, Mirzapur-9, Chunar-10, Varanasi-11, Ghazipur-12, Ballia-13, Buxar-14, Patna-15, Bhagalpur-16, Farakka-17, Jangipur-18, Berhampore-19, Balagarh-20, Tribeni-21, Godakhali-22, Diamond Harbour-23, Fraserganj-24. The important physico-chemical parameters with respect to fish health and environment were monitored, which were water temperature, water depth, flow, transparency, turbidity, water pH, specific conductance, dissolved oxygen, total alkalinity, total hardness, salinity, total solids, available phosphorus, total phosphorus, available nitrogen, total nitrogen, silicate, BOD, and chlorophyll.

Fig. 136 (A-C). Photographs of the on spot water quality analysis performed during the project

4.35.1. Present water quality status of river Ganga (2021-2023)

The study of the different stretches was made, and significant differences were observed in all the parameters among the stretches. The mean temperature . in the entire stretch during 2021–23 was observed at 25.28 ± 0.50 °C, with the lowest temperature . in the upper stretch (17.40 ± 1.20 °C) and the highest in the estuarine stretch (28.50 ± 0.75 °C) of the river. The mean depth during 2021–23 in the river was observed at 4.88 ± 0.43 m, with the highest in the estuarine stretch and the lowest in the middle stretch (2.5 ± 0.26 m) of the river. Velocity, the important parameter for the evaluation of river health, was observed at 0.6 ± 0.04 m/sec during 2021-23, with the highest mean velocity observed in the upper (0.81 ± 0.12 m/sec) and estuarine stretch (1.28 ± 0.36 m/sec) of the river. The mean pH during 2021–23 in the entire stretch was within the safe and standard limits, with a mean pH value of 8.31 ± 0.42. The dissolved oxygen (DO), which is also one of the important parameters used for the assessment of the water quality status, was observed to be congenital for the aquatic organisms, as in the entire river stretch, the mean during 2021–23 DO was observed to be > 6.5 ppm, with the highest mean DO value (8.30 ± 0.20 ppm) in the upper stretch of the river and the lowest in the lower stretch of the river (6.5 ± 0.17 ppm). The mean alkalinity in the river was observed to be 124.13 ± 4.08 ppm, with the highest alkalinity values in the middle stretch of the river (145.80 ± 5.60 ppm), while the upper stretch of the river confers relatively lower alkalinity values. The mean total hardness of the river was observed at 369.68 ± 92.90 ppm, with the highest hardness observed in the estuarine stretch of the river due to the influence of salt water from the sea.

4.35.2. Timescale variation of the significant water quality parameters

For the monitoring of the restoration strategies, a time-scale assessment of the water quality data is essential. So, in the study, multi-decadal changes have been monitored for the essential water quality parameters, which may directly or indirectly affect the entire riverine ecology, including aquatic organisms such as fish, plankton, benthos, dolphins, etc. The key decadal changes for the parameters have been portrayed in tabular form for the vital water quality parameters in major sampling sites for which multi-decadal datasets are available. The analysis showed that significant variation has been observed over the year; however, the restoration strategies have positively impacted the riverine water quality. But the change in climate and weather conditions has significantly impacted riverine water quality.

4.35.2.1 Variation of water temperature

The variation of the water temperature has been observed at majority of the stations, which may be due to the impact of climate change, which have chiefly affected the ecological niche of the majority of the aquatic organisms and entire food web.

Table 8. Values depicting multidecadal variation in temperature (°C) for the period 1960-2023; Range (Min-Max)

Sampling sites	Period	Temperature(°C)	Sampling station	Period	Temperature (°C)
Haridwar	1984-85	11.25-19.75	Buxar	1960	18.0-31.0
	1995-96	12.5-26.0		1995-96	19.0-33.0
	2016-20	15.95-28.2		2016-20	13.13-31.3
	2021-23	13.85-22.55		2021-23	18.30-31.30
Kanpur	1960	16.0-30.5	Patna	1960	18.5-31.0
	1995-96	16.0-30.0		1995-96	19.5-31.0
	2016-20	15.6-31.15		2016-20	16.2-32.3
	2021-23	14.40-30.80		2021-23	22.10-31.70
Prayagraj	1960	17.5-31.5	Bhagalpur	1960	18.5-31.5
	1995-96	17.0-32.0		1995-96	18.5-31.0
	2016-20	13.13-31.3		2016-20	16.4-33.5
	2021-23	18.25-32.25		2021-23	21.80-30.40
Varanasi	1960	18.5-31.5	Farakka	1960	18.5-31.5
	1995-96	20.0-31.5		1995-96	18.5-31.0

	2016-20	27.76		2016-20	13.1-31.8
	2021-23	18.05-31.70		2021-23	22.70-32.60
			Diamond Harbour	1953-55	18.0-33.0
				1995-96	20.5-30.0
				2016-20	22.0-31.7
				2021-23	24.80-30.30

Source : (Vass et al. 2008; CIFRI bulletin No. 154) and present study from 2016-2023

4.35.2.2 Multidecadal variation in the pH level in the entire river system

The present study showed significant variation in the water pH have been observed over the years. However, the present study also showed that entire studied stretch possesses alkaline pH which is observed congenital for the survival of majority of the aquatic organisms.

Table 9. Values depicting mean multidecadal variation in water pH for the period 1960-2023; Range (Min-Max)

Stretches	Period	pH	Stretches	Period	pH
Kanpur	1960	7.9	Patna	1960	7.9
	1987-88	7.2		1987-88	8
	2001-06	8.2		2001-06	8.1
	2016-20	7.53		2016-20	7.54
	2021-23	8.51		2021-23	8.08
Prayagraj	1960	8.1	Bhagalpur	1960	8.2
	1987-88	8		1987-88	8.1
	2001-06	8.2		2001-06	8.2
	2016-20	7.73		2016-20	7.51
	2021-23	8.57		2021-23	8.20
Varanasi	1960	8	Farraka	1960	NA
	1987-88	7.4		1987-88	NA
	2001-06	8.1		2001-06	8.1
	2016-20	7.72		2016-20	7.66
	2021-23	8.59	Diamond Harbour	1953-55	8.2
				2016-20	7.40
				2021-23	7.84

Source : (Vass et al. 2008; CIFRI bulletin No. 154) and present study from 2016-2023

4.35.3. Analytical report of a few important Physico-chemical parameters is as under: -

4.35.3.1. Water temperature (°C)

Water temperature plays a pivotal role in the determination and classification of the ecological habitat of most aquatic organisms. Water temperature directly or indirectly affects the hormonal metabolism of the fish and is a significant contributor to their breeding process. In the present study, the water temperature was monitored at all the sampling sites. In the analysis, it was observed that significant variation had been observed among the different sampling sites. Among all the sampling sites, the maximum average temperature of 28.9 ± 1.62°C was observed at Godakhali, while the lowest was observed at 7.8 ± 3.06 °C. The higher temperature at Godakhali may be due to the influx of city sewage from Kolkata, which is nearly 30 km away.

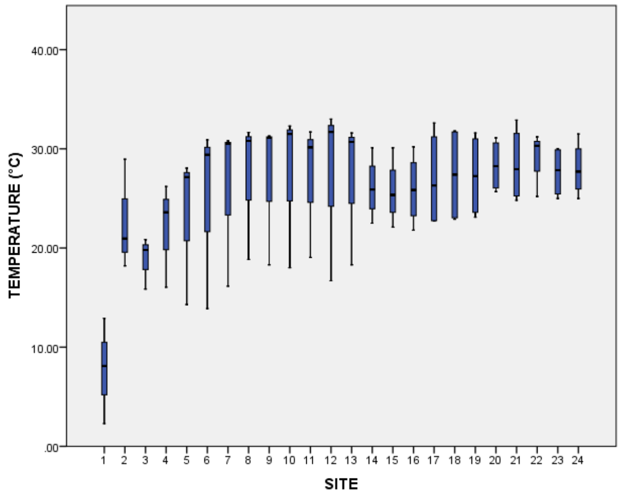


Fig. 137. Variation of temperature across all the sampling sites

4.35.3.2. Dissolved Oxygen (ppm)

Like temperature, dissolved oxygen (DO) is also a significant parameter that is essentially required for the majority of aerobic aquatic organisms, including fish. It also plays an important role in their growth and survival. Fish are organisms that use dissolved oxygen as their respiratory input, including swimming, survival, metabolism, respiration, reproduction, immunity, etc. The parameter is influenced by many biotic as well as abiotic factors, such as riverine flow, sewage, etc. In the present analysis, the average dissolved oxygen in the entire stretch was recorded at 7.21 ± 0.23 ppm. The recorded highest dissolved oxygen in the entire stretch was at Harshil (9.20 ± 0.84 ppm). The higher oxygen levels in the region signify the pollution-free status of the region. The lowest oxygen was recorded at 4.50 ± 1.50 ppm at Godakhali, which may be due to the influx of city sewage from the metropolitan city of Kolkata.

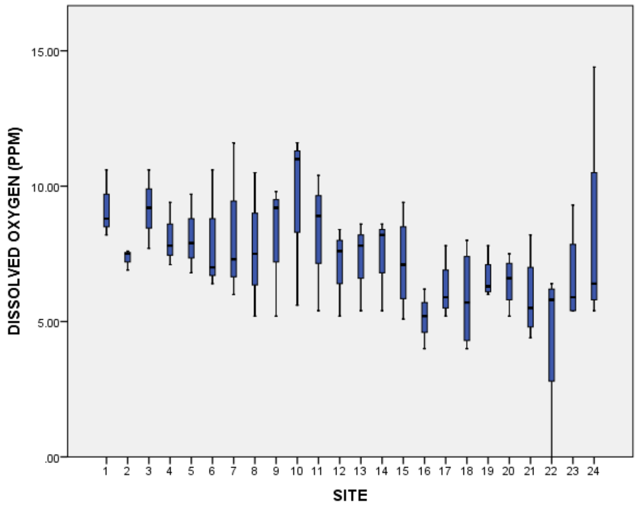


Fig. 138. Variation of dissolved oxygen across all the sampling sites

4.35.3.3.Velocity (m sec^{-1})

Riverine flow plays an important role in the determination of the ecological habitat of aquatic organisms. Flow also decides the pollution status of the river, as the flowing river is said to be pollution-free due to its ability to assimilate major riverine pollutants. The discharge from various anthropogenic sources and the construction of dams and barrages have resulted in a reduction of riverine flow. In the present study, the mean riverine flow is 0.42 ± 0.04 m/s. The highest mean flow was observed at 1.77 ± 0.03 m/s at Harshil. The lowest riverine flow was observed at 0.1 ± 0.00 m/s at Tehri. The lower riverine flow in the region is due to the dam, which might have hindered the riverine flow in the region and adversely affected the ecological habitat of many of the aquatic organisms.

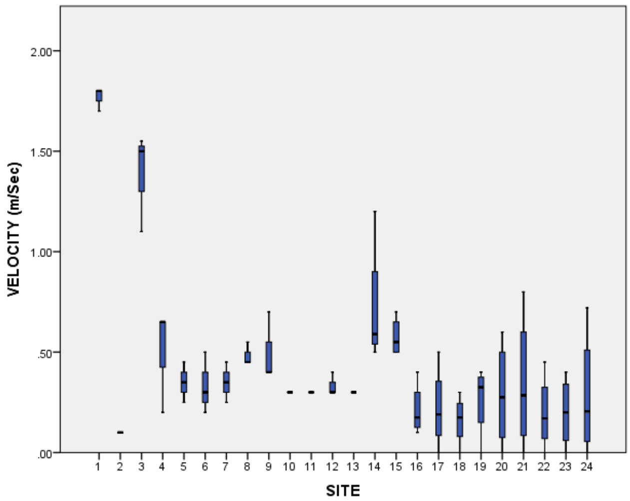


Fig. 139. Variation of Velocity (m sec^{-1}) across all the sampling sites

4.35.3.4. Water pH

pH describes the ecological habitat with respect to the acidity and basicity of the riverine water. In the present study report, it has been observed that pH in the entire stretch varied significantly as the entire stretch is coupled with multiple factors. The middle and lower stretch show maximum variation and deviation in the data. The entire stretch of water has a pH value >7, which shows the basic nature of river Ganga water quality, which is favorable from the point of view of fish physiology. The mean dissolved oxygen in the entire stretch was 8.33±0.05. The maximum mean pH value in the entire stretch was recorded at Prayagraj (8.85±0.34), while the minimum was recorded at Fraserganj, which signifies the importance of the tidal zone and the backflow of water from the Bay of Bengal in the region.

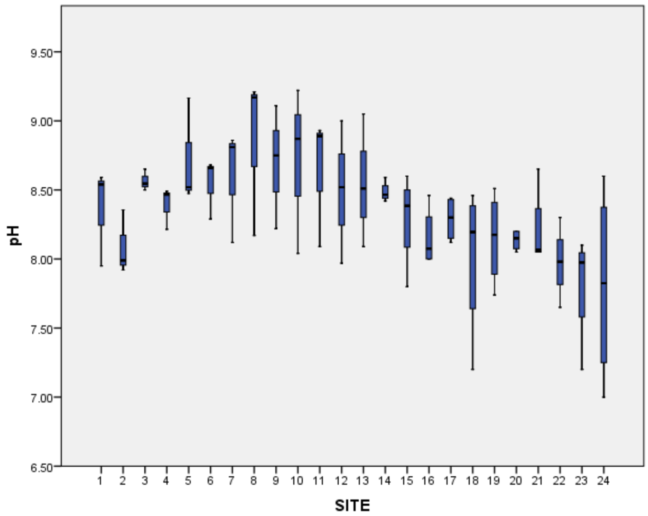


Fig. 140. Variation of pH across all the sampling sites

4.35.3.5. Conductivity (μScm^{-1})

The conductivity of the riverine water is due to the presence of cations and anions. It is a very sensitive, authentic, and polluted indicator of the river system. The increased value of conductivity signifies the eutrophic status of the river. In the present study also a higher range of conductivity was observed in the lower stretch of the river due to a higher salinity range in the region, which induces the flow of anions and cations in the riverine water. Among the upper and middle stretches, relatively higher conductivity values were observed from Kanpur to Bhagalpur indicating the influence of city and dependent population on it.

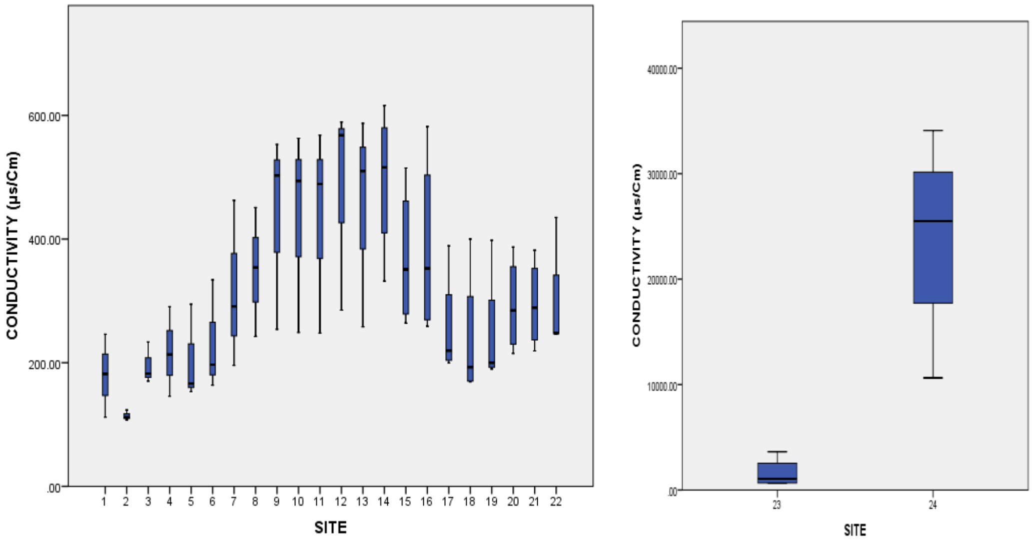


Fig. 141. Variation of conductivity across all the sampling sites

4.35.3.6. Total chlorophyll (mg/m^3)

Chlorophyll is the most important part of plants and contributes essentially to the process of photosynthesis. Chlorophyll plays a significant role in the determination of planktonic diversity. The chlorophyll pigmentation is affected by riverine flow, as the stagnant water amplifies the chlorophyll content in the river, leading to the relatively eutrophic status of the river. In the present analysis, higher chlorophyll content was observed at Prayagraj, Mirzapur, Chunar, and Varanasi.

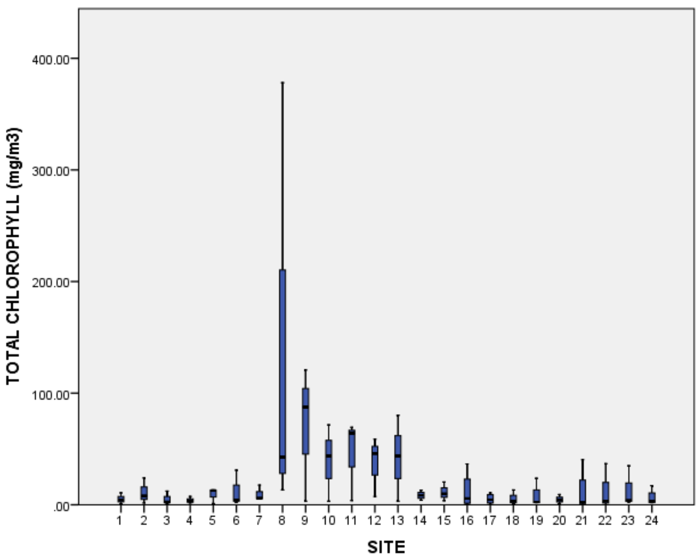


Fig. 142. Variation of Total chlorophyll across all the sampling sites

4.35.3.7.Total Alkalinity (ppm)

The alkalinity of the water is chiefly due to bicarbonate and carbonates from alkali metals, which play a significant role in maintaining the buffering capacity of the riverine water. In the present analysis, significant variations ($p > 0.05$) have been observed across all the sampling stations but were found in the optimum range for most freshwater fish (60–300 ppm). The mean alkalinity in the entire stretch was 120.87±5.50 ppm. The lowest mean total alkalinity in the entire stretch was recorded at Harshil at 30±7.21 ppm. The maximum variation was recorded at Godakhali.

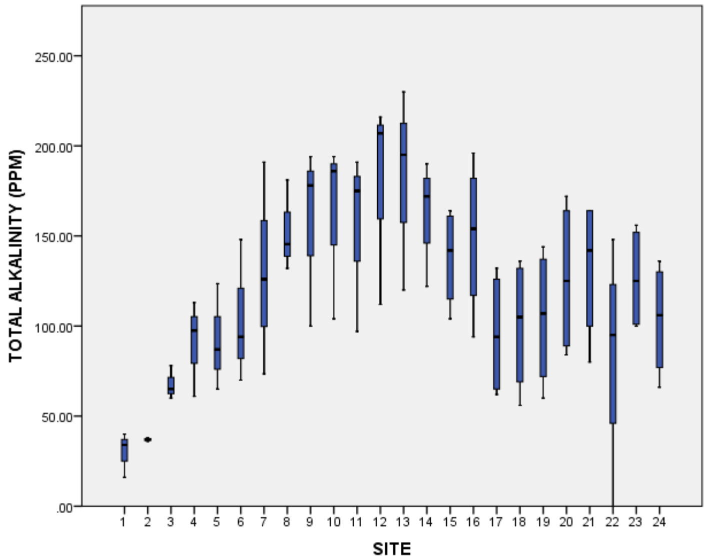


Fig. 143. Variation of Total alkalinity across all the sampling sites

4.35.3.8. Biochemical Oxygen Demand (ppm)

Biochemical oxygen demand (BOD) is the measurement of oxygen consumed by the microorganisms present in the water and is also an important pollution indicator as the increased number of microbes consumes a larger amount of dissolved oxygen present in the aquatic environment. Significant variations in the BOD have been observed at all the sampling sites. The mean BOD among all the sampling sites was recorded at 2.11 ± 0.18 ppm. The highest mean BOD has been recorded at 3.89±1.38 ppm at Chunar, which is due to the higher BOD, which is due to the city sewage effluents. The lowest mean value of BOD has been recorded at 0.55±0.28 ppm at Tehri.

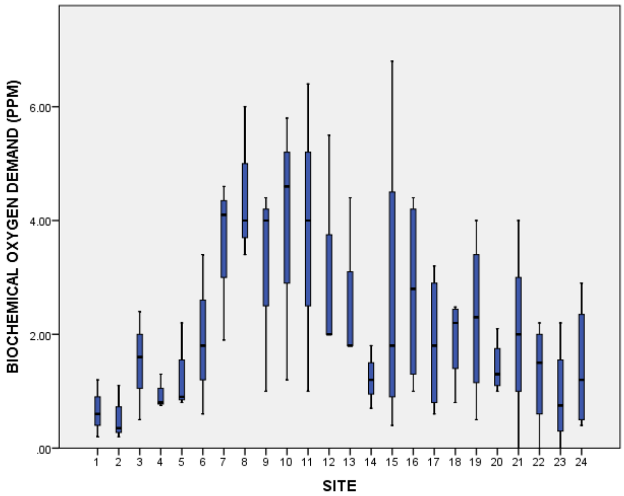


Fig. 144. Variation of Biochemical Oxygen demand across all the sampling sites

4.35.3.9. Total Nitrogen (ppm)

Total nitrogen is the essential nutrient parameter chiefly responsible for the productivity status of the riverine system as it contributes essentially to the production of aquatic plants as well as the planktonic distribution in the aquatic environment. The over-accumulation of the nutrient in the specific region may also lead to eutrophication indicating the pollution status of the river system. At all the stations' significant variation has been observed in the nitrogen. The mean total nitrogen in the entire river is 0.33±0.04 ppm. The highest value of Total Nitrogen is 1.42±0.68 ppm at Narora, while the least value of the nutrient was observed at 0.9±0.04 ppm at Balagarh. Although in the entire riverine system the nitrogen content was observed in the optimum range in view of fish production. The maximum variation has also been observed at Narora.

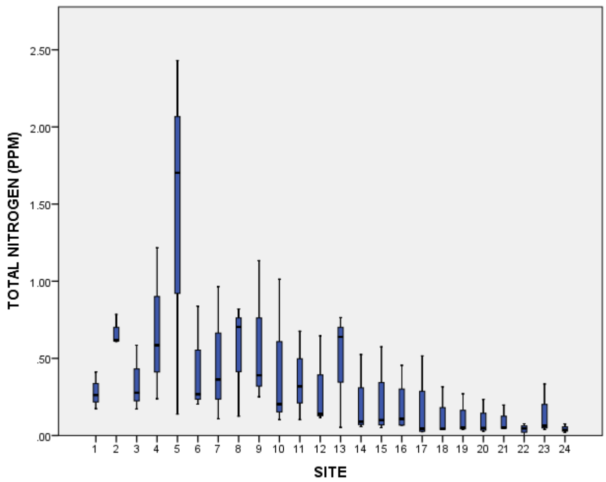


Fig. 145. Variation of Total Nitrogen across all the sampling sites

4.35.3.10. Total Phosphorus (ppm)

Like total nitrogen, total phosphorus is also an important nutrient that contributes to the productivity of the river system and its higher concentration may lead to eutrophication in the riverine system. The mean total phosphorus in the entire stretch was observed to be 0.13±0.01 ppm. The highest value was observed at 0.38±15 ppm at Prayagraj, while the lowest value was observed at 0.04±0.00 at Fraserganj. The higher concentration of the nutrient in the middle zone of the river signifies the partly eutrophic status in the riverine system.

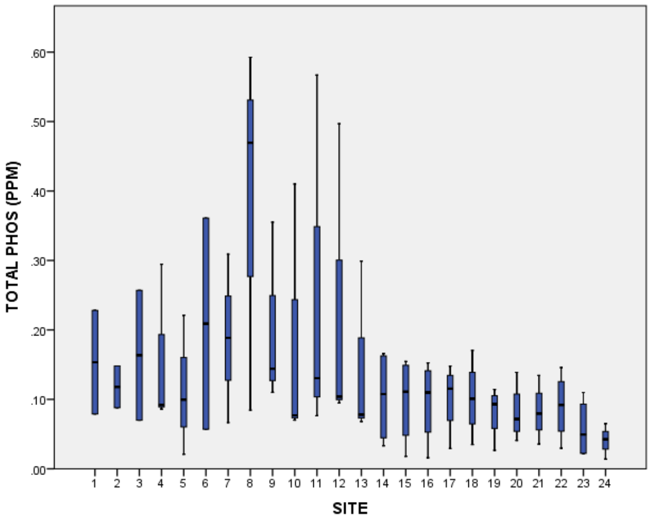


Fig. 146. Variation of Total Phosphorus across all the sampling sites

4.35.3.11. Cluster Analysis of sites based on water quality

Based on the mean water quality parameters Bray Curtis cluster analysis was performed to determine the similarity among the different sampling stations (Fig. 76). For the analysis, the paired group algorithm (UPGMA) was used. In the analysis, the cophenetic correlation was observed at 0.95, signifying the suitability of the data. In the analysis, seven major groups were formed. The impact of Bay of Bengal Diamond Harbour and Fraserganj shows a close similarity. Berhampore, Jangipur, Farakka, and Farrukabad show a similar nature of water quality, forming a separate group and showing close association with the groups Bijnor, Narora, and Haridwar. Prayagraj shows a close association with Bhagalpur and Patna due to the eutrophic nature of water quality in the region. Harshil and Tehri also formed a separate group as the region is very less affected by anthropogenic activities due to the relatively low population in the region. Buxar formed the group with Chunar, Varanasi, Mirzapur, Balia, and Ghazipur. The sampling stations in Bhagalpur and Patna show close association with Godakhali, Kanpur, Tribeni, and Balagarh.

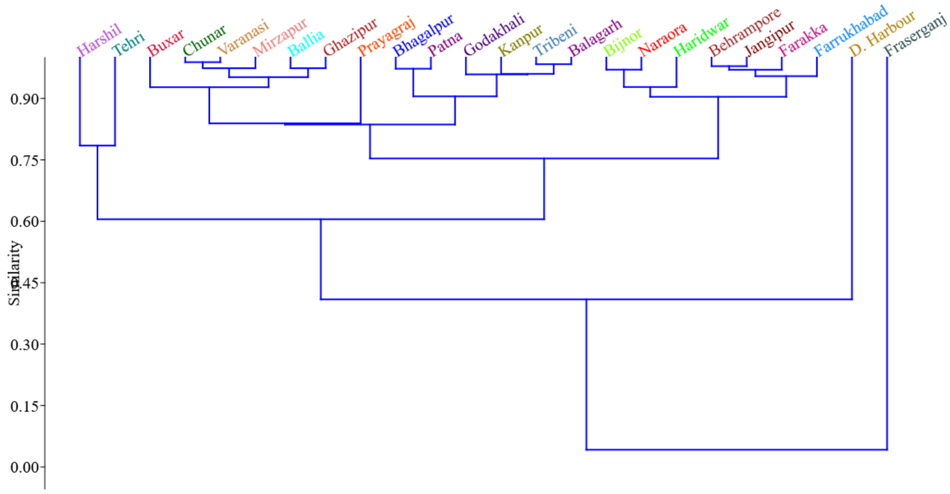


Fig. 147. Cluster analysis of the sampling sites based on different water quality parameters across all the sampling sites

4.35.3.12. Salient observations on physicochemical characteristics in the upper and middle stretch of the river

- High Available Sulphur content (compared to other sites) was noticed at Harshil during all the seasons which may be attributed due to the rocky belt as well as the confluence of hot springs emerging from the rocks at a few places.
- At Haridwar below the barrage site (Village-Ajitpur) effluent of a Gas plant directly terminates into the river Ganga which makes it polluted. Sand mining activities is also a major concerning the area.
- At Bijnor above the barrage site, Haidarpur wetland is recognized as a famous bird sanctuary. The local people of village Navalpur utilize the wetlands for farming of water chestnut (Singhara), fox nut (Makhana) etc. Utilization of several kinds of insecticides, weedicides etc. for farming. This chemical affects the life cycle of fishes, bird eggs and other aquatic animals. There is also a possibility that these chemicals drain into River Ganga.
- Results from water quality analysis show that the major pollution in river Ganga starts after Farrukhabad and it continues up to Varanasi. However, after the confluence of

several tributaries Viz. River Yamuna & tons at Praygraj, River Varuna at Varanasi, River Gomti at Ghazipur, etc. the water quality gets improved up to an extent.

- In comparison to other sites, Kanpur, Prayagraj, and Varanasi have lesser quality Ganga water. The river Ganga is significantly impacted by pollution from the River Kali at Kannauj (before Kanpur). The river Kali, as its name suggests, is dark in colour and discharges waste from the sugar, leather, and distillery industries. These industries' effluents significantly contributed to the rise in BOD and the decline in DO. The city's sewage effluent from Prayagraj significantly contributes to the Ganga's pollution. The water quality of the river Ganga is greatly degraded by the River Varuna, which it meets at Adi Kshav Ghat in Varanasi. Due to the vast amount of untreated sewage effluents present in the river Varuna, contains a significant quantity of untreated sewage effluents, giving it a dark colour.
- An increase in pH was noticed from the upper to middle stretch.
- From upper to middle stretch, phosphorus, nitrogen, silicate, BOD, and total phosphorus increase, although total nitrogen was high at Bijnor and Narora because the water was sluggish at these locations due to barrage construction.

4.36. Plankton abundance in River Ganga

4.36.1. Methodology

A total of 100 liters of plankton samples were collected from the subsurface depth of 0.5-1.0 m using a water sampler, from which one liter of the mixed representative sample was taken. A common plankton net with a mesh size of 20 µm was used for collecting phytoplankton, and a 40 µm net was used for zooplankton. Plankton samples were then collected in dry polyethylene containers using 4% buffered formalin as a preservative. The identification was done following the standard literature. For valid and updated names for the phytoplankton, Algae Base (https://www.algaebase.org/) was followed. For taxonomic identification and qualitative assessment, 0.5 ml of each mixed sample was analyzed under the microscope (20 X, 40 X, and 60 X magnification; Model No.-Zeiss scope A1). The counts were recorded in cell l^{-1}. Quantitative analysis was done by calculating the total number of plankton present by following:

$N = n \times v/V$, Where n = average density of plankton presents in 1 ml of sample, v = volume of plankton concentrated (ml), V = volume of total water filtered (litre).

4.36.2. Plankton Density and diversity

The role of plankton as ecological indicators of the environmental health of water bodies depends on the investigation of community structure, diversity, distribution, and species richness. A total of 93 genera of plankton belonging to 9 groups and 6 phyla were recorded across all stenches during the study period. The major algal groups are represented as Bacillariophyceae (26 genera), Mediophyceae (5 genera), Coscinodiscophyceae (4 genera), Noctilucophyceae (1 genus), Dinophyceae (1 genus), Xanthophyceae (3 genera), Synurophyceae (1 genus), Ulvophyceae (1 genus), Chlorophyceae (19 genera), Trebouxiophyceae (6 genera), Cyanophyceae (16 genera), Zygnematophyceae (6 genera), and Euglenophyceae (4 genera). A total of 24 genera of zooplankton belonging to 4 phyla (Rotifera, Arthropoda, Ciliophora, and Amoebozoa) were recorded during the study. Among zooplankton, Rotifera accounted for 13 genera, followed by Ciliophora (5 genera), Cladocera (3 genera), Copepoda (2 genera), and Amoebozoa (1 genera). The abundance of plankton groups ranged from 4.24 x 10^8 cells/ll to 5.38 x 10^3 cells/ll with the maximum at Bhagalpur and the minimum at Fraserganj. The abundance of phytoplankton was found to be maximum during the pre-monsoon (4.31 x 10^8 cells/ll) and minimum during the post-monsoon (2.19 x 10^6 cells/ll) season. Cyanophyceae were found to be the dominant group, followed by Coscinodiscophyceae and Bacillariophyceae. The density of zooplankton at the lower stretch ranged from 2.12 x 10^4 to 5.82 x 10^4 ind/l, i.e., minimum during pre-monsoon and maximum during monsoon. The group Copepoda contributed the highest density, followed by Rotifera.

Upper Stretch

The total plankton density varied from 4.79 x 10^4 cells/l to 1.23 x 10^5 cells/l, i.e., the minimum at Harshil and the maximum at Tehri. Among the plankton groups, Bacillariophyceae contributed the most in terms of density (65.63%), followed by Cyanophyceae (13.30%), Mediophyceae (6.49%), Coscinodiscophyceae (6.30%), and Chlorophyceae (4.76%), respectively.

Middle stretch

The abundance of plankton was found to be highest at Prayagraj (6.20 x 10^5 cells/l) and lowest at Balia (1.11 x 10^5 cells/l). The group with the group with the highest contribution among the phytoplankton groups was Bacillariophyceae (21.75%), followed by Chlorophyceae (20.32%) and Coscinodiscophyceae (17.72%). In the case of zooplankton, Copepoda accounted for the for the maximum (79.92%), followed by Rotifera (17.34%) and Protozoa (2.40%).

Lower Stretch

The plankton abundance was found to be maximum at Bhagalpur (4.24 x 10^8 cells/ll) and minimum at Godakhali (6.8 x 10^4 cells/ll). Cyanophyceae (98.28%) contributed the maximum density to the total phytoplankton density. Copepoda made the largest contribution to zooplankton density (45.96%), followed by Rotifera (42.10%).

Estuarine Stretch

Total plankton density varies from 5.38 x 10^3 cells/l to 5.49 x 10^4 cells/l, i.e., minimum at Fraserganj and maximum at Diamond Harbour. Among the phytoplankton groups, Coscinodiscophyceae contributed the most in terms of density (11.34%), followed by Zygnematophyceae (1.45%). Among Zooplankton, the highest contributing group was Rotifera (49.37%), followed by Copepoda (32.47%). The percentage contribution of plankton groups is given in Fig. 148.

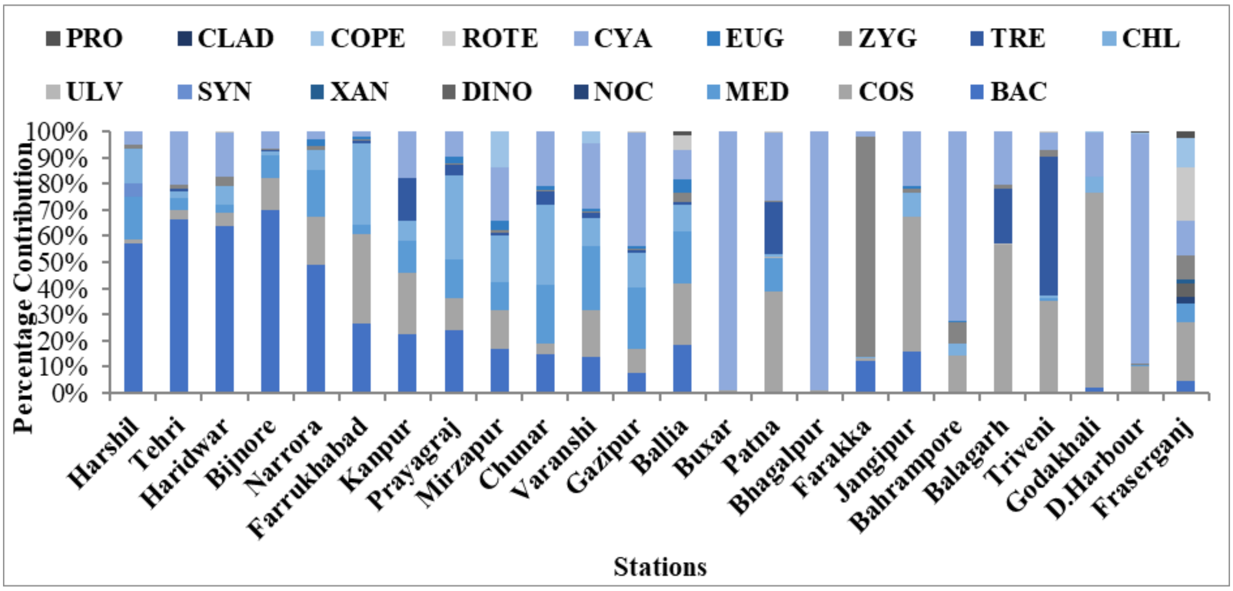


Fig. 148. Percentage (%) contribution of plankton groups in different stretches (BAC - Bacillariophyceae, COS - Coscinodiscophyceae, MED - Mediophyceae, DINO-Dinophyceae, SYN - Synurophyceae, ULV -Ulvophyceae, CHL - Chlorophyceae, TRE -Trebouxiophyceae, ZYG - Zygnematophyceae, EUG-Euglenophyceae, CYA-Cyanophyceae, ROTE – Rotifera, CLAD – Cladocera, COPE – Copepoda, PRO – Protozoa)

4.36.3. Species richness

The diversity indices of different stretches were calculated and depicted in Fig. 149. The values of Simpson (0.90, 0.24) were found to be maximum at the upper and middle stretch and minimum at the lower stretch. The Shannon_H index was found to be high at the middle stretch (2.86) and lower at the lower stretch (0.62). Evenness indices were found to be high at the upper stretch (0.39) and lowest at the lower stretch (0.02). The Margalef index (4.72) was found to be high at the lower stretch and low at the estuarine stretch (2.63). The calculated value of the Margalef index of plankton was more than 2.7 at the middle and lower stretch, depicting richness in plankton diversity. The richness of plankton was found to be high at the lower stretch (80 genera), followed by the middle (65 genera), the upper (45 genera), and the estuary stretch (30 genera).

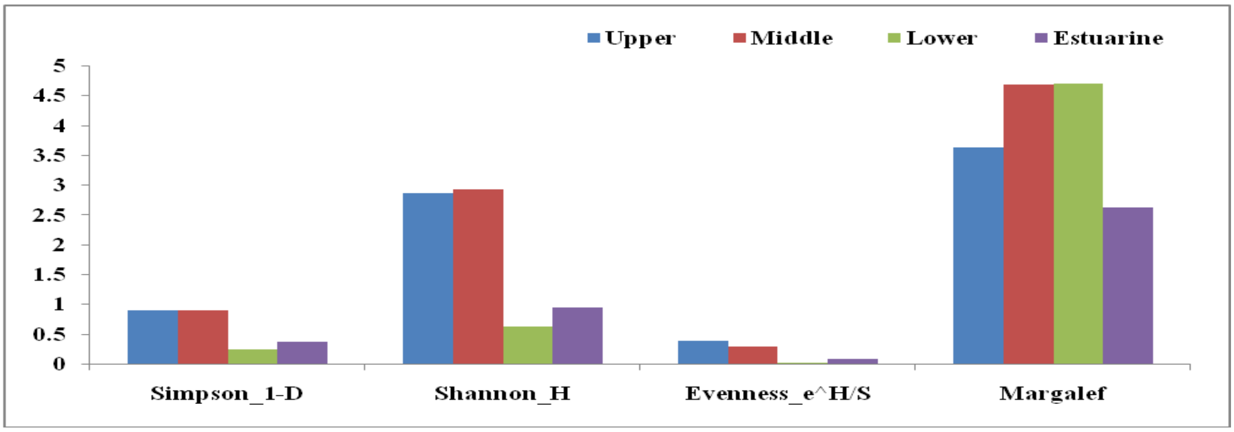


Fig. 149. Diversity indices of recorded planktonic groups across the river Ganga

4.36.4. Relation of phytoplankton with physico-chemical parameter

From Canonical correspondence Analysis (Fig. 150), it has been observed that the planktonic group Cyanophycae, Arthopoda, and Dinophycae were chiefly influenced by conductivity. The Euglinophycae, Cosinodicophycae, and, Trebouxiophyceae were negatively been influenced by the parameter conductivity. The majority of the planktons such as Amoboidae, Bacilarophycae, Rotifera, Ciliophora, Zygnematophyceae, Chlorophycae, Mediophycae, and Bacilariophycae were influenced by the water quality parameters such as Biochemical Oxygen Demand, pH, Total Chlorophyll, Velocity, Total Phosphorus, Total Nitrogen, and Dissolved Oxygen of the water.

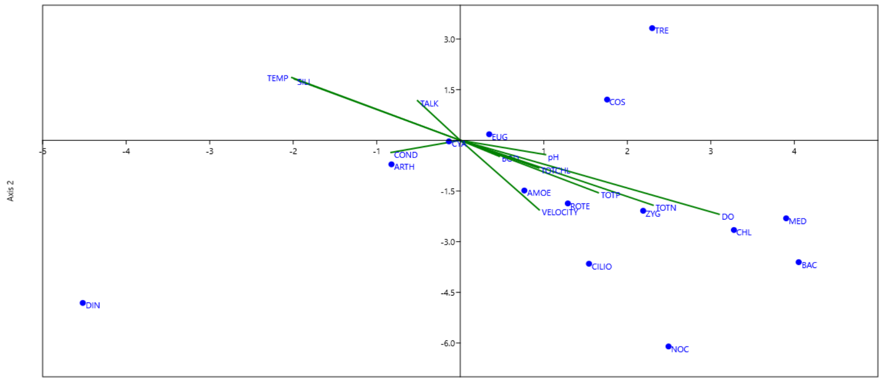


Fig. 150. CCA analysis of different plankton groups

4.36.5. Pollution indicating plankton

Out of the twenty algal genera listed as pollution indicators by Palmer (1969), all twenty genera were recorded from the river Ganga during the different seasons. API was recorded as maximum at Allahabad (38) and minimum at Harshil (18). The index value is noticed to be more than 20 at all the stations except Harshil, indicating a high organic load. The algae pollution index is given in Fig. 151.

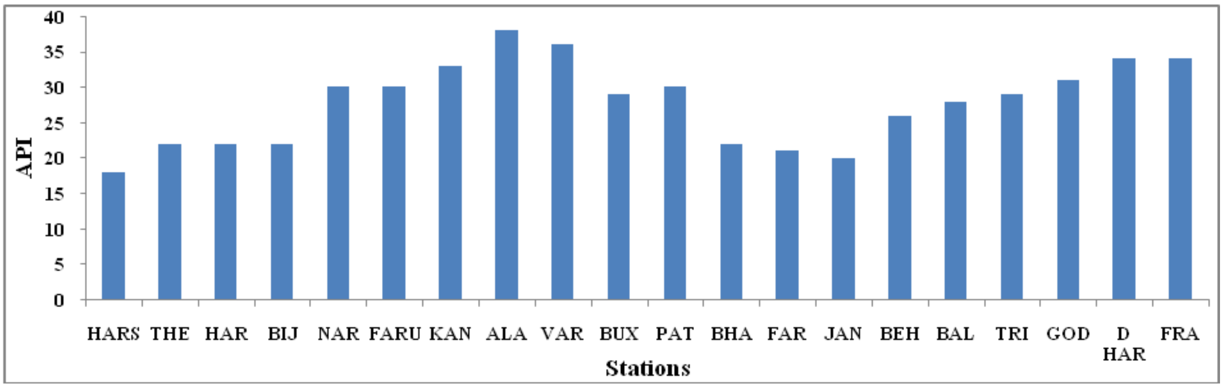
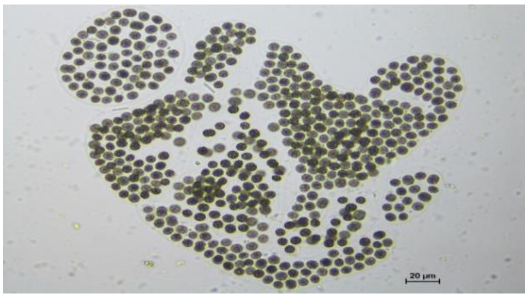
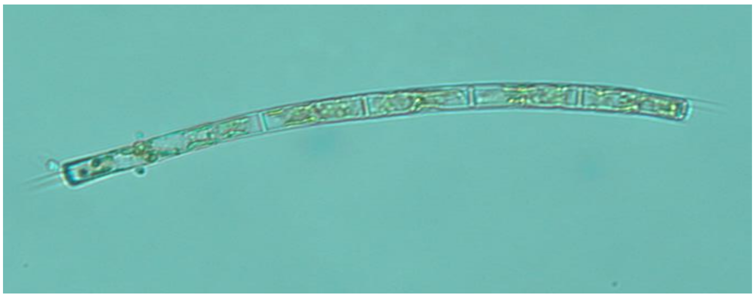


Fig. 151. Algal pollution index in different stations of river Ganga

Microcystis aeruginosa (4.22 x 10^8 cells/l) was recorded as the as the highest in the premonsoon. It is a harmful toxin-secreting species that belongs to the class Cyanophyceae. For the proliferation growth of *Microcystis* sp., ideal water temperature (32^0 °C–350 °C), specific conductivity, dissolved oxygen, and sufficient total nitrogen and phosphate were needed. Species *Aulacoseira granulata* was found to dominate the centric diatom at the middle and lower stretch. *A. granulata* signifies the deteriorated environmental condition of the riverine system, which hinders the growth and survival of the native aquatic organisms. Environmental factors such as dissolved oxygen, depth, and altitude showed a significant influence on the growth of the genera.





Microcystis aeruginosa *Aulacoseira granulata*

Fig.152. Bloom forming plankton genera in river Ganga

Fig. 153. Collection of plankton from river Ganga

4.36.6. Time scale variation in plankton community

The density of plankton varied more with time, while in terms of diversity, a little change had been noticed. According to Sinha and Khan's (2001) report, the density of plankton was lower in 1956–66 as compared to 1960 in the middle to lower stretches of the Ganga. The study was carried out by Sarkar et al. (2019) from Baranagar to Lalbag of the Ganga, and the abundance of plankton during normal conditions was 3,513 u/l and during barge movement was 1,997 u/l. Srivastava et al. (2020) documented that the density of plankton varies from 1,060 u/l to 1613 u/l in the upper stretch of the Ganga (Chinyalisaur to Rishikesh). In the years 2016–2020, the plankton density of the Ganga (Harshil to Fraserganj) ranged from 2.5 x 104 u/l to 6.57 x 10^4 u/l, while in 2021–2023, the density of plankton increased.

The Plankton community is affected by pollution and other human-induced impacts. Several pollutions induced by untreated sewage, industrial effluents, agricultural runoff, and reduced river flow from the construction’s dams and barrages and barge movement disrupt the balance of the planktonic community, affecting the entire ecology by affecting the riverine food web. So, for the same, the multidecadal comparison has been made from the previous studies on the river Ganga by several authors in Fig. 154.

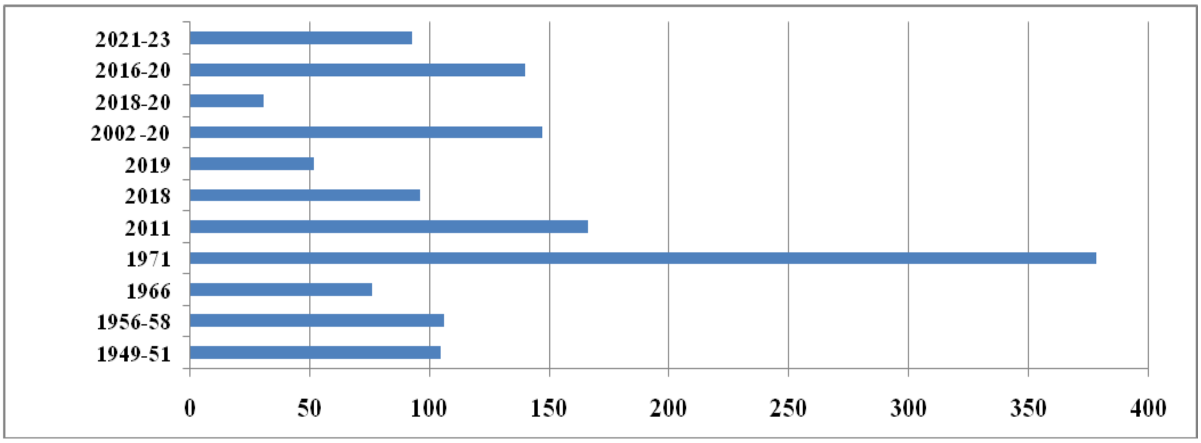
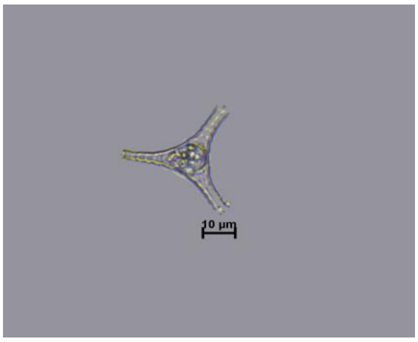


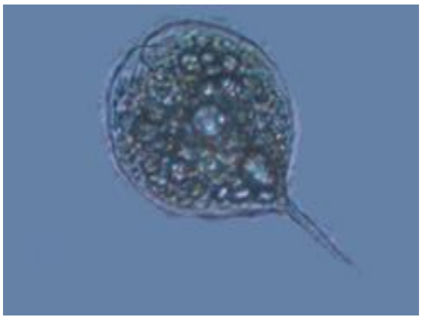
Fig. 154. Diversity of plankton during different time period (1949-2023) in river Ganga



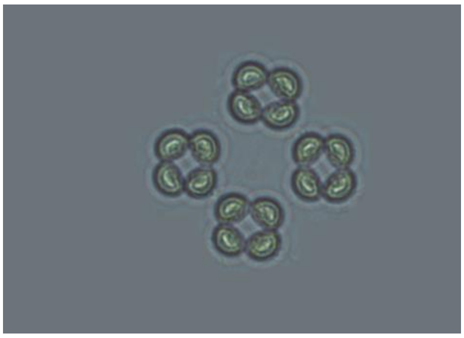
Staurastrum sp.

Cymbella sp.

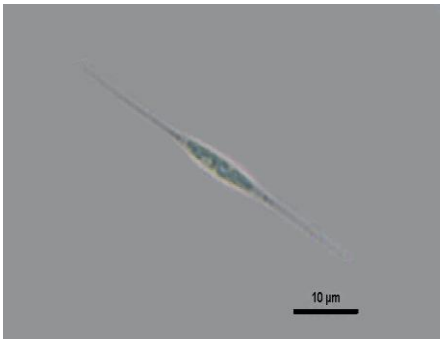
Ceratium sp.



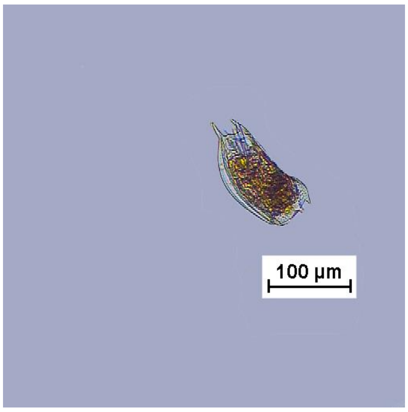
Phacus sp.



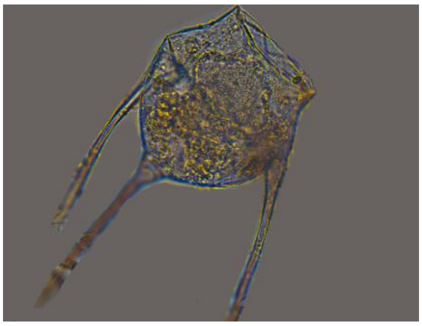
Crucigenia sp.

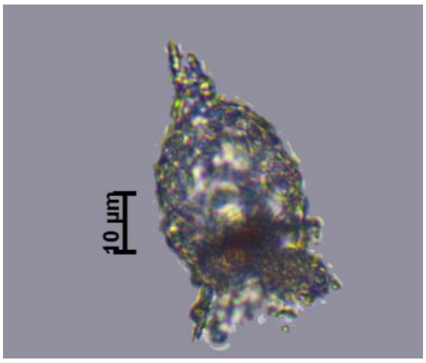


Ankistrodesmus sp.



Mytilina sp. *Trichocera* sp. *Centropyxis* sp.





Filinia sp. *Notholca* sp. Difflugia

Fig. 155. Pictures of some recorded genera of plankton from river Ganga

4.36.7. Periphyton

4.36.7.1. Methodology

For the periphyton community structure study, seasonal samples were collected from the submerged natural substrates (wooden logs and stones) at the respective stations. Periphyton mass was scraped out using a clean flat blade "scalpel" from a known area (4 x 4 cm in each spot) at three spots of the natural substrates and then combined into a single composite sample. The scrapped area was measured using a digital caliper (Mitutoyo: CD-6″ASX). Each sample was handled carefully to minimize the loss of attached organisms. The concentrated samples were transferred to small polyethylene vials and preserved in 4% buffered formalin for analysis of their diversity and abundance. The scrapped mass (periphyton) was shaken by using electrical vortex shakers (Spinix Vortex Shakers-3020) for 5 minutes to achieve the maximum number of single individuals from the periphyton matrices. The Sedgwick-Rafter counting cell (S-R Cell) was used for enumeration of periphyton by employing a trinocular light microscope (20 X, 40X, and 60X magnification; Model No.-Zeiss scope A1) and identified up to genus or species level based on the standard taxonomic identification keys. The recognized periphytic algal taxonomic names were further confirmed with Algae Base (Guiry and Guiry 2020).

4.36.7.2. Periphyton Density and diversity

Periphyton is the type of organism that gets attached to the submerged substratum and grows in the localized environment. It plays a significant role in the productivity of water bodies because the productivity of periphyton can be similar to or exceed that of phytoplankton. A total of 75 genera of phytoplankton belonging to eight groups were recorded across the sampling stations. The major algal groups are represented as Bacillariophyceae (24 genera), Mediophyceae (2 genera), Coscinodiscophyceae (2 genera), Ulvophyceae (3 genera), Chlorophyceae (16 genera), Cyanophyceae (12 genera), Zygnematophyceae (7 genera), Trebouxiophyceae (5 genera), and Euglenophyceae (4 genera). 19 genera of zooplankton belonging to 2 groups, i.e., Rotifera (1 genus) and Protozoa (9 genera), were recorded during the study period. Recorded taxa of Bacillariophyceae were *Nitzschia* sp., *Navicula* sp., *Gomphonema* sp., and *Cymbella* sp. *Cyclotella* sp., *Pinnularia* sp., etc. The group Chlorophyceae was represented by *Chlorella* sp., *Scenedesmus* sp., *Pediastrum* sp., *Ankistrodesmus* sp., *Selenastrum* sp., *Microspora* sp., etc. Cyanobacteria represented by the genera *Merismopedia* sp., *Chroococcus* sp., *Gomphosphaeria* sp., *Oscillatoria* sp., *Phormidium* sp., *Microcystis* sp., *Lyngbya* sp., *Nostoc* sp., and *Anabaena* sp., *Cosmarium* sp., *Closterium* sp., *Staurastrum* sp., *Zygnema* sp., *Mougeotia* sp., and Spirogyra sp. were found under the group Zygnematophyceae. Group Rotifera was represented by one genus each, i.e., *Brachionus* sp. Group Protozoa was represented by *Tintinids* sp., *Didinium* sp., *Stylonychia* sp., *Podophrya* sp., etc. The abundance ranged from 2.18 x $10^{4\ Ucm2}$ to 1.11 x $10^{6\ Ucm2,}$ with the maximum at Varanasi and the minimum at Jangipur. However, in the periphytic component, Bacillariophycea (52%) was the chief contributor, followed by Cyanophyceae (18%) and Chlorophyceae (12%). In the zooplankton group, Protozoa (90%) contributed the most to the total population, followed by Rotifera (10%). Total periphyton abundance was found to be maximum during postmonsoon (4.87 × 106 Ucm-2) and minimum during monsoon (2.97 × 10^6 Ucm^{-2}).

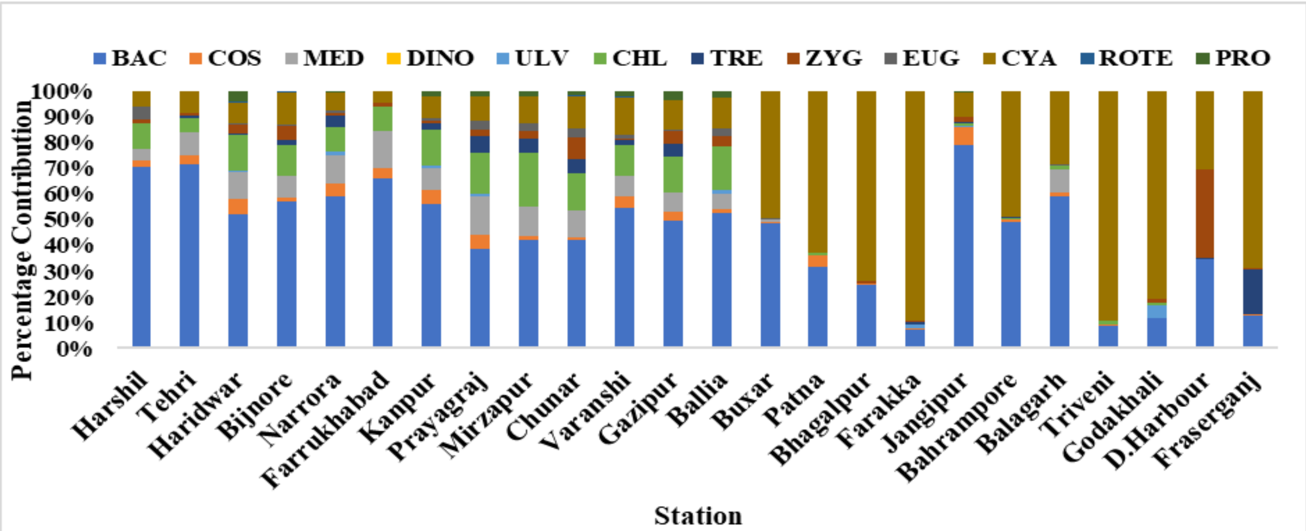


Fig. 156. Percentage (%) contribution of periphyton groups in different stretches of river Ganga

BAC - Bacillariophyceae, COS - Coscinodiscophyceae, MED - Mediophyceae, DINO-Dinophyceae, SYN - Synurophyceae, ULV -Ulvophyceae, CHL - Chlorophyceae, TRE - Trebouxiophyceae, ZYG - Zygnematophyceae, EUG-Euglenophyceae, CYA-Cyanophyceae, ROTE – Rotifera, PRO - Protozoa

4.36.7.3. Species richness

The diversity indices of different stretches were calculated and depicted in Fig. 157. The values of Simpson (0.96, 0.80) were found to have a to have a maximum at the middle stretch and a minimum at the lower stretch and etuarine stretch. The Shannon_H index was found to have a to have a maximum at the middle stretch (3.66) and a minimum at the lower stretch (1.97). Evenness indices were found to be high at the middle stretch (0.44) and lowest at the lower stretch (0.10). The Margalef index (5.68) was found to be high at the upper stretch and low at the estuarine stretch (3.78). The richness of plankton was found to be high at the lower stretch (75 genera), followed by the middle (73 genera), the upper (62 genera), and the estuary stretch (49 genera).

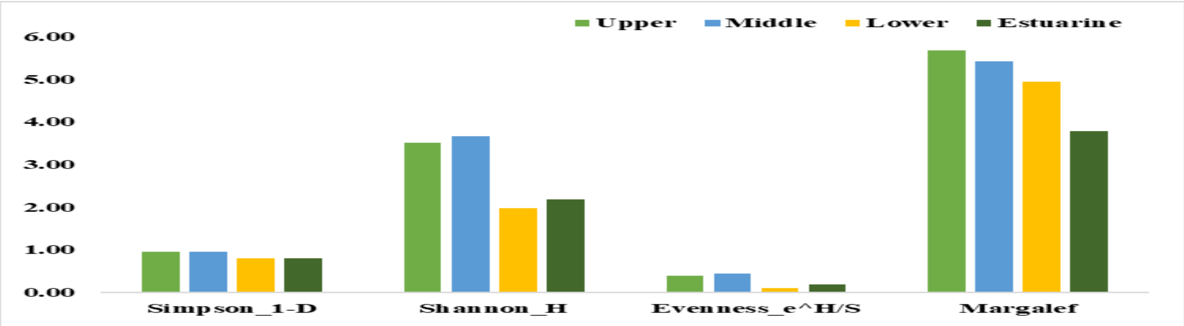


Fig. 157. Diversity indices of recorded periphyton groups across the river Ganga

Year wise changes in periphyton composition

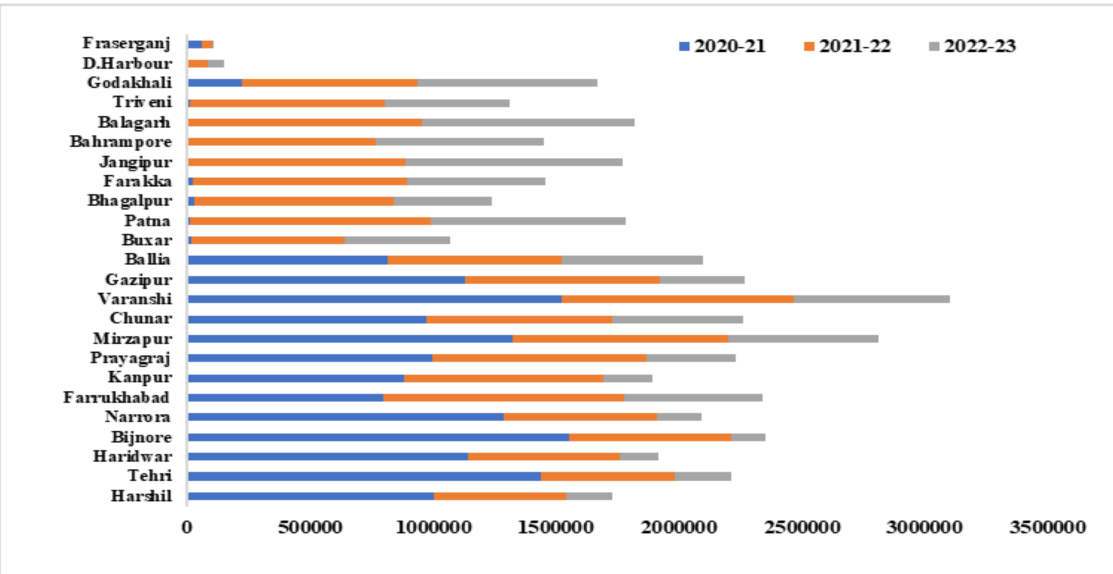


Fig. 158. Year wise changes in periphyton abundance across the river Ganga

The abundance was ranged from 1.06 X 10^7 Ucm^{-2} to 1.72 X 10^7 Ucm^{-2} with maximum during 2021-22 and minimum during 2022-23. During 2020-21 the highest density of periphyton was recorded at Bijnor (1.55 X 10^6 Ucm^{-2}). During 2021-22 the highest density of periphyton was recorded at Farrukhabad (9.78 X 10^5 Ucm^{-2}), while during 2022-23 highest abundance was noticed at Jangipur (8.82 X 10^5 Ucm^{-2}).

4.38. Diel Analysis of River Ganga

To examine the day and night hydrological and planktonic variation in the Ganga, a study was carried out in Barrackpore (nearby city of Kolkata) and Balagarh, two freshwater tidal stretches in West Bengal, during the period of November 2021 to October 2022. The findings of the Diel analysis of both water quality and microscopic plankton are represented below.

4.38.1. Water quality results

4.38.1.1 Water temperature (°C)

Fluctuation in the water temperature has been observed during the study in river Ganga at Barrackpore. In the analysis, it has been observed that the maximum average temperature was observed at 12 P.M. (28.9±0.59 °C), while the minimum was observed at 12 A.M. (26.76±0.8 °C). The mean temperature at 6 A.M and 6 P.M are 28.85±0.8 °C and 27.74±0.7 °C The higher temperature at 12 pm and the lowest at 12 am is due to earth rotation and the solar radiation causes a rise in the temperature.

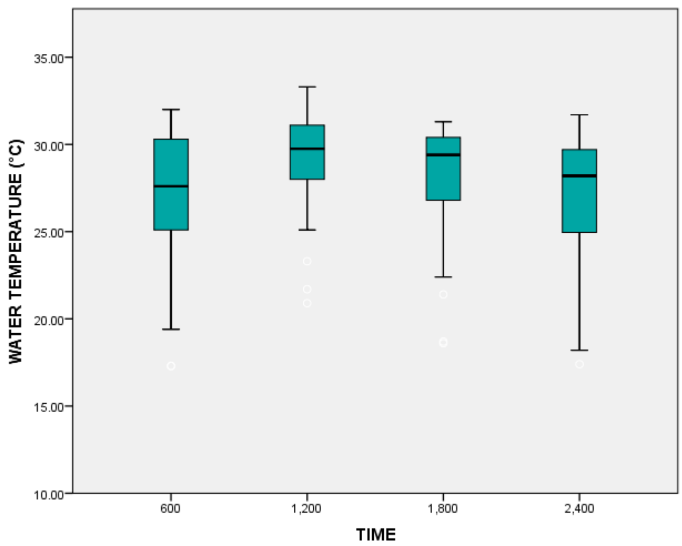


Fig. 159. Variation of temperature at the different time intervals in river Ganga at Barrackpore

4.38.1.2. Dissolved Oxygen (PPM) (DO)

During the diel analysis, the dissolved oxygen ranged between 6.3±0.20 to 6.9±0.27. The maximum DO was observed at 12 pm and the lowest was observed at 12 am Although very less fluctuation has been observed in the DO due to the flowing status of the river. The slight rise in the DO value at 12 pm is due to the presence of sunlight which helps in the amplification of the dissolved oxygen status of the river.

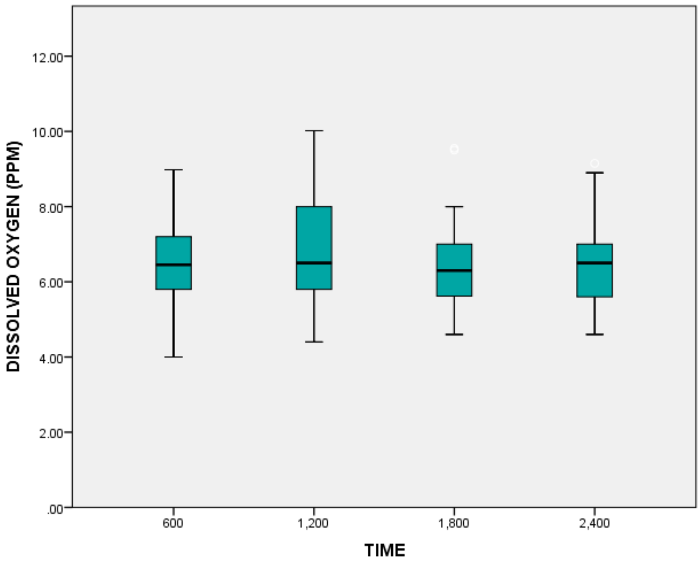


Fig. 160. Variation of Dissolved Oxygen at the different time intervals in river Ganga at Barrackpore

4.38.1.3. Water pH

During the Diel study, the mean pH value was recorded as>7, which shows the basic nature of river Ganga water quality, signifying its favorability of the river water for most aquatic organisms including fish and fisheries. The maximum mean value of pH value during the study was recorded at 6 pm (7.95±0.08), while the minimum was recorded at 6 am (7.76±0.08).

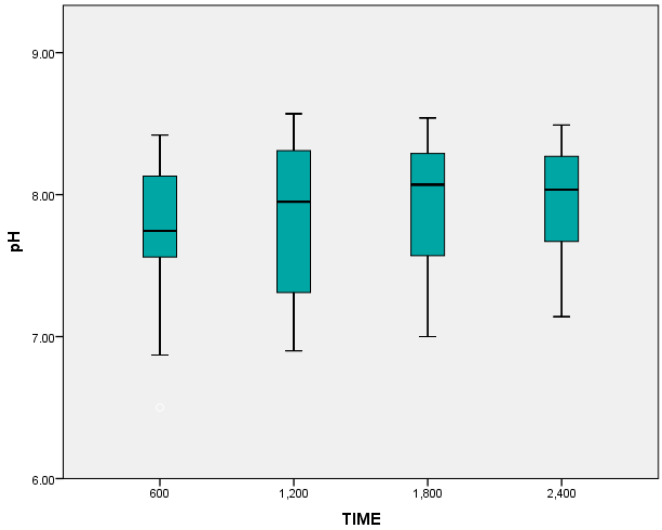


Fig. 161. Variation of pH at the different time intervals in river Ganga at Barrackpore

4.38.1.4. Total Alkalinity (ppm)

The total alkalinity in the entire stretch was within the prescribed limits of BIS2012, and the average alkalinity in the river system was observed at 121.76±3.60 ppm. The lowest mean total alkalinity was recorded at 12 am (118.56±7.0 ppm). While the maximum mean alkalinity was recorded at 12 pm (124.28±7.14 ppm). During the entire study, the maximum fluctuation in the total alkalinity was recorded at 6 pm.

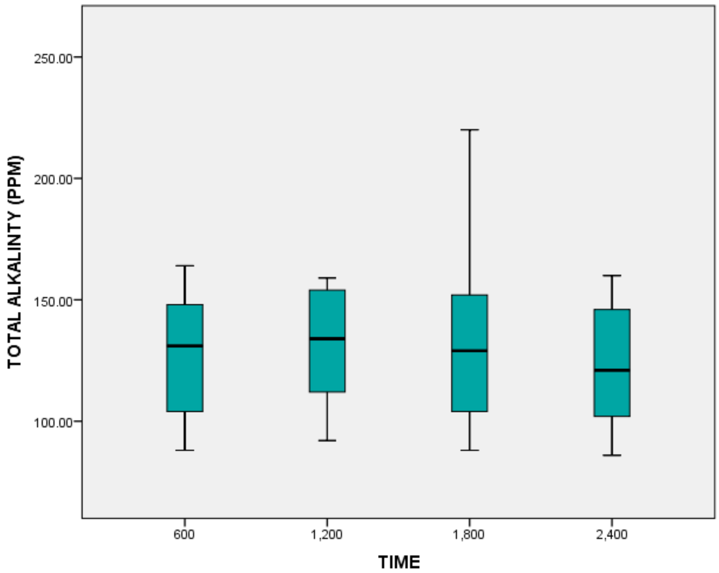


Fig. 162. Variation of total alkalinity at different time intervals in river Ganga at Barrackpore

4.38.1.5. Biochemical Oxygen Demand (ppm)

The mean BOD at all the time intervals in the river was 1.26±0.6 ppm, which signifies the less polluted status of the river water as per the standard guidelines of BIS 2012 and WHO 2011. Among the different time intervals, the highest mean BOD has been recorded at 1.50± 0.12 ppm at 12 pm, which may be due to the discharge of effluents from small-scale industries and nearby households in the Barrackpore region. The lowest mean value of BOD has been recorded at 1.13±0.11 ppm at 6 pm. The maximum variation in the BOD value was observed at midnight (12 pm).

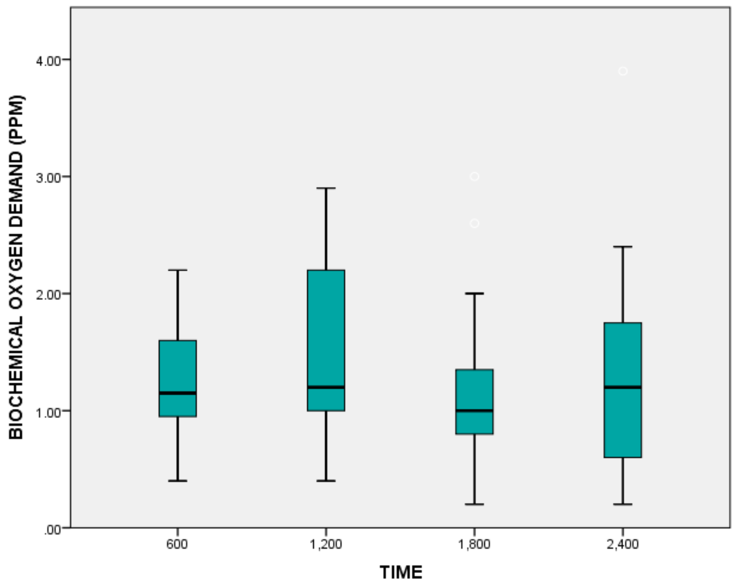


Fig. 163. Variation BOD at different time intervals in river Ganga at Barrackpore

4.38.1.6. Specific Conductivity (µS/cm)

The mean Sp. conductivity in the region was observed at 332 ±5.94 µS/cm. Among all the time intervals, the mean sp. conductivity was observed to be highest at 12 am (337.14±11.3µS/cm). The lowest Sp. conductivity was observed at 6 am, signifying a lower pollution load and the status of the river in the early morning. The maximum fluctuation in the SP. conductivity was recorded at 6 a.m.

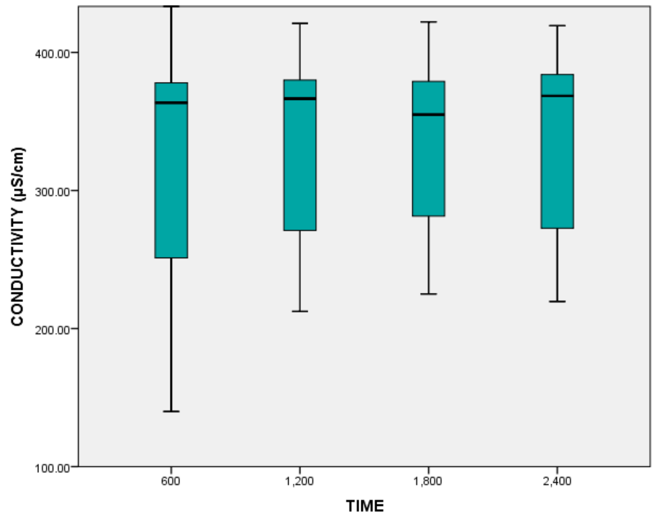


Fig. 165. Variation Specific Conductivity at the different time intervals in river Ganga at Barrackpore

4.38.1.7. Total Nitrogen (ppm)

The mean total nitrogen in the region was 0.03 ± 0.0 ppm. The highest mean value of total nitrogen was recorded at 12 a.m. (0.038±0.005 ppm), while the least value of total nitrogen was observed at 6 a.m. (0.031±0.004 ppm). The maximum fluctuation in the box plot was observed at 6 p.m. and 12 a.m. in both quartiles; however, relatively higher fluctuations were observed in the upper quartiles, signifying a higher fluctuation of nitrogen in the region, which may be due to the tidal influence in the region.

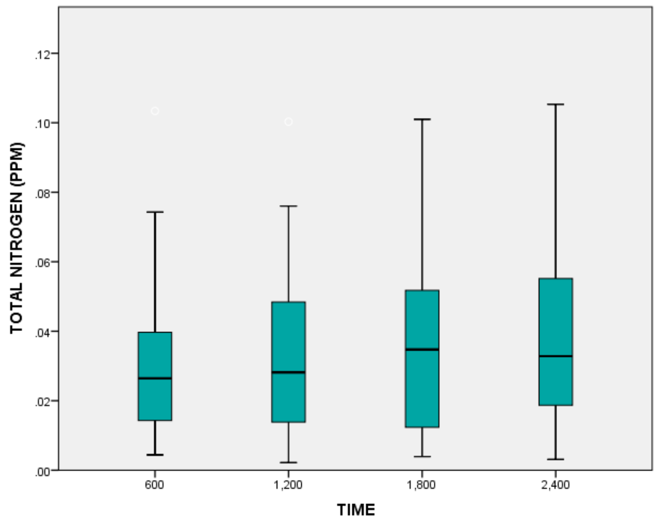


Fig. 166. Variation of Total Nitrogen in different time intervals in river Ganga at Barrackpore

4.38.1.8. Total Phosphorus (ppm)

The mean total phosphorus in the region was recorded at 0.10±0.01 ppm, signifying a lower nutrient load in the region. Among all the time intervals, the highest mean value of phosphorus was observed at 6 pm (0.113±0.01 ppm), while the lowest value was observed at 6 am (0.104±0.01).

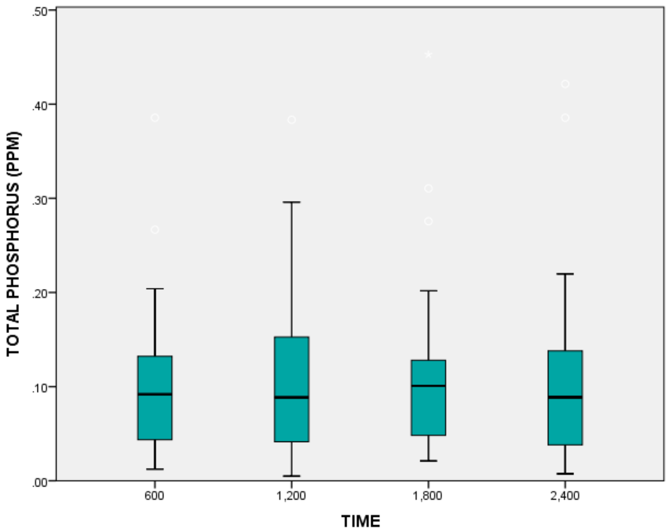


Fig. 167 Variation of total Phosphorus at the different time intervals in river Ganga at Barrackpore

4.38.2. Diel analysis of Plankton at Barrackpore

A total of 54 genera of phytoplankton belonging to 11 algal groups were recorded during the diel study. The recorded algal groups were Bacillariophyceae (14 genera), Coscinodiscophyceae (3 genera), Chlorophyceae (8 genera), Trebouxiophyceae (4 genera), Cyanophyceae (13 genera), Zygnematophyceae (5 genera), Euglenophyceae (3 genera), Mediophyceae (1 genus), Synurophyceae (1 genus), Ulvophyceae (1 genus), and Dinophyceae (1 genus). Among the eleven algal groups, Coscinodiscophyceae (59%) contributed the most in terms of density, followed by Cyanophyceae (29%), and Bacillariophyceae (3%). *Aulacoseira granulata* was found to be dominant in the water body. The study revealed that the highest phytoplankton density was observed at 12 pm at midnight (2.8307 x 10^4 cells/L), followed by 12 am (1.4971 x 10^4 cells/L), 6 am (1.0632 x 10^4 cells/L), and 6 p.m. (1.0490 x 10^4 cells/L). The percentage contribution of different algal groups during different time intervals is given in Fig. 91.

A total of 20 genera of zooplankton belonging to 4 phyla (Rotifera, Arthropoda, Ciliophora, and Amoebozoa) were recorded during the diel study. The zooplankton groups were Rotifera

(8 genera), Copepoda (3 genera), Cladocera (2 genera), Amoebozoa (2 genera), and Ciliophora (5 genera). Group Copepoda contributed the most in terms of density (39%), followed by Rotifera (32%), Ciliophora (20%), Cladocera (5%), and Amoebozoa (4%). Among zooplankton, the genus *Keratella* sp. was found to be dominant in the zooplankton population. The study revealed that the highest zooplankton density was observed at 6 a.m. (8.04 x 10^2 ind. l^{-1}), followed by 12 pm (3.32 x 10^2 ind. l^{-1}), 12 am (1.84 x 10^2 ind. l^{-1}), and 6 pm (1.56 x 10^2 ind. l^{-1}).

4.38.3. Study findings of Diel Analysis at Balagarh, West Bengal

4.38.3.1. Water quality results

The sampling site Balagarh is the river's freshwater zone. No major industries are in the nearby vicinity which can impact the water quality status of the river system. The river stretch has slight influence using chemical fertilizers from the farmland. The recorded significant physicochemical parameters of the stretch and the diel variation are as follows:

4.38.3.2. Water temperature (°C)

The recorded average water temperature in the stretch was 23.32±0.77 °C. The highest mean water temperature of 25.48±1.59 °C was recorded at 12 pm, and the lowest recorded mean water temperature was observed at 21.95±1.59 °C at 6 am. However, no significant variation in the water temperature has been observed between different time intervals. But the box-plot analysis reveals that, among all times, the upper quartile has the maximum variation.

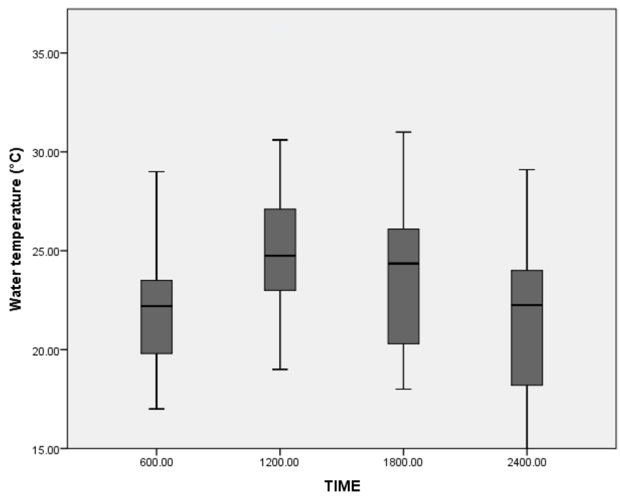


Fig. 168. Variation in the diel water temperature (°C) in river Ganga at Balagarh

4.38.3.3. Dissolved Oxygen (PPM) (DO): -

As dissolved oxygen plays a significant role in riverine ecology and is consumed by most aquatic organisms, The stretch has a mean DO value of 7.17 ± 0.22 ppm. The highest mean DO was recorded at 7.20±0.29 ppm, and the lowest DO value was observed at 6.76±0.35 ppm. The relatively higher variation in the DO was recorded at midnight (12 pm), and the lowest variation has been observed at 6 a.m. and 12 am.

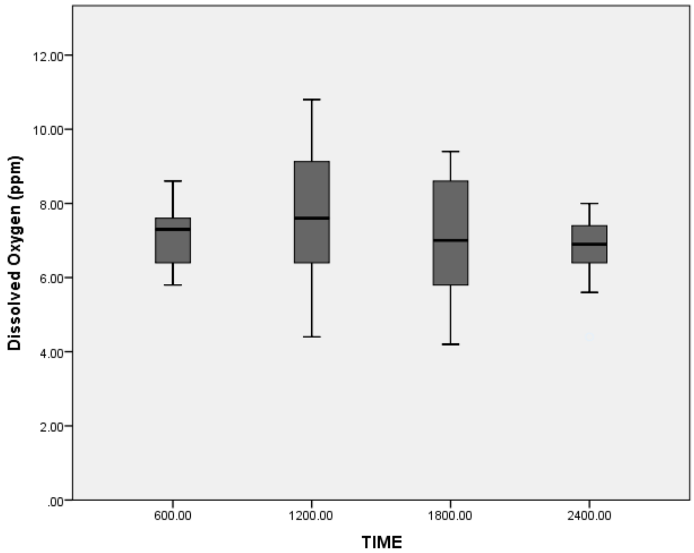


Fig. 169. Variation in the diel Dissolved Oxygen (ppm) at Balagarh

4.38.3.4. Specific conductivity (μS/cm)

Specific conductivity is the pollution-indicating parameter. No such significant variation was observed during the study. The mean conductivity in the stretch was found to be 371.93±1.91 μS/cm. The lowest mean conductivity was recorded to be 369.10±2.99μS/cm at 6 am, while the highest mean conductivity was recorded at 12 pm. The maximum variation has been recorded at 6 pm, while the lowest variation in conductivity was recorded at 12 am.

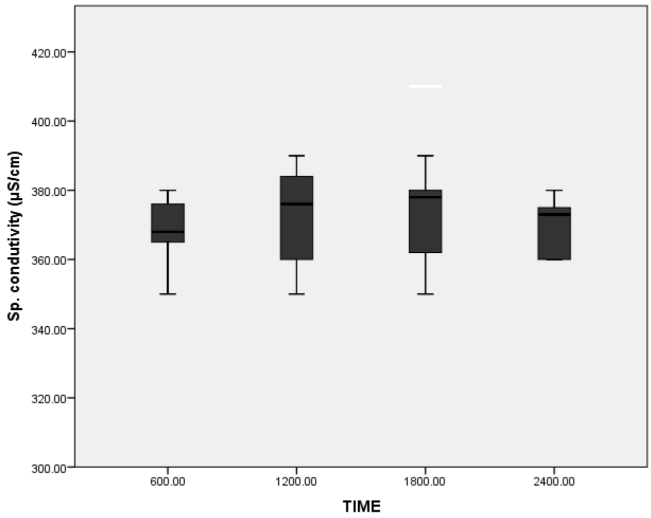


Fig. 170. Variation in the Specific conductivity (µS/cm) at Balagarh

4.38.3.5. Water pH

pH helps in the regulation of acidity and the basicity of riverine water. During the entire study, the river shows the basic nature of pH, which is suitable for aquatic life. The river water has no significant variation at any time interval. During the study, the mean pH value of the river water in the stretch was recorded to be 8.46±0.02. The highest mean pH value was recorded at 8.51±0.60, while the lowest pH value was observed to be 8.40±0.40 at 12 am. The maximum variation has been observed in the lower quartile at all the time intervals.

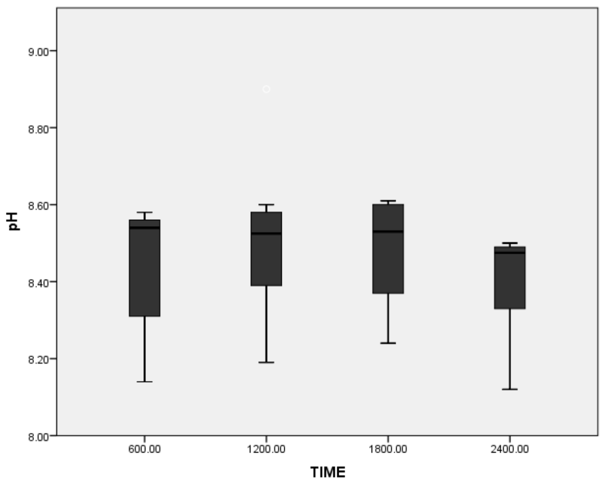


Fig. 171. Diel variation of pH at Balagarh

4.38.3.6. Total Alkalinity (ppm)

The average total alkalinity in the stretch was recorded to be135.58±5.04 ppm. The lowest total alkalinity was recorded at 131.40±11.46 ppm. The highest total alkalinity was recorded at 137.60±11.36 ppm. The maximum variation in the total alkalinity was recorded during 12 PM and 6 pm at 6 pm. The maximum variation in the upper quartile and lower quartile was recorded at 6 pm.

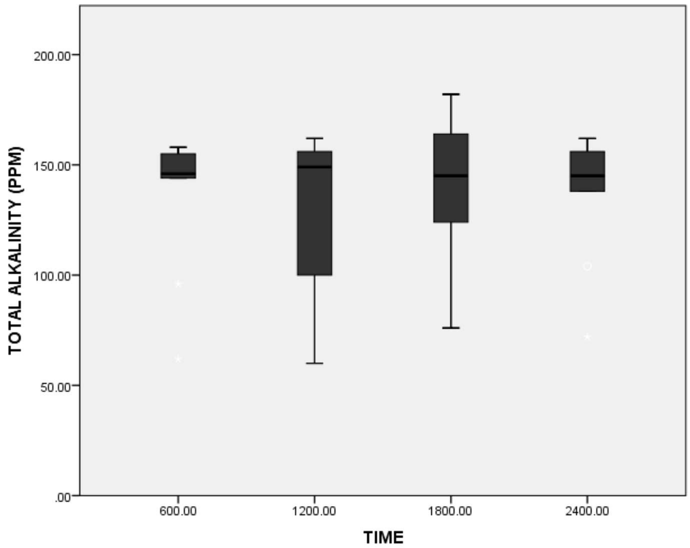


Fig. 172 Diel variation of Total Alkalinity recorded at Balagarh

4.38.3.7. Total Hardness (ppm)

The mean total hardness in the riverine water was recorded to be 143.60±2.98 ppm. The lowest mean total hardness in the entire stretch was 139.30±8.90 ppm at 6 pm, while the highest total hardness was recorded at 148.20±2.88 at 6 am. The Maximum variation in the total hardness was recorded at 12 pm and 6 pm.

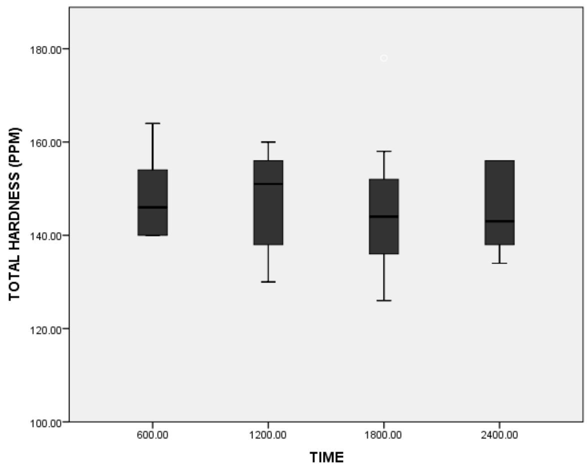


Fig. 173. Diel variation of Total Hardness recorded at Balagarh

4.38.3.8. Total Phosphorus (ppm)

Total phosphorus is the essential nutrient that essentially contributes to the productivity status of the riverine system. In the present study, the mean total phosphorus in the studied stretch is 0.22±0.03 ppm signifying the non-eutrophic zone of the river. The highest mean total phosphorus was 0.266 ppm recorded at 6 am, while the minimum total phosphorus was recorded at 0.15±0.02 ppm at 12 pm. However, the maximum variation in the total phosphorus was also recorded at 6 am and 12 am.

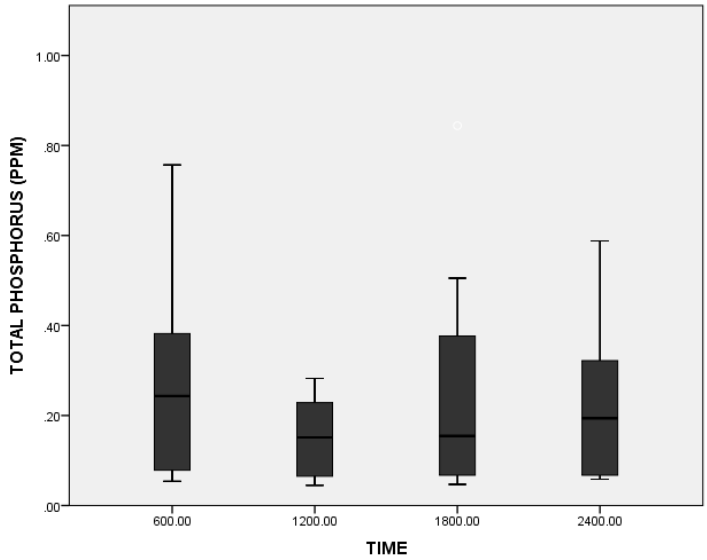


Fig. 174. Diel variation of Total Phosphorus recorded at Balagarh

4.38.3.9. Biochemical Oxygen Demand (ppm) (BOD)

The BOD is the important pollution-indicating parameter actively responsible for the monitoring of the riverine ecosystem. The present study reveals that among all the sampling times, the mean BOD was 0.99±0.08 ppm. The highest BOD was recorded at 12 pm while the lowest BOD was recorded at 0.70±0.18 ppm.

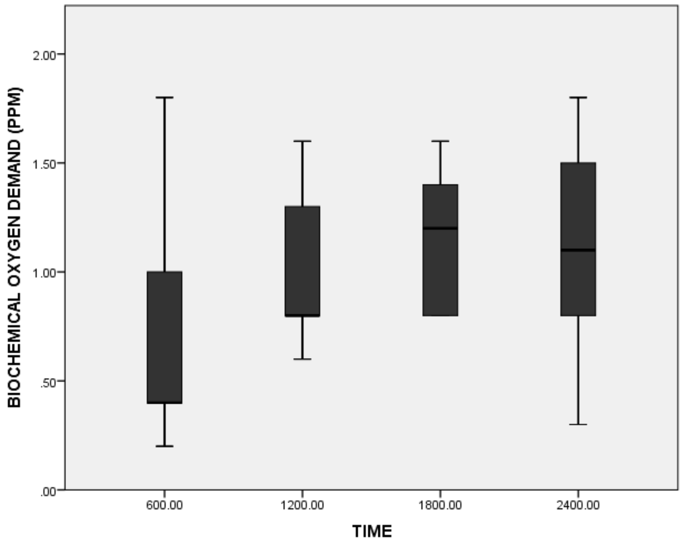


Fig. 175. Diel variation of BOD recorded at Balagarh

4.38.4. Diel Analysis of plankton at Balagarh

A total of 41 genera of phytoplankton belonging to 9 algal groups were recorded during the diel study at Balagarh. The recorded algal groups were Bacillariophyceae (14 genera), Coscinodiscophyceae (2 genera), Chlorophyceae (5 genera), Trebouxiophyceae (5 genera), Cyanophyceae (7 genera), Zygnematophyceae (5 genera), Euglenophyceae (1 genus), Mediophyceae (1 genus), and Xanthophyceae (1 genus). Among the eleven algal groups, Cyanophyceae (56 %) contributed maximum terms of density followed by Coscinodiscophyceae (34%), and Bacillariophyceae (7%). The study revealed the highest phytoplankton density was observed at 6 pm (2.04074 x 105 cells), followed by 12 am (1.02590 x 10^5 cells), 12 pm (7.6602 x 10^4 cells), and 6 am (7.2732 x 10^4 cells). The percentage contribution of different algal groups during different time intervals is given in Fig. 99.

A total of 15 genera of zooplankton belonging to 4 phyla (Rotifera, Copepoda, Cladocera, and Ciliophora) were recorded during the diel study. The zooplankton groups were Rotifera (6 genera), Copepoda (3 genera), Cladocera (4 genera), and Ciliophora (2 genera). Group Rotifera contributed the most in terms of density (39%), followed by Copepoda (41%), and Cladocera (4%). Among zooplankton, the genus *Keratella* sp. was found to be dominant in the zooplankton population. The study revealed that the highest zooplankton density was observed at 6 a.m. (5.84 x 10^3 indl^{-1}), followed by 12 a.m. (1.742 x 10^3 indl^{-1}), 6 pm (1.036 x 10^3 indl^{-1}), and 12 pm (4.36 x 10^2 indl^{-1}). The percentage contribution of different Zooplankton groups during different time intervals is given in Fig. 100.

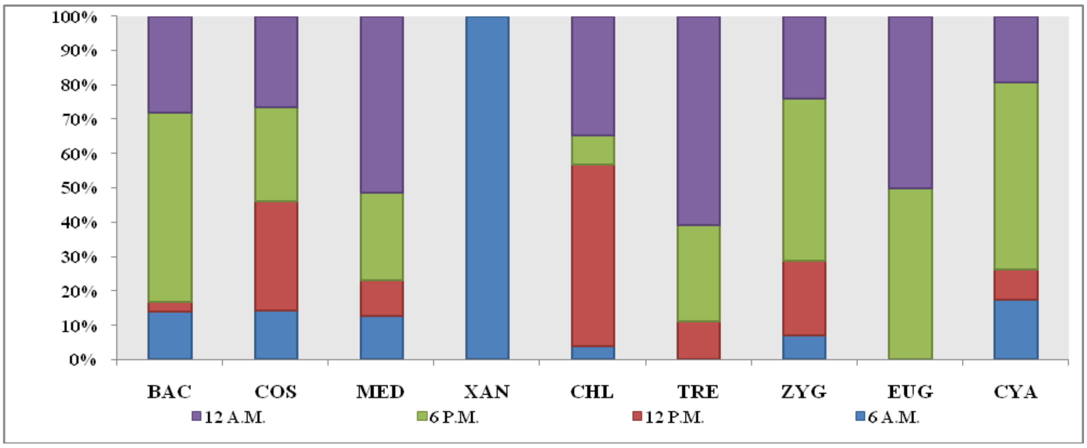


Fig. 176 Time phase diversity indices of phytoplankton (group %) collected during diel sampling at Balagarh (BAC - Bacillariophyceae, COS - Coscinodiscophyceae, MED - Mediophyceae, XAN-Xanthophyceae, CHL - Chlorophyceae, TRE -Trebouxiophyceae, ZYG - Zygnematophyceae, EUG-Euglenophyceae, CYA-Cyanophyceae)

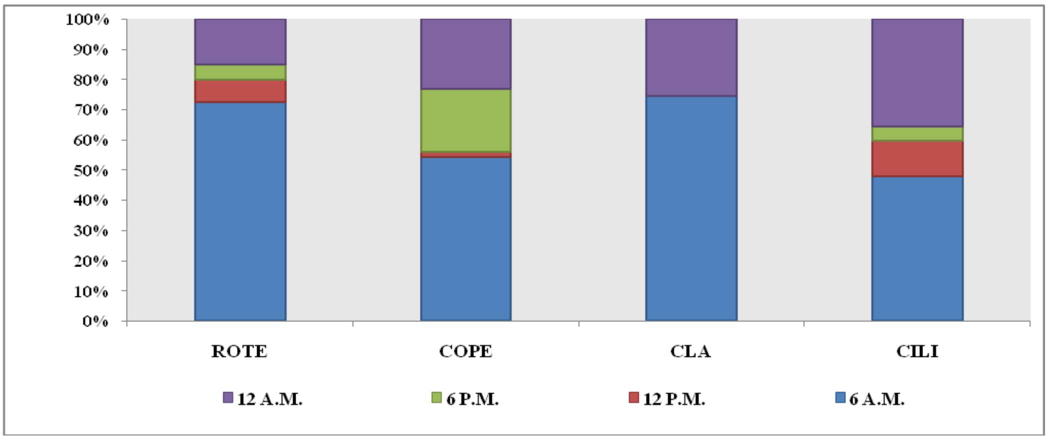


Fig. 177. Time phase diversity indices of zooplankton (group %) collected during diel sampling at Balagarh (Rot-Rotifera, Arth- Arthropoda, Cilio- Ciliophora, Amoe – Amoebazoa)

Diversity indices Simpson (0.68) and Shannon (1.55) of phytoplankton were found to be maximum at 12 am, while the Margalef index (2.14) value was noticed to be maximum at 6 a.m. The minimum values of all indices were noticed at 12 pm. The richness of phytoplankton was found to be high at 6 a.m. and 12 am (25 genera), followed by 6 p.m. (22 genera), and 12 pm (17 genera). Simpson (0.77), Shannon (1.76), and Margalef (1.38) indices of zooplankton were found high at 6 am, whereas the values were found low at 6 pm. The richness of zooplankton was found to be high at 6 am (13 genera), followed by 12 a.m. (9 genera), 12 pm (6 genera), and 6 a.m. (5 genera). The diversity indices of phytoplankton and zooplankton are given in Figs. 178 and 179, respectively.

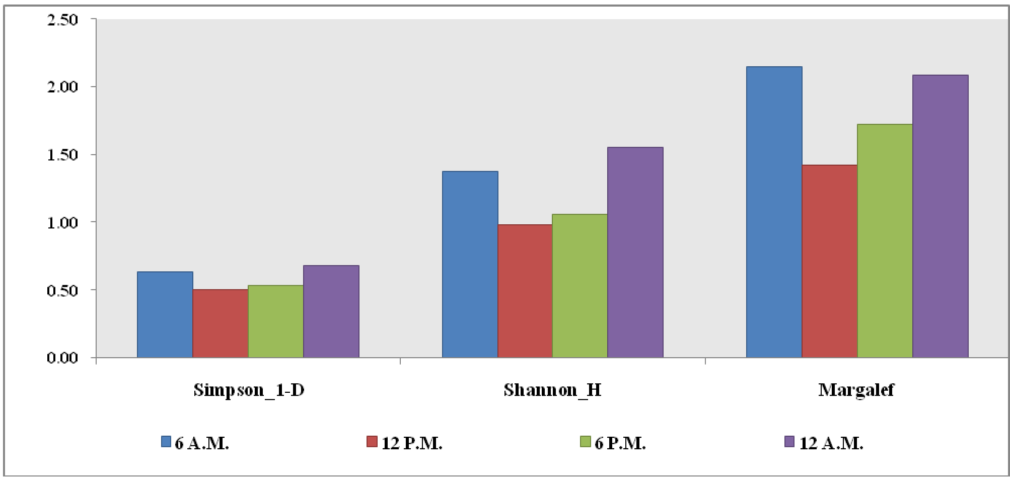


Fig. 178. Time phase diversity indices of phytoplankton during diel sampling at Balagarh

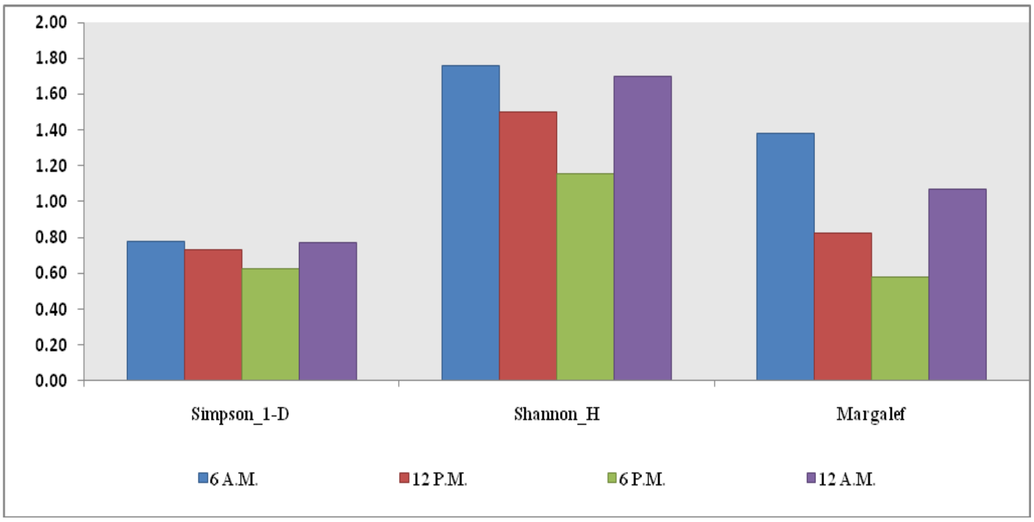


Fig. 179. Time phase diversity indices of zooplankton during diel sampling at Balagarh

4.38.5. Diel analysis (Barrackpore)

A total of 54 genera of phytoplankton belonging to 11 algal groups were recorded during the diel study. The recorded algal groups were Bacillariophyceae (14 genera), Coscinodiscophyceae (3 genera), Chlorophyceae (8 genera), Trebouxiophyceae (4 genera), Cyanophyceae (13 genera), Zygnematophyceae (5 genera), Euglenophyceae (3 genera), Mediophyceae (1 genus), Synurophyceae (1 genus), Ulvophyceae (1 genus), and Dinophyceae (1 genus). Among the eleven algal groups, Coscinodiscophyceae (59%) contributed the most in terms of density, followed by Cyanophyceae (29%), and Bacillariophyceae (3%). *Aulacoseira granulata* was found to be dominant in the water body. The study revealed that the highest phytoplankton density was observed at 12 pm (2.8307×10^4 cells/l), followed by 12 am (1.4971×10^4 cells/l), 6 am (1.0632×10^4 cells/l), and 6 p.m. (1.0490×10^4 cells/l). The percentage contribution of different algal groups during different time intervals is given in Fig. 180. A total of 20 genera of zooplankton belonging to 4 phyla (Rotifera, Arthropoda, Ciliophora, and Amoebozoa) were recorded during the diel study. The zooplankton groups were Rotifera (8 genera), Copepoda (3 genera), Cladocera (2 genera), Amoebozoa (2 genera), and Ciliophora (5 genera). Group Copepoda contributed the most in terms of density (39%), followed by Rotifera (32%), Ciliophora (20%), Cladocera (5%), and Amoebozoa (4%). Among zooplankton, the genus *Keratella* sp. was found to be dominant in the population. The study revealed that the highest zooplankton density was observed at 6 a.m. (8.04×10^2 ind. l^{-1}), followed by 12 pm (3.32×10^2 ind. l^{-1}), 12 am (1.84×10^2 ind. l^{-1}), and 6 p.m. (1.56×10^2 ind. l^{-1}). The percentage contribution of different Zooplankton groups during different time intervals is given in Fig. 181.

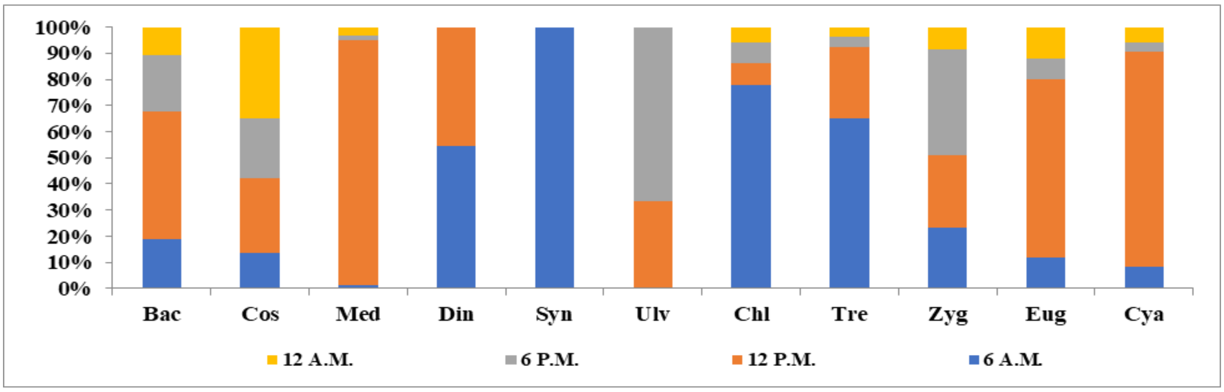


Fig. 180. Time phase diversity indices of phytoplankton (group %) during diel sampling at Barrackpore

Bac - Bacillariophyceae, Cos - Coscinodiscophyceae, Med - Mediophyceae, Din- Dinophyceae,Syn - Synurophyceae, Ulv -Ulvophyceae, Chl - Chlorophyceae, Tre - Trebouxiophyceae, Zyg - Zygnematophyceae, Eug-Euglenophyceae, Cya – Cyanophyceae

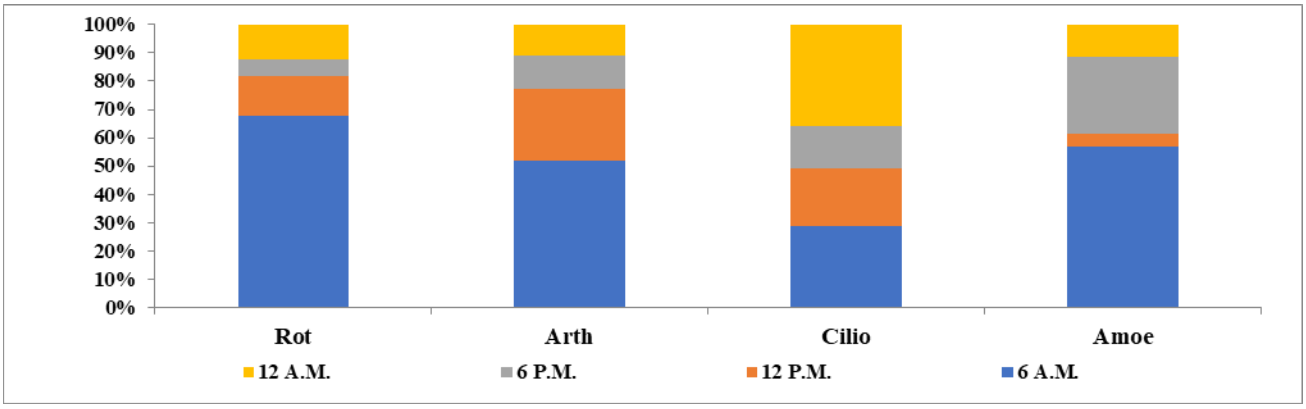


Fig.181. Time phase diversity indices of zooplankton (group %) during diel sampling at Barrackpore (Rot-Rotifera, Arth- Arthropoda, Cilio- Ciliophora, Amoe –Amoebazoa)

4.38.5.1. Diversity indices

The Simpson (0.72), Shannon (1.71), and margalef indices (4.10) of phytoplankton were found to be maximum at 6 am, whereas the minimum value was noticed at 12 am. The calculated value of the Margalef index of plankton was found to be greater than 3, indicating a richness in phytoplankton diversity. The richness of phytoplankton was found to be high at 6 a.m. (39 genera), followed by 12 pm and 6 p.m. (37 genera), and 12 am (34 genera). The Simpson (0.82) and Shannon (1.98) indices of zooplankton were found high at 12 am, while the Margalef (3.0) index was found high at 6 pm. The Shannon (1.34) and Margalef (1.95) indices were found low at 6 am, while Simpson (0.69) was found low at 12 pm. The richness of zoo-plankton was found to be high at 6 pm (16 genera), followed by 12 pm, 12 am, and 6 am (14 genera). The diversity indices of phytoplankton and zooplankton are given in Figs. 182 and 183, respectively.

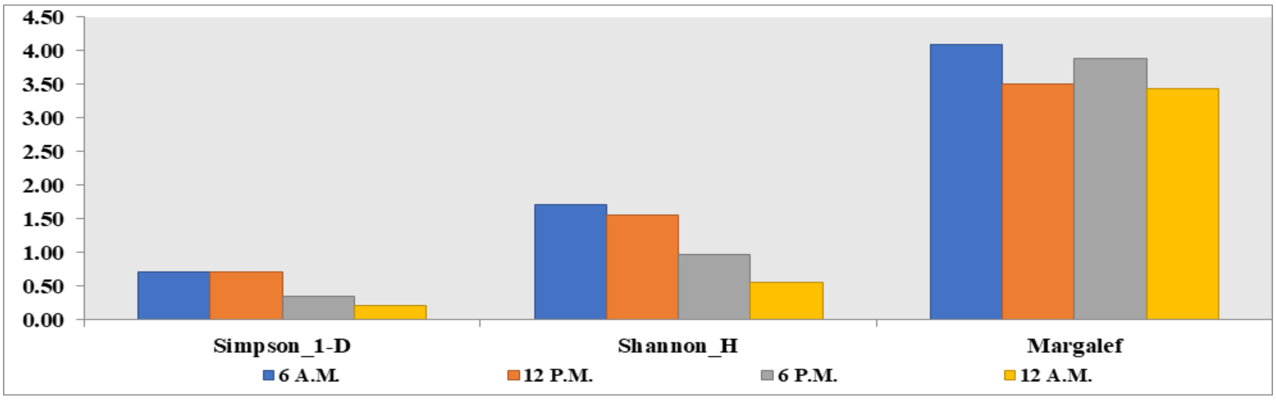


Fig. 182. Time phase diversity indices of phytoplankton collected during diel sampling at Barrackpore

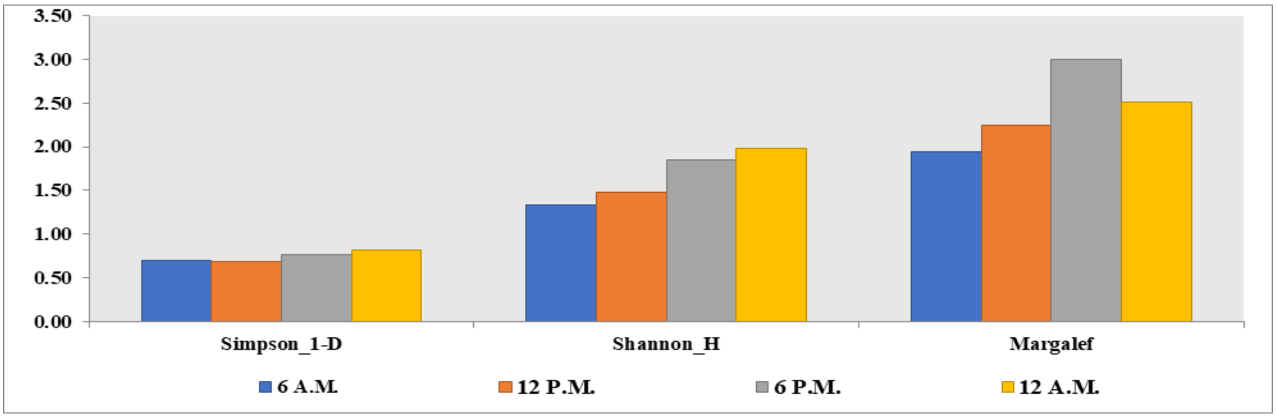


Fig. 183. Time phase diversity indices of zooplankton collected during diel sampling at Barrackpore

4.38.6. Diel analysis at Tehri

A total of 67 genera of plankton belonging to 12 algal groups were recorded during the diel study at Tehri. The recorded algal groups were Bacillariophyceae (11 genera), Coscinodiscophyceae (2 genera), Mediophyceae (2 genera), Xanthophyceae (1 genus), Ulvophyceae (1 genus), Chlorophyceae (19 genera), Trebouxiophyceae (6 genera), Cyanophyceae (12 genera), Zygnematophyceae (6 genera), and Euglenophyceae (2 genera). Among the eleven algal groups, Bacillariophyceae (9.38 x $10^{5\ \text{cells/L)}}$ contributed the most in terms of density, followed by Mediophyceae (6.42 x 10^5 cells/L$^{)}$ and Chlorophyceae (2.85 x 10^5 cells/L$^{).}$ The study revealed that the highest phytoplankton density was observed at 6 pm (3.33 x 10^5 cells/L), followed by 12 pm (3.01 x 10^5 cells/L), 12 am (2.47 x 10^5 cells/L), and 6 a.m. (2.20 x 10 ^{5} cells/L). The recorded zooplankton groups were Rotifera (3 genera) and Ciliophora (2 genera). Group Rotifera contributed the most in terms of density (4.80 x 10^{-3} cells/L), followed by Ciliophora (600). The study revealed that the highest zooplankton density was observed at 12 p.m. (2.8 x 10^3 ind./l), followed by 6 a.m. (2.0 x 10^3 ind./l), and 6 p.m. (6.0 x 10^2 ind./l), respectively. The percentage contribution of different plankton groups during different time intervals is given in Fig. 184.

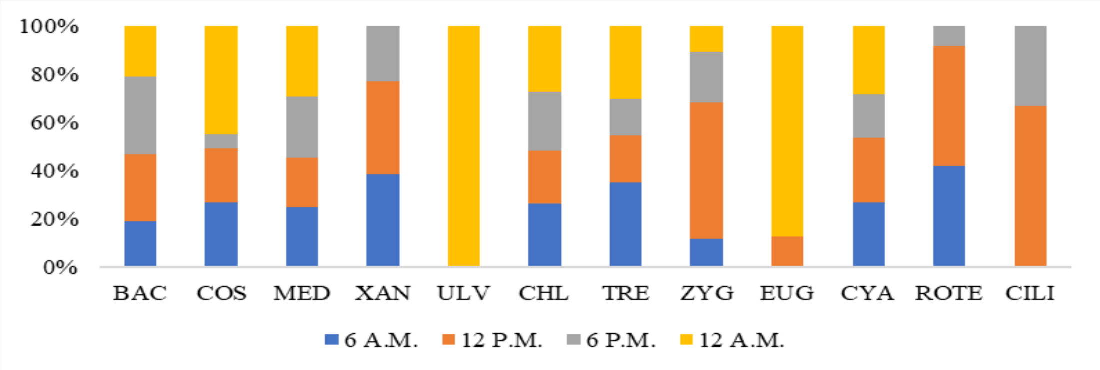


Fig. 184. Time phase diversity indices of phytoplankton (group %) diel sampling at Tehri

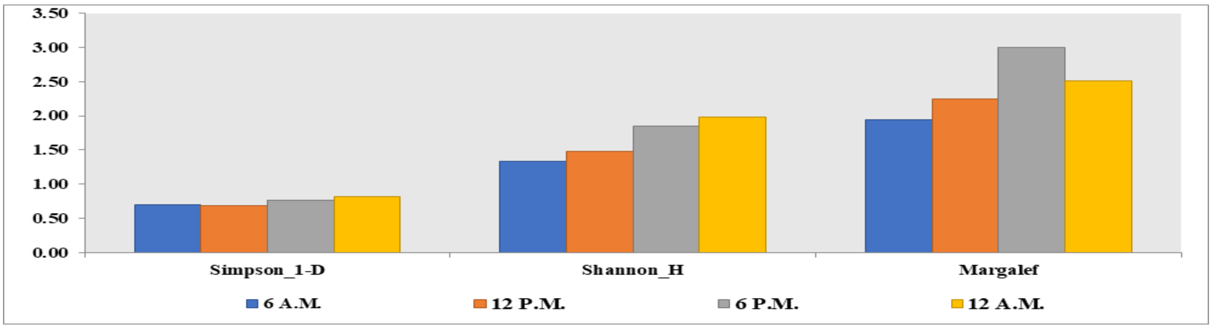


Fig. 185. Diversity indices of phytoplankton during diel sampling at Tehri

4.38.6.1. Diversity indices

The Simpson index was found to be maximum at 12 am and 6 am (0.45) while the minimum value was noticed (0.34) at 6 pm. The Shannon index was recorded at its maximum at 12 am and 6 am (1.27), while the minimum value was noticed (0.95) at 6 pm. Similarly, the Margalef index was recorded at its maximum at 6 pm (2.75) and minimum at 6 am (2.36). The diversity was found to be high at 6 pm (36 genera), followed by 12 pm (34 genera), and 12 am (33 genera), respectively. The diversity indices of phytoplankton are given in Fig. 186.

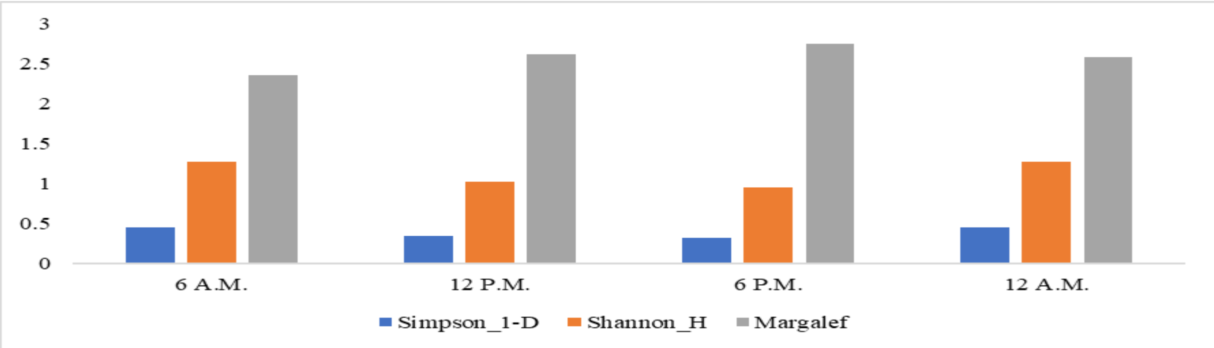


Fig. 186. Time phase diversity indices of phytoplankton collected during diel sampling at Tehri

4.39. Benthic diversity and abundance in River Ganga

4.39.1. Status of Gangetic Benthic Diversity

The aquatic life in the Ganga River is diverse and abundant. The abundance of benthic communities is influenced by the nutrition of the riverine silt. The geomorphological structure of the Indian subcontinent divides the river into four distinct zones: the upper zone, which spans from Harsil to Narora; the middle zone, which spans from Farrukhabad to Ballia; the lower zone, which spans from Buxar to Tribeni; and the estuarine zone, which spans from Godakhali to Fraserganj. Emerging contaminants are any artificial or naturally occurring substances, as well as any microorganisms, that are not regularly observed in the environment but have the potential to do so and have known or suspected negative impacts on the environment, human health, or the ecosystem.They consist of synthetic chemicals, pharmaceuticals, pesticides, industrial chemicals, surfactants, personal care products, and heavy metal contamination that are consistently found in groundwater, surface water, municipal wastewater, drinking water, and food sources. These get accumulated in the soft tissues of the benthic organisms and further biomagnify at the higher trophic level. Thus,these serve as biological markers of the contaminated habitat of any aquatic system.

4.39.2. Materials and Methods

The sampling was done at pre-selected stationsalong the river Ganga. The samples were taken using a Peterson grab. The specimens were stored in 100 ml sample bottles containing 4% formalin. The materials were thereafter taken to the lab for additional identification and analysis. Estimation of quantitative abundance was evaluated by simply standardised protocol mentioned by Welch, 1948.

$N = O/(A. S) \times 10,000$

Where,

N = No. of macro-benthic organisms/ m^2

O = No. of organisms counted

A = Area of a sampler in square meter

S = No. of samples taken at each station.

Fig. 187. Collection of benthic organism from the river Ganga

4.39.3. Statistical Analysis

Several analytical software programs have been used to assist with the statistical analysis. Past Version 4.02 is used to analyse the diversity indices. Using SPSS Version 22, correlation with several physicochemical characteristics was examined.

4.39.4. Observations recorded

The diversity of the Ganga River course and 38 different families of benthic fauna were observed throughout the study. The study period comprised the Unionidae family belonging to Bivalvia, which included 8 species and 21% of the overall variety of benthic invertebrates in the river. In the upper stretch, Narora had the most diversity of benthic species, followed by Mirzapur, Kanpur, and Prayagraj in the middle stretch; in the lower stretch, Farakka demonstrated the dominance of *Pila globosa*. The dominant benthic species were as follows: Gastropods (*Filopaludina bengalensis*>*Tarebia granifera*>*Lymnaea acuminata*>*Gyraulus convexiusculus, Indoplanorbisexustus*); Bivalves (*Parreysia corrugata*>*Corbicula striatella, Lamellidens marginalis*>*Lamellidens ecorrians); and* Clitellata (Hirudinaria and *Tubifex tubifex)* insect (*Chironomus* sp., *Baetis*sp., *Heptagenia* sp., *Anax* sp.) and only one polychaete species (*Nereis* sp.) were recorded along the river Ganga.

Upper and Middle Zone

The abundance of benthic species (Fig. 188) ranged between 30 and 335 U/m^2 at Ghazipur, followed by 140 U/m^2 of *Gyraulusconvexiusculus* at Bijnor, 5-140 U/m^2 at Narora and Varanasi, 5–125 U/m^2 at Chunar, and 18–168 U/m^2 at Bijnor, respectively. *Anax* sp. belonging to class Insecta, order Odonata, and family Aeshnidae were observed at Raj Ghat, Varanasi. *Parreysiacaerulea*belonging to class (Bivalvia), order (Unionoida), and family (Unionidae) were observed only at Narora. *Nereis* sp. belonged to class Polychaeta, order Phyllodocida, and family Nereididae. It was observed at Kilaghat Varanasi. In the middle stretch, there are 21 molluscan species, and 12 other species, comprising insects and annelids, are found in the upper stretch. The abundance of the species was recorded to be at its maximum during the post-monsoon, followed by the pre-monsoon and the monsoon. The dominance of four gastropod species during the post-monsoon was highly observed during the study period, namely *Thiara scabra, Gyraulus labiatus*, *Idiopoma dissimillis,* and *Lymnaea luteola*. The abundance of *Tubifex tubifex, Cybisters* sp., *Sigara* sp*., and Antocha* sp. dominated the upper stretch during the monsoon.

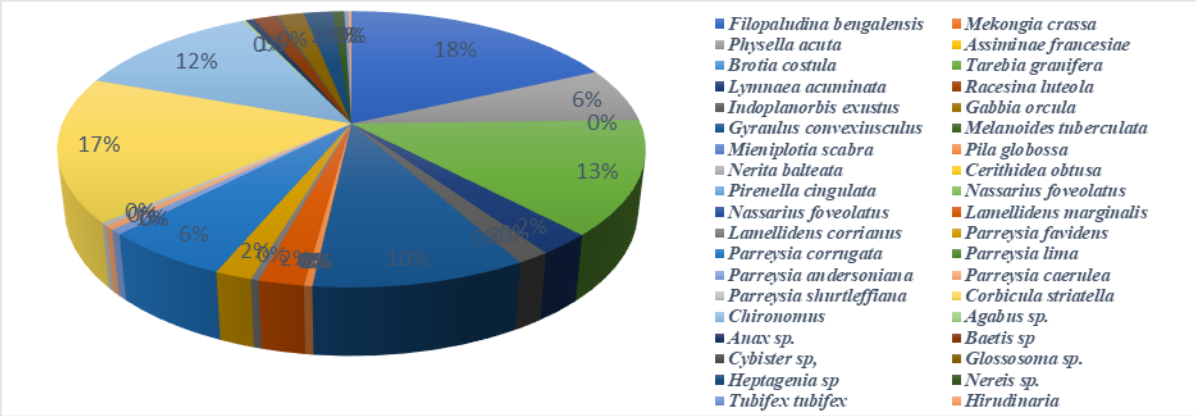


Fig. 188. Percentage (%) of macrobenthic organisms available across the upperand middle stretch of river Ganga

4.39.5. *Lower and Estuarine Zone*

A total of 11 species were recorded in the lower and estuarine stretch of river Ganga (Fig. 189). The abundance of *F. bengalensis* (45471 ind/m^2) was reported maximum at Patna during pre-monsoon. *Tarebia granifera* (25793ind/m^2) was recorded to be maximum at Tribeni during this time while *Mekongia crassa* was estimated (1861 ind/m^2) at Patna. From monsoon 14 species were recorded of which the abundance of *T. granifera* was reported from Tribeni (1290 ind/m^2). The Shannon diversity index was recorded maximum from Farakka (2.23)> Patna while the evenness of the species was recorded maximum at Reginagar. Availability of *Lymnaea acuminata* (602 inds/m^2) was reported to be highest during monsoon at Patna. The diversity indices in the lower stretch showed maximum diversity at Farakka (2.032). The estuarine stretch extending from Diamond Harbour and Fraserganjcomprises of *Assiminae francesiae* (5282 inds/m^2)belonging to Assiminidae family and *Telescopium telescopium, Pirenella cingulata*and *Cerithidea obtusa*belonging to Potaminidae family.

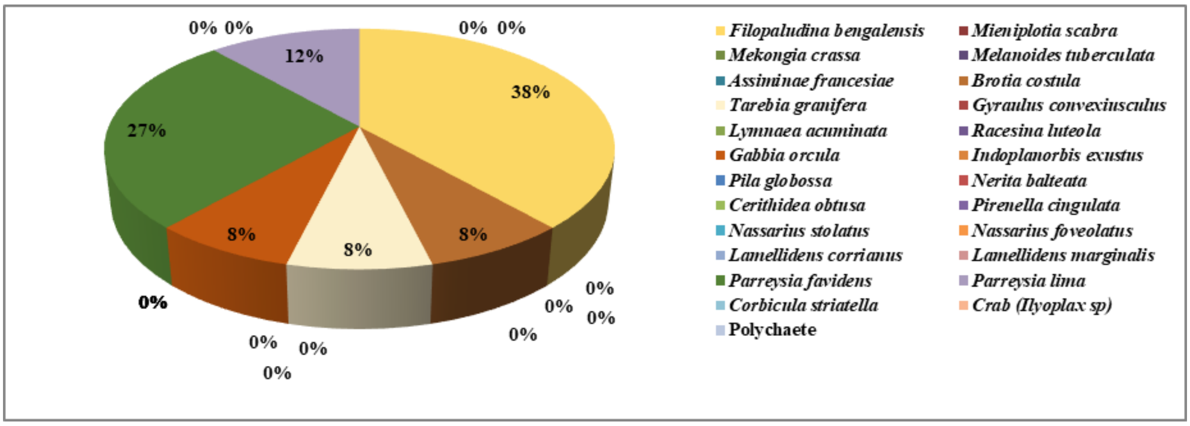


Fig. 189. Percentage (%) of macrobenthic organisms available across the lower and estuarine stretch of river Ganga

4.39.6. *Year-wise Observations*

In Fig. 190, the abundance of benthic species was observed to be highest during the COVID period in 2020 (42899 ind/m^2), followed by 2021 (36625 ind/m^2). During this period, anthropogenic activities ceased, and industrial and sewage effluents were also controlled in the river. It was observed that the quality of the water in the Ganga improved with an increase in the biodiversity of the aquatic fauna.

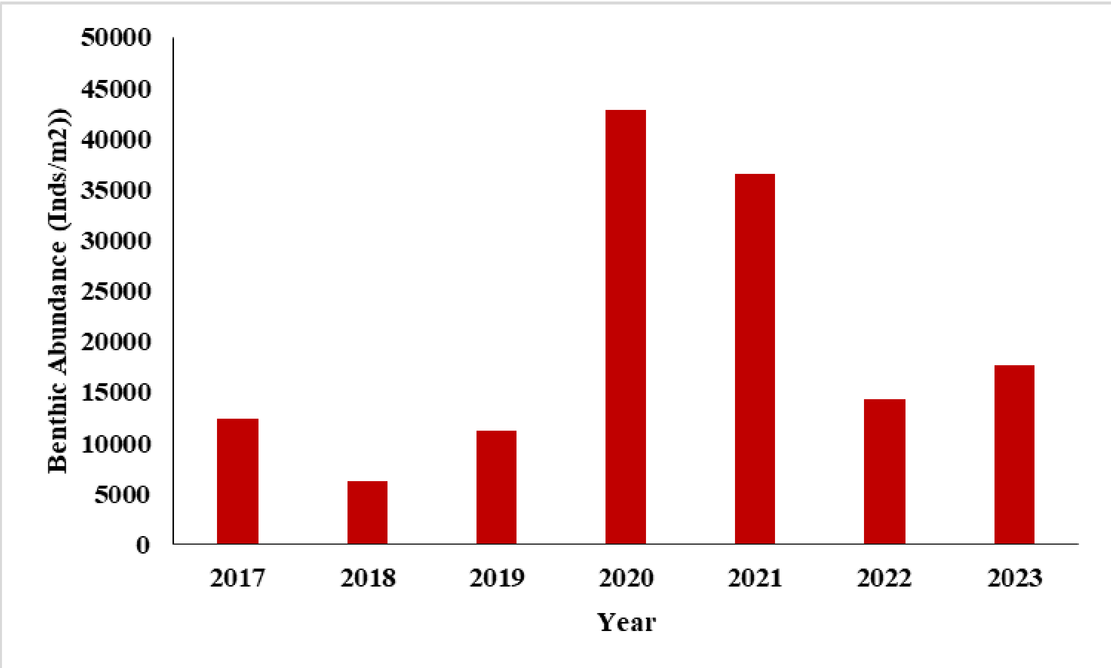


Fig. 190. Parenthesis of the yearly abundance of the benthic diversity of the river Ganga from the year 2017 to 2023

4.39.7. Special Observations in Benthic diversity

- Summer sampling was conducted for the investigation of the benthic diversity and other biotic and abiotic parameters in the upper and middle starches of the Ganga River. During this period, we observed some newly distributed macrobenthic invertebrates. They are *Cybister* sp., *Sigara, and Antocha* sp.
- The *Cybister* sp. belonging to class – Insecta, Order – Coleoptera and family – Dytiscidae was recorded from AB Narora. Beetle is generally found in almost all kinds of fresh water habitats.*Cybisters* are carnivorous in nature and are used as feed by small fish and small aquatic insects.
- *Sigara* was recorded from above the Narora barrage and belongs to the family Corixidae, which is globally distributed in virtually all freshwater habitats, and a few

species live in saline water bodies. *Sigara* sp. is mostly non-predatory, feeding on aquatic plants and algae. The forelegs are covered with hairs and shaped like oars, hence the name water boatman.

- *Antochawas* were recorded from below the Bhimgoda barrage at Haridwar. The genus *Antocha* is commonly known as crane fly larvae. They are generally found in bodies of cold water, living inside silken tubes that are attached to rocks and stones. *Antocha* are omnivores in nature, and they usually feed on decaying plant matter and associated microbes, while some species feed on living plants, fungi, or other invertebrates.

Phylum: Arthropoda
Class: Insecta
Order: Coleoptera
Family:Dytiscidae
Genus: *Cybister*

Phylum:Arthropoda
Class: Insecta
Order: Hemiptera
Family:Corixidae
Genus: *Sigara*

Phylum: Arthropoda
Class: Insecta
Order: Diptera
Family: Limoniidae
Genus: *Antocha*

Cybister sp.

Sigara sp.

Antocha sp.

Fig. 191. New record of the benthic diversity

4.40. Heavy Metal Contamination in Gangetic molluscs

Ganga, flowing through the most populated and religious cities in India, has undergone many hydrobiological changes and deteriorated over a prolonged period of time. Various anthropogenic and religious activities, industrial effluents, sewage pollution, and agricultural runoff are the primary sources of pollution in the river. Metallic accumulation is a common phenomenon due to waste disposal directly in the river. Hence, the biotic health of the river is similarly affected by the drastic aqua-environmental change. The benthic macroinvertebrates of the Ganga are more likely to exhibit metal accumulation in their living bodies. The current study showed the accumulation of heavy metals like cadmium, cobalt, chromium, lithium, and lead in the soft tissues of five common freshwater gastropods: one estuarine gastropod and one freshwater bivalve. The study depicted the metal concentration as being highest from Buxar to Bhagalpur. The metal concentration trend observed from Buxar to Bhagalpur is Cr > Cd > Pb > Co > Li; from Farakka to Tribeni, Cr > Co > Pb > Li > Cd; and at Fraserganj, Cr > Li > Cd > Co >Pb. It was observed that the accumulation of cadmium and chromium was reported to be greater in bivalves than in gastropods, while the concentration lowered beyond Bhagalpur. The selected popular species (*Telescopium telescopium*) from Fraserganj showed less accumulation.

Parreysia corrugata showed maximum accumulation of the heavy metals cadmium and chromium. *Filopaludina bengalensis* is the second most contaminated macrobenthic gastropod found in this stretch, with a maximum accumulation of lead (6.69 µg/g) in the soft tissues. *Lymnaea acuminata* is one of the dominant species that is recorded to accumulate all the heavy metals studied (Fig. 191).

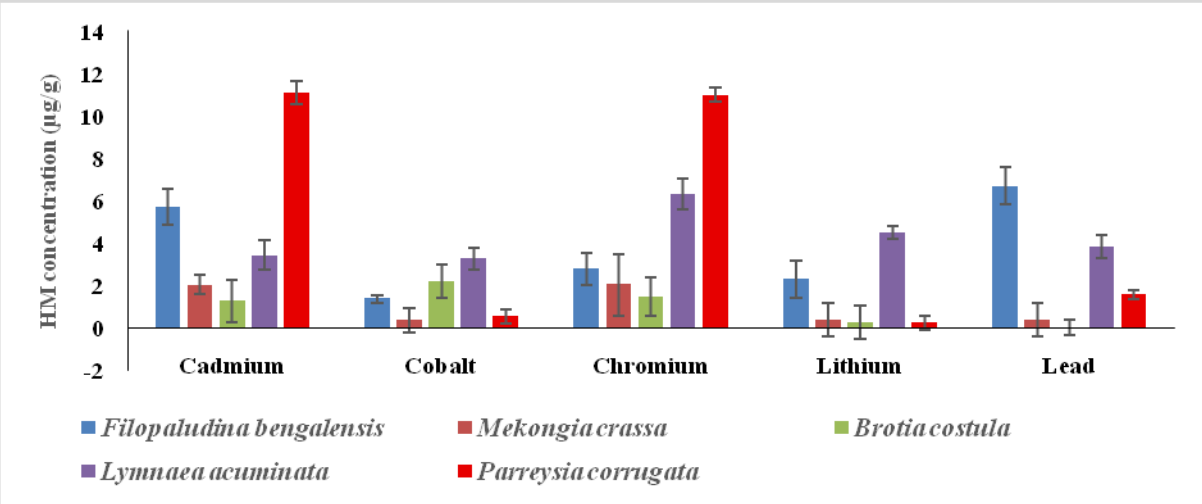


Fig. 191. Accumulation of heavy metals in the soft tissues of benthic molluscan species (Buxar to Bhagalpur)

The metal concentration of river Ganga showed a dominance of chromium over other metals (Fig. 192). The species *Lymnaea acuminata* was observed to have higher concentrations of all the five mentioned heavy metals. *Parreysia corrugata* was highly contaminated with cadmium concentration (3.44 µg/g). *Tarebia granifera*, the dominant species in the lower stretch was observed to be contaminated by Cr> Co> Cd >Li > Pd.

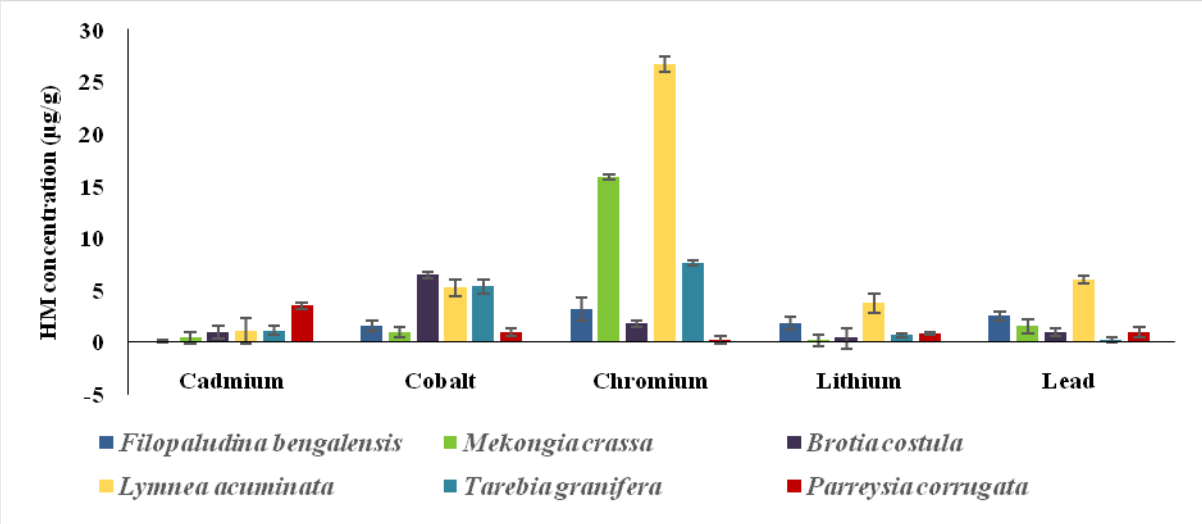


Fig. 192. Metal accumulation in the wet mass of macro invertebrates (Farakka to Tribeni) of river Ganga

The concentration of heavy metal at Fraserganj (Fig. 193) was observed to be less than in the middle and lower stretch of river Ganga. The most common estuarine species *Telescopium telescopium* recorded maximum accumulation of Cr, followed by Cd, Li, Co, and Pb.

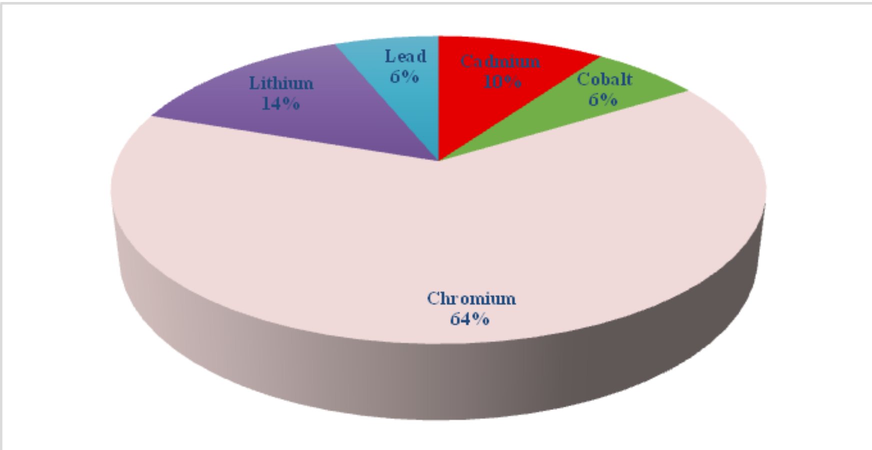


Fig. 193. Metal accumulation in the body of estuarine gastropod (*Telescopium telescopium*) of river Ganga

4.41. Gangetic benthic species as bioindicators

Freshwater riverine systems are facing a series of stresses due to different anthropogenic activities, eutrophication, and geomorphological alterations. Pollution is the current ecological hazard leading to the deterioration in river water quality and, thereby, the modification of the quantitative distribution of the inhabiting organisms. The Ganga, flowing through a vast stretch of land from Uttrakhand to West Bengal in India, receives an ample amount of inorganic and organic waste due to sewage, industrial, and agricultural disposal. The benthic organisms settled at the bottom of the aquatic ecosystem are one of the prime species affected by the increase in pollution.

In the present study, four major eco-physicochemical parameters are selected to correlate with the available benthic species distributed throughout the entire stretch of the Ganga. Species like *Filopaludina bengalensis* and *Physella acuta* are marked as potent bioindicators of heavy metal contamination like copper, lead, and cadmium. These organisms also indicate the presence of pesticides and polyaromatic hydrocarbons (PAH). They detected the hazard in the past and are recorded as a source of surveillance for the present riverine condition. Gastropods like *Physella acuta* and *Mekongia crassa* and Bivalvia (*Parreysia corrugata*); seven species belonging to the class Insecta (*Anax* sp. and Dragonfly Nymph); *Notonecta* sp., *Caenis* sp., *Rhyacophila* sp., *Philopotamus* sp., and Chironomus larvae; and two species belonging to the class Clitellata (*Tubifex tubifex* and *Lumbriculus variegatus*) are considered indicator species. The present study can conclude that these identified benthic species can be used as bioindicator organisms for pollution monitoring and riverine health.

4.42. Health Card Report of River Ganga

Health report cards are used to examine environmental, social, and/or economic data in relation to predetermined goals or objectives. River health report cards offer performance-based numerical scores or letters that regularly indicate a river's state, much like report cards for schools. They effectively combine and synthesis copious amounts of frequently difficult information into straightforward scores that can be shared with decision-makers and aid the general public in making wise choices.

The Ganga River Health Report Card is an evaluation and communication tool based on Gangetic benthos population especially molluscs, to monitor community development, coordinate partners and initiatives, and spur change that enhances the health of the river and its watershed while safeguarding the local economy and livelihood.

The report card was developed based on sampling points distributed among four stretches namely upper stretch, middle stretch, lower stretch and estuarine zone. The availability of molluscan species have been included in the health card and based on their assessment, the health card has been developed.

A successful health report card is one that contains metrics that indicate a wide range of river availability and value. The process used to create the health card was adapted from the Center for Environmental Science at the University of Maryland. The molluscan species have been chosen as bio indicators after identifying the stretches that are threatened to get the big picture. The indicators' threshold values were then found, followed by calculations, grades were given to them, and lastly, the story was finished by communicating the results.

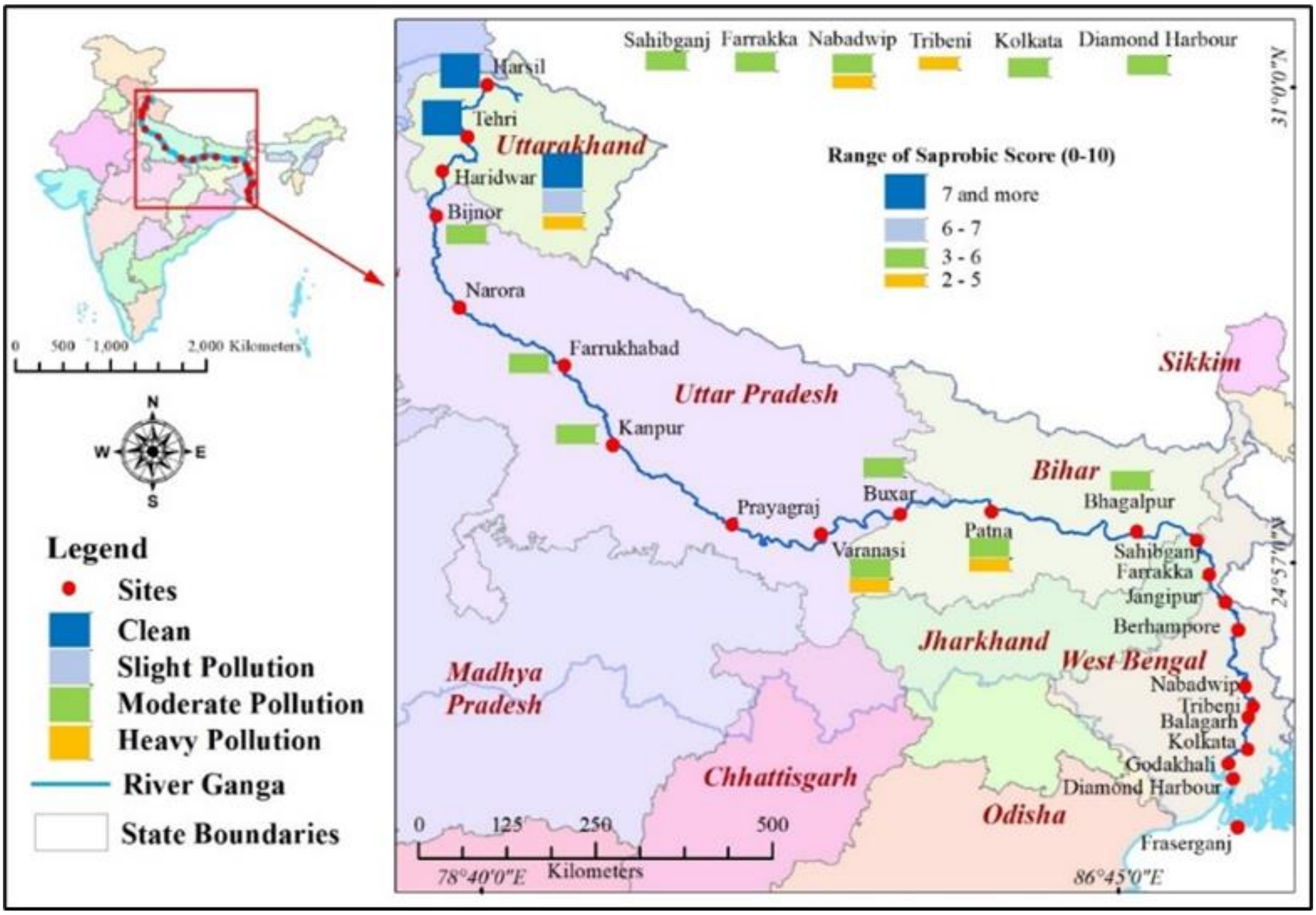


Fig. 194. Pollution stretches of river Ganga

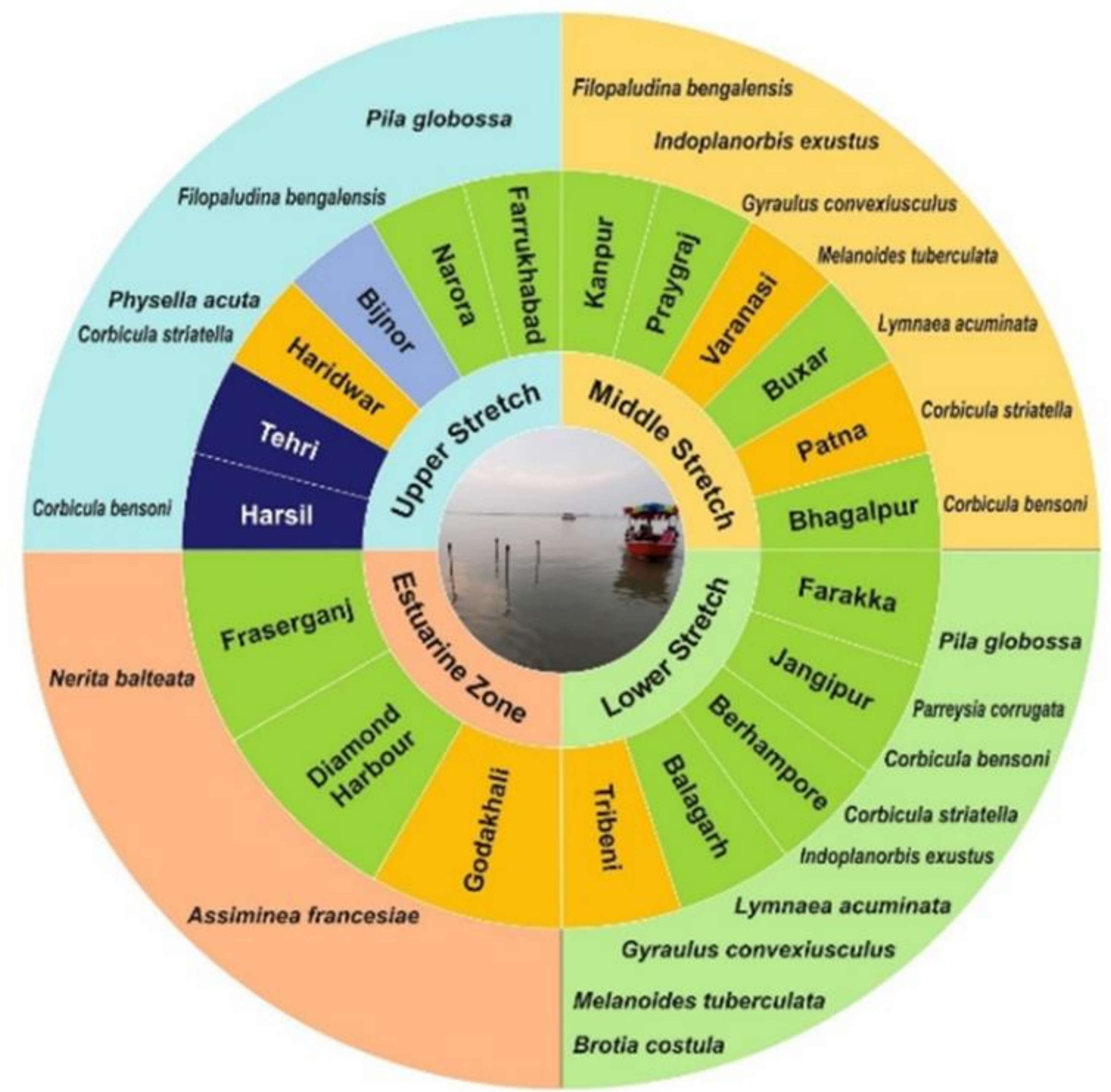


Fig. 195. Riverine Health Card: Based on the availability of macrobenthic mollusks along Ganga

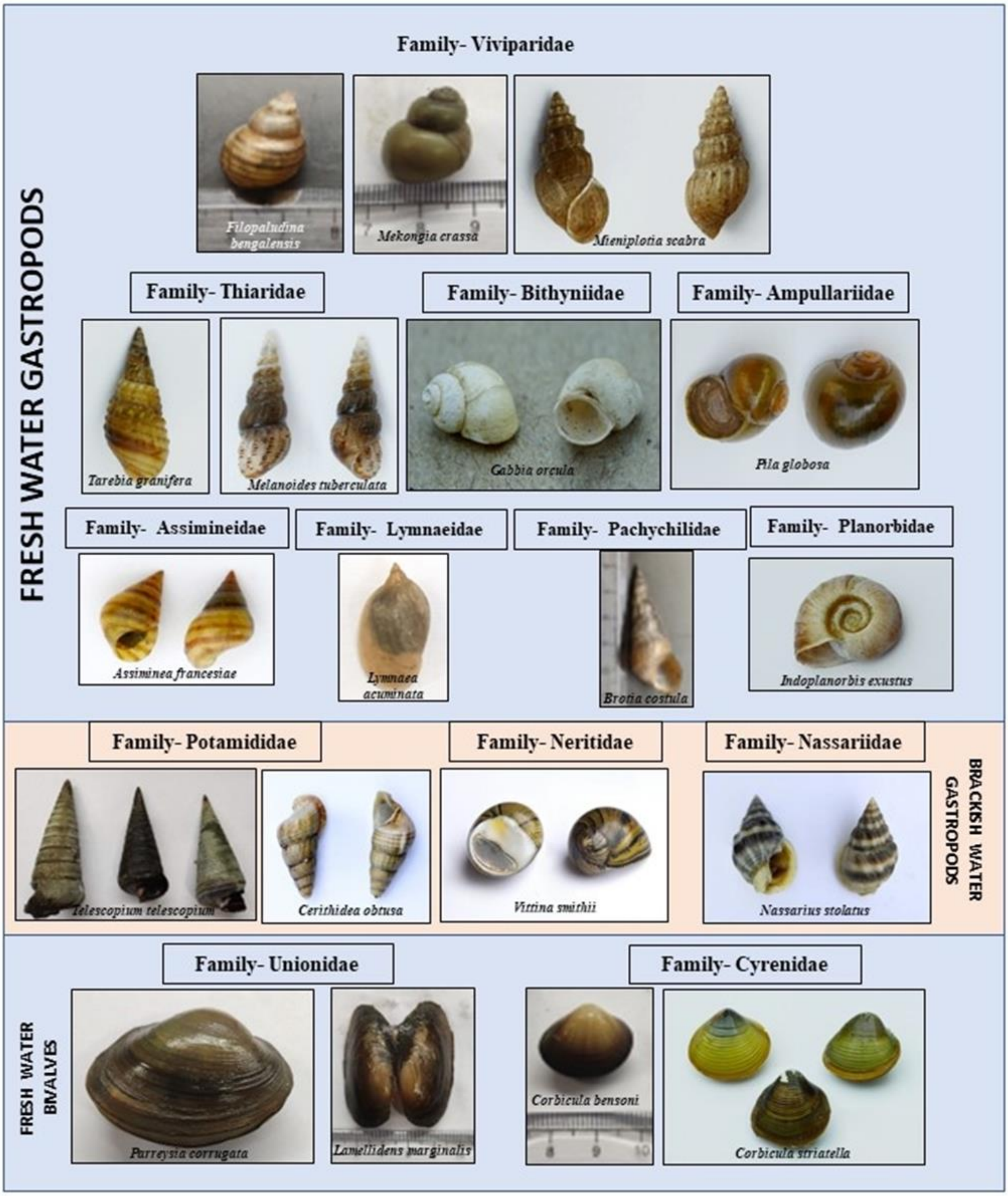


Fig. 196. Molluscan Diversity in river Ganga from Harsil to Fraserganj

4.43. PRELIMINARY STUDY ON FISH AND FISHERIES OF TWO TRIBUTARIES OF RIVER GANGA

ICAR-CIFRI has surveyed two important Gangetic tributaries, viz., the River Koshi and the River Haldi, in order to record and find present fisheries and limnological status. The detailed reports of the two rivers studied are mentioned below.

4.43.1. Fish and fisheries of Koshi River

Bihar is the 13th largest state in India and situated in the central portion of the Indo-Gangetic Plain; the total area covered by the state of Bihar is 94,163 km^2. The state is located between 24°-20'-10" N and 27°-31'-15" N latitude and between 83°-19'-50" E and 88°-17'-40" E longitude. The state is situated along the Ganga river basin, which includes 38 districts, of which 21 are in north Bihar and 17 are in south Bihar. As per the "Second Bihar State Irrigation Commission 1994" report, the rivers and riverine stretch of Bihar have been divided into 14 basins (with length in km), namely, Ghaghra (83), Gandak (260), Burhi Gandak (320), Bagmati-Adhwara (394), Kamla-Balan (120), Koshi (260), Mahananda (376), the main Ganga stem (445), which includes the drainage area of Kao, Dharmawati, Ganga, Mahi, and Baya rivers, Karmnasa (24), Sone (202), Punpun (235), Kiul-Harohar (41), Badua (130), and Chandan (118). The Ganga flowing from east to west in this state is the main drainage channel, with seven major rivers and basins, namely Ghaghra, Gandak, Burhi-Gandak, Kamla-Balan, Bagmati, Koshi, and Mahananda, on its north and six, namely Karmnasa, Sone, Punpun, Kiul-Harohar, Badua, and Chandan, on its south. All the rivers excluding Burhi-Gandak joining Ganga on its left bank in Bihar originate from the Himalayas, flow through a considerable length in Nepal, and a large part of their catchment falls in the glacial regions of the great Himalayas. These rivers are snow-fed and hence perennial. About 80% to 90% of the annual rainfall occurs in monsoon months on account of the south-west monsoon. As a result, the entire northern region of this state is affected by flooding almost every year due to excessive rainfall in their catchment. The average annual rainfall in Bihar is 1205 mm, with significant variations in its area distribution.

Among the Ganga tributaries, the Koshi River originates at an altitude of over 7,000 m above MSL in the Himalayas. The upper catchment of the river system lies in Nepal and Tibet. It traverses a total distance of 736 km and joins the Ganga near Kursela in Bihar. The river Koshi drains a total catchment area of 74030 sq. km. in India and other countries. Out of the total catchment area of the Koshi, only 11410 sq. km. lies in India, and the rest, 62620 sq. km., lies in Tibet and Nepal. The River Koshi and its tributaries are regarded as the most dynamic river systems in the world (Wells and Dorr, 1987), and the river basin itself is one of the global hotspots of climate change (Fang et al., 2020). Koshi River is a unique ecological zone owing to its varied topography, which harbors unique fish fauna that supports the livelihood of indigenous fishermen communities. But the frequent changing of fluvial features significantly influences most of the important commercial fisheries along the river Koshi (Shetty & Malhotra, 1983). The majority of the bibliographic sources regarding the fisheries of Koshi pertain to those studies conducted along the upper reaches of the river in Nepal (Swar, 2002; Sharma, 2008; Pinkey, 2016). Except for some isolated studies on shellfish fisheries (Prabhakar & Roy, 2008), no comprehensive information is available on the fish and fisheries of Koshi in the Indian region.

4.43.2. Reconnaissance survey

The present exploration was done to collect information on fish and fisheries in the Koshi River and other aquatic animals during the post-winter (February-March) in 2023. The exploration covered 12 riverine villages in 4 districts (~200 km), namely, Supaul, Saharsa, Khagaria, and Bhagalpur. The exploratory survey included assessments of fish diversity, soil and water quality parameters, plankton, benthos, dolphin, and turtle availability. Additionally, the surveying team sensitized fishermen and villagers about conservation of aquatic life and river pollution. The outcomes of the survey are mentioned below.

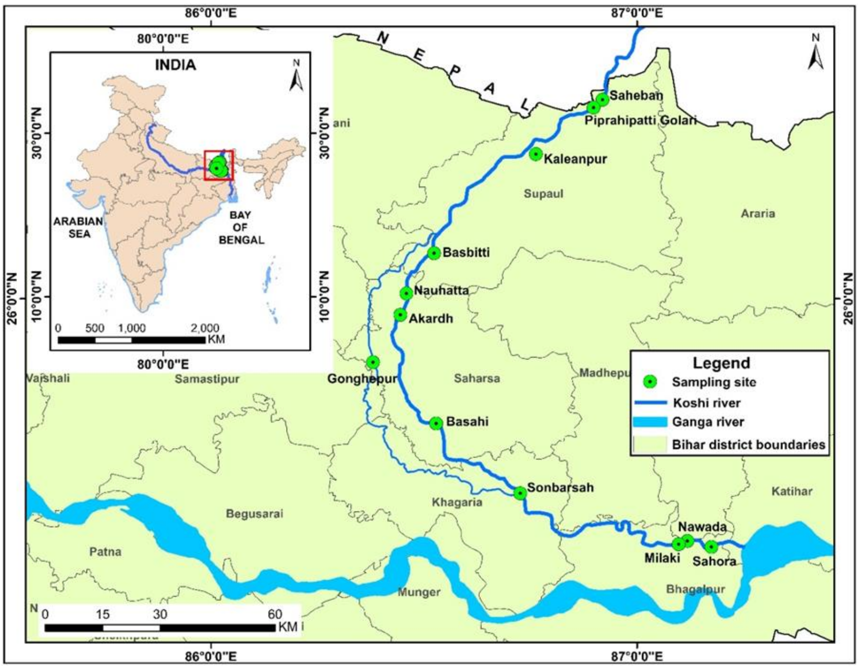


Fig. 197. GIS map of surveyed stretch of the Koshi River

4.43.3. Water quality

The water quality of the Koshi River was within favourable range for aquatic life. The water quality parameters having importance in sustaining aqua-life of the river are as follows: air temperature (26.9±0.09) ˚C, water temperature (24.5±1.02) ˚C, pH (8.5±0.03), specific conductivity (0.2±0.01) µS, transparency (47.8±5.30) cm, turbidity (19.6±2.32), carbonate (18±5.29) ppm, bicarbonate (795±10.14) ppm, total alkalinity (97.5±14.86) ppm, total hardness (120.5±23.21) ppm, dissolved oxygen (8.5±0.17) ppm and biochemical oxygen demand (1.3 ± 0.37) ppm.

4.43.4. Plankton community

Eleven groups of plankton were recorded, of which 10 belonged to phytoplankton and 1 to the zooplankton group. The relative abundance of plankton groups was as follows: Bacillariophyceae (35.94%)>Trebouxiophyceae (31.95%)>Cyanophyceae (10.38%), Coscinodiscophyceae (10.14%)>Chlorophyceae (8.79%)>Zygnematophyceae (1.81%), Rotifera (0.33%)>Dinophyceae (0.26%)>Mediophyceae (0.13%)>Synurophyceae (0.13%)> Euglenophyceae (0.13%). Among the phytoplankton genera, *Keratella* sp. and *Brachionus* sp. were most abundant. The representatives of the above-mentioned plankton group are given below.

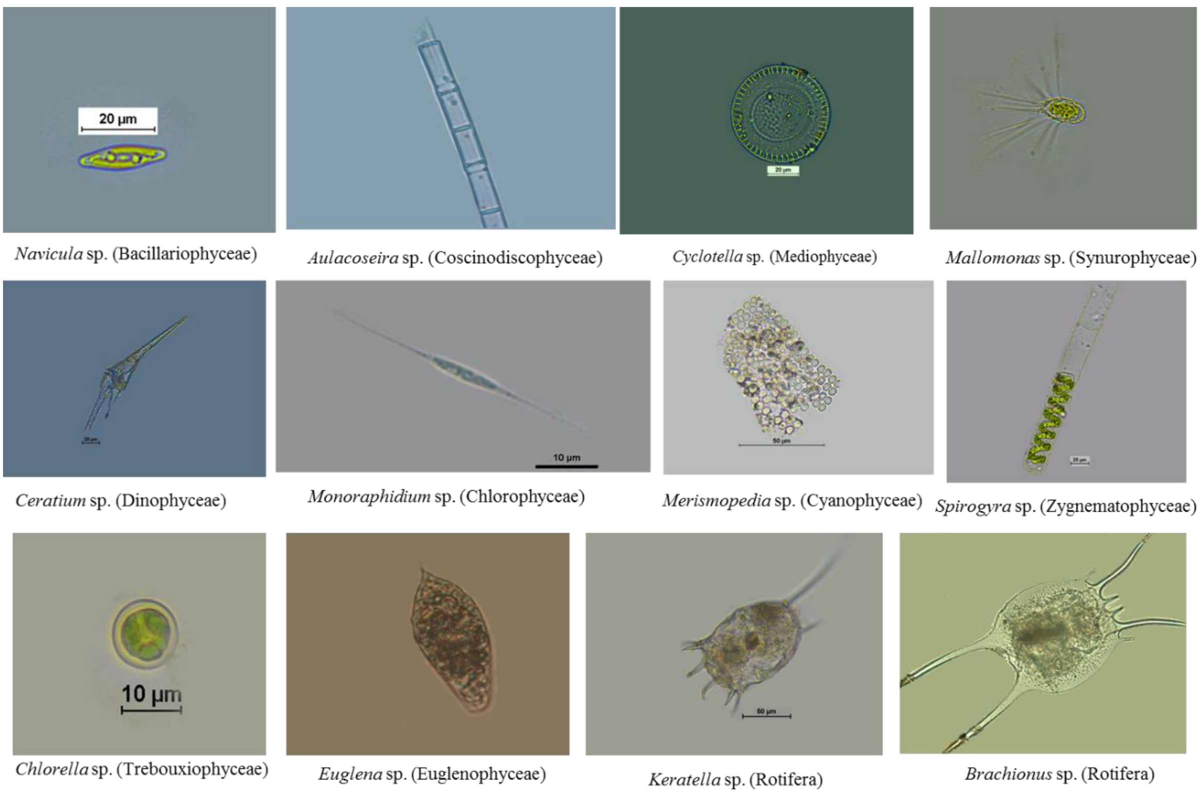


Fig. 198. Important plankton of the Koshi River

4.43.5. Benthos community

Three freshwater gastropods, namely *Filopaludina bengalensis*, *Mekongia crassa*, and *Lymnaea acuminate*, were recorded, dominating more than 52% of the total mollusc population in the surveyed stretch of the Koshi River.

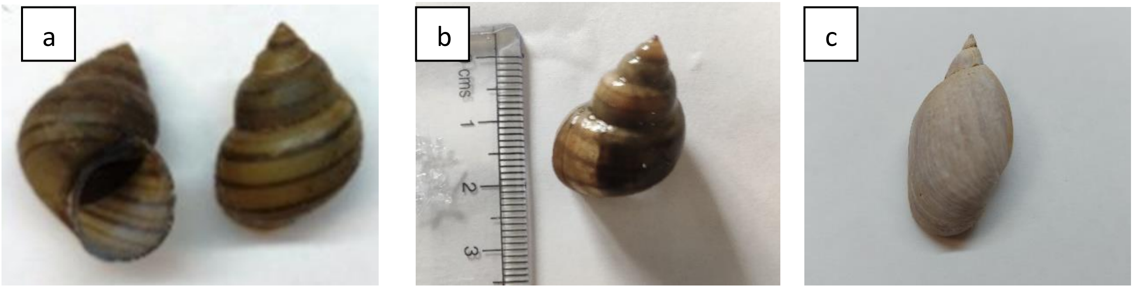


Fig. 199. Freshwater gastropods of river Ganga, (a) *Filopaludina bengalensis*, (b) *Mekongia crassa* and (c) *Lymnaea acuminate*

4.43.6. Fish community

The Koshi River was surveyed during the post-winter season and recorded 56 fish species. Sahora (Bhagalpur) had the highest fish species richness (33) while Piparahipatti Golari (Supaul) had the least. Major commercially important fish observed were *Bagarius* sp., *Sperata* spp., *Wallago attu*, *Labeo catla*, *L. rohita*, *Chitala chitala*, and *Rita rita*. Among small indigenous fish, the major catch was observed in the following manner: *Cabdio morar, Ailia coila, C. Reba, L. bata, L. boga,* and *Salmostoma bacaila.* The invasion of exotic fish was not recorded; however, pond-cultured exotic fish were seen in the fish market.

Fig. 200. Fish catch diversity of Koshi River

4.43.7. Notable observation of aquatic life in Koshi River

The Gangetic dolphin (*Platanista gangetica*) was sighted in all the surveyed district of Bihar. Additionally, crowned river turtle (*Hardella thurjii*) was recorded in Paharpur, Nauhatta (26º00' 46.1 " N, 86º27' 31.0") of Saharsa district while Indian peacock soft shell turtle (*Nilssonia hurum*) was recorded from Dumrighat (25º32' 35.7 " N, 86º43' 23.4" E) of Khagaria district.

Fig 201. Dolphin sighting at Dumri ghat, Sonbarsah, Khagaria

Crowned/Hard shell River turtle | Soft shell River turtle

Fig 202. Different riverine turtles spotted at river Koshi

4.43.8. Crafts and gear of Koshi River

Inland fisheries in India play a major role in alleviating poverty and providing nutritional and livelihood security for millions of rural households. Riverine fisheries are mostly small-scale and unsophisticated involving traditional fishing methods. Depending on the prevailing conditions of the river, fish stocks and the degree of development of the fishing community, various types of fishing methods have been developed to exploit the resources (Welcomme, 1985). Due to the complex nature of riverine fish assemblages as well as its seasonal distribution, size and ecology, a wide variety of fishing gears are necessary to harvest the fish rather than relying on a single one. The fishing crafts employed for fish harvest in Koshi River were made of up locally available wood and materials. Plank-built boat is the most common boat used along the stretch of Koshi River. It is locally called the '*naav'*. And different sizes of the boat are used in different locations. Depending on the size of the boat, it can accommodate 2-3 persons.

Fig. 203 Fishing crafts of river Koshi (g, h) and gears (a,b,c) of Koshi River

4.43.9. Fish and fisheries of Haldi River

In the East Midnapur District of West Bengal, a survey was carried out in September 2023 to collect fish and other hydrological data from various chosen sites in the river Haldi (a tributary of the river Ganga). A stretch of the river Haldi measuring around 30.74 km was covered by five sampling stations. Table 10 displays the positional coordinates and the site's name. Twice daily, there is tidal influence on the sampling stretch, with a rise of around 4 metres during high tide. Fish abundance, pollution discharge points, easy accessibility, and the potential impact of fish migration upstream and downstream all played a role in the selection of sampling locations.The current study's goals are to (i) analyse how fish diversity, distribution patterns, and community structure change in response to different environmental gradients and (ii) educate and sensitise the public about a topic or issue with the hope of influencing their attitudes, behaviours, and beliefs regarding the preservation and reintroduction of hilsa fish in the river Haldi.

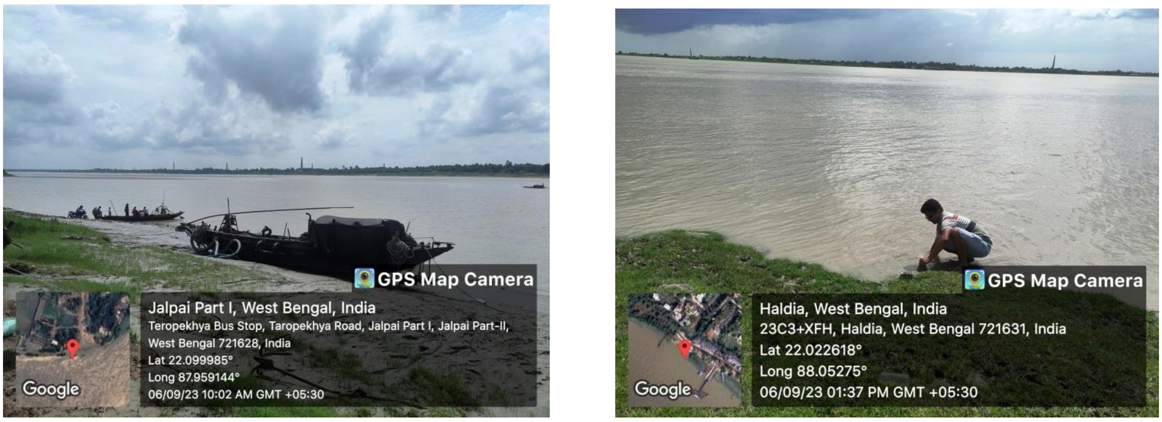


Fig. 204. River view and google earth images of river Haldi

Table 10. GPS coordinates along with the site name in river Haldi

Sl no.	Sites	GPS Coordinates
1.	Haldia	22º0´22.618´´ N 88º0´5.275´´ E
2.	Balughata	22º0´76.965´´ N 88º0´17.981´´ E
3.	Teropekhya	22º09´99.985´´ N 87º9´59.144´´ E
4.	Narghat Rail Bridge	22º1´12.304´´ N 87º94´51.14´´ E
5.	TeroparaLockgate (TLC)	22º9´30.122´´ N 87º51´48.478´´ E

4.43.10. Fish diversity

Fish samples were taken from the main estuary channel, which is where the rivers Haldi and Hooghly converge. Gill nets (mesh size: 40–120 mm) and surface bag nets (assorted mesh sizes) were used to catch fish from the river in every available habitat niche along the sampling sites. The majority of the fish samples came from landing areas. The gill net and bag net were used for a 6-hour sampling period (low tide to high tide). Three shellfish species

(*Penaeus monodon*, *P.semisulacatus* and *Scylla serrata*) and 15 finfish representative specimens were recognised. The fishes were divided into six orders, twelve families, twenty genera, and fifteen species (Table 11). The dominating group was discovered to be the Family Clupeidae (39.86%), followed by the Engraulidae (32.13%), Polynemidae (17.67%), and Bagridae (5.58%) families, in that order. The main species in the river Haldi was found to be *Tenualosa ilisha* (RA 39.57%), followed by *Setipinna phasa* (18.11%), *Polynemus paradiseus* (16.10%), and *Coilia dussumieri* (14.02%).

Mystus gulio, a catfish with a size range of 5.88 to 8.69 cm, was noted to be a notable catch in the stretch. Hilsa was noted to be the most popular species of market among fish that are significant for commerce. Sizes of species ranged from 25.2 to 34.0 cm in length, with prices per Kg ranging from Rs. 900 to 1300. Among other fish, it was discovered that *Setipinnaphasa* and *Polynemusparadiseus* are significant commercial species that sell for a high price of Rs. 400–600 per Kg.

Table 11. Fish & shell fish species recorded from river Haldi

Sl. No.	Name of the species	Family	Order	IUCN status
1.	*Scatophagus argus*	Scatophagidae	Perciformes	LC
2.	*Cynoglossusarel*	Cynoglossidae	Pleuronectiformes	NE
3.	*Trichiuruslepturus*	Trichiuridae	Perciformes	LC
4.	*Harpadonneherueus*	Synodontidae	Aulopiformes	NT
5.	*Glossogobiusgiruis*	Gobiide	Perciformes	LC
6.	*Platycephalus indicus*	Platycephalidae	Scorpaeniformes	DD
7.	*Mystusgulio*	Bagridae	Siluriformes	LC
8.	*Coiliadussumieri*	Engraulidae	Clupiformes	LC
9.	*Lates calcarifer*	Latidae	Perciformes	LC
10.	*Pama pama*	Sciaenidae	Perciformes	NE
11.	*Polynemusparadiseus*	Polynemidae	Perciformes	LC
12.	*Boleophthalmusboddarti*	Gobiidae	Perciformes	NE
13.	*Rhinomugilcorsula*	Mugilidae	Mugiliformes	LC
14.	*Otolithoidespama*	Sciaenidae	Perciformes	LC
15.	*Tenualosa ilisha*	Clupeidae	Clupeiformes	LC

4.43.11. Habitat profile of river Haldi

In the present seasonal exploration of the September, 2023 habitat profile of each sampling site of river Haldi has been portrayed and data was recorded (Table 12.). The mean depth of the studied stretches varied from 11.2-16.4 m. Depth was recorded from the shoreline (L and R banks) and mid-channel. The substrate type was dominated by clay in all the sites which are considered to be ideal habitats for the freshwater ecosystem. Water velocity recorded ranged from 0.3 to 0.5 m/sec. Aquaculture and minor agriculture practices were observed in catchment areas in all the sampling sites. River water was observed to be pumped out for practicing aquaculture practices alongside the main river channel. Good riparian vegetation on the catchment area and riverbanks is considered to be an important part of the river habitat. In the present study, fairly good bank vegetation was observed with residential houses.

Table 12. Habitat profile of river Haldi at Haldia (West Bengal)

Parameters	Haldi
Width of wetted channel (m.)	1044.39
Width of the bank to bank of the river (m.)	1057.47
Av. Depth (m.)	14.30
Deep pools	No
Scar pools	Not recorded
Substrate type	Claye (Clay-85%, Sand- and others- 15%)
Refill	Not recorded
Elevation (m.)	08
Riparian vegetation	Trees (25%) & shrubs (20%), and urban house (55%)
Avg. Water velocity (m/sec.)	0.33
In-stream cover	Not recorded due to rise of water volume
Meandering nature	Meander
Source of pollution	Observed several city sewage channels discharging into the river
Agriculture practices	Observed on the banks

4.43.12. Water quality of river Haldi

In the present investigation water and soil samples were collected from Haldia ferry ghat, Balughata Ferry ghat, Teropekhya Ferry Ghat, near Narghat and Teropara Lockgate area across the upstream of the river. The water sample was collected across the river as well as from the two banks and also from the sub-surface layer of the middle of the river to obtain composite water and soil from each center. Water quality parameters were measured within 2 km. of the fishing sites. On-field water samples were analyzed for pH, total hardness, dissolved oxygen (DO), conductance, salinity, carbonate, bicarbonate, total hardness, calcium, BOD, chlorinity, flow, transparency, etc.

4.43.13. Results

In the present study as is evident from Table 13, in general terms water quality of river Haldi at different sites were slightly alkaline as the observed pH value ranged from 7.24 to 7.92which signifies the favorable niche for fish survival.The dissolved oxygen (DO) value varied from 5.0 to 7.2 ppm. The Balughata site is having comparatively lower DO (5.0 ppm) value in comparison to Haldia (7.2 pm). Similarly, other parameters like Total hardness (950-1020 ppm) & Total alkalinity (130-140 ppm) did not show not much variation among the sampling sites. The BOD values at all the sampling stations ranged from 2.4 ppm to 5.4 ppm. The comparatively higher value of BOD at the sampling site at Haldia is a matter of concern. The salinity values of the river water ranged from 3.85-16.07 ppt with the highest at Haldia (16.07ppt) which lies close to the estuary. Water temperature showed slight downstream variation and is probably a major environmental factor influencing the distribution of fish communities in the river as indicated in the observation, the water temperature ranged from 29.7-31.5 °C. The turbidity value of water varied from 184 to 448 NTU. The Balughata site is having Comparatively slightly higher turbid water was recorded (448 NTU) from other sites. Mean depth ranged between 9.4-16.4 m. Similarly, mean water velocity ranges from 0.10 to 0.50 m / sec.

Table 13. Water parameters in different sampling sites of river Haldi.

Sampling Station	Narghat	Teropekhya (T.P.)	TeroparaLockgate (TLC)	Balughata	Haldia Ferry Ghat
Date	06.09.2023	06.09.2023	06.09.2023	05.09.2023	06.09.2023
Weather	Cloudy	Sunny, Partly Cloudy	Sunny	Cloudy	Sunny, Windy
Tide	Low	Low	Low	Low	High
Time	8.30 am	10.40 am	11.50 am	4.00 pm	1.40 pm
pH	7.71	7.66	7.24	7.92	7.71
Water Temp. (°C)	29.7	30.6	31.0	30.3	31.5
Air Temp. (°C)	28.3	30.0	31.0	29.0	30.0
Conductivity (micro S/ ms)	880 microS	1035 microS	813 microS	4.56 ms	6.47 ms
Salinity (ppt)	0.434	0.513	0.398	2.45	3.53
TDS (ppt)	0.626	0.737	0.577	3.24	4.60
Transparency (cm)	3.6	2.6	6.2	2.4	3.1
Turbidity (NTU)	337	425	184	448	399
Free CO_2 (ppm)	4	4	8	4	8
Bicarbonate (ppm)	120	112	132	140	114
Total Alkalinity(ppm)	120	112	132	140	114
Total Hardness(ppm)	148	152	138	564	740
Ca+2 Hardness (ppm	27.2544	28.056	26.4528	57.7152	67.3344
Magnesium (ppm)	19.4268	19.9125	17.4831	102.0321	138.9634
Chlorinity (ppt)	0.228	02619	0.184	2.0999	2.3399
D. O. (ppm)	5.2	6.6	6.8	5.2	5.6
BOD Bottle No.(ppm)	2.2	2	1.6	0.6	4.2
Water velocity (m/sec.)	0.4	0.3	0.4	0.4	0.3
Depth	11.1	10.8	3.5	14.7	18.2

Fig. 205. Sampling at river Haldi, Haldia, West Bengal

4.43.14. Plankton diversity of River Haldi

It records a total of ninegroups of plankton during the present investigation, in which the highest relative abundance was observed for the Cyanophyceae (41.24%), followed by the Coscinodiscophyceae (38.14%), Bacillariophyceae (8.87%), Mediophyceae (5.77%), Ciliophora (5.15 %), while rest of groups such as Chlorophyceae, Rotifera, Coopepoda, and Amoebazoa contributed negligible percentage in the diversity. Among the zooplankton,Ciliophora (500 individuals/l) was found the most abundant, whereasCyanophyceae (4000 cells/l) dominates the phytoplankton abundance.

4.43.15. Benthic diversity of River Haldi

A total of nine species of benthic organisms were recorded during the present study in Haldi River, of whichsix species are gastropods, one species of bivalve mollusc (*Parreysia corrugata*), one annelid (*Tubifex tubifex*) and a crab species (*Ilyoplax* sp.). The benthic community in the river was found dominated by a small salt-tolerant gastropod snail, *Assiminae francesiae* (25%) of the total followed by the sludge worm, *Tubifex tubifex* (19%).

OBJECTIVE III: TO CREATE AWARENESS AMONG STAKEHOLDERS REGARDING SUSTAINABLE FISHERIES

Mass awareness programmes were organized to create awareness among local fishers and other stakeholders for conservation and to develop sustainable fisheries in different depleted stretches of river Ganga. People awareness means community-wide or audience-specific programming, initiatives, and strategies that increase audience knowledge and share information and resources to prevent loss of bio resources including aquatic resources.
As it is well established that fishery is declining rapidly due to different anthropogenic and natural stresses. With this believes and to mitigate the issue and restore the fishery in river Ganga along with other endangered fishes, ICAR-CIFRI under National Mission for Clean Ganga (NMCG), initiated several programmes towards conservation of fishes and dolphin. As it is evident that people awareness programme is one of the important work components of *in situ* conservation strategy. The objectives of this campaign were to educate and boost public towards conservation of fishes along with dolphins and convey them to beliefs and values on present issues like detrimental effects of destructive fishing methods like use of zero meshed net and other methods such as poisoning, dynamiting, etc.The poisoning for fishing and were advised not to catch the juveniles and brooders especially in the breeding seasons (June-August) for their sustainable fisheries in river Ganga. CIFRI's initiation to restore the prized fishes of the river Ganga under the project has created an impact among the local fishers. The campaigns were strategically planned to reach a target audience and to communicate specific message to the group and make them strong potential supporters. The awareness programme was conducted following the Covid-19 protocol at different ghats with the distribution of masks and sanitisers. Active participation was noticed among all the sections of the society including local fishers at different Ganga banks. The local people were also advised to attain sustainable development goals for improving the fish stocks of river Ganga which in turn could augment the fisheries production in the future.

During the project duration from November 2020 to September 2023, ICAR-CIFRI under National Mission for Clean Ganga (NMCG), carried out a total number of 165 awareness programmes at different states like Uttarakhand, Uttar Pradesh, Bihar, Jharkhandand West Bengal. In mass awareness programme a total no of 10,496 local fishermen and entrepreneurs participated. During November 2020 to October 2021, a total of 41 awareness programe were organized in different locations in which a fairly good nos. of participants (n=2285) took part in the programme. Likewise, during the year October 2021- September 2022 a total 58 nos. awareness programme were organized and a good nos. of people (n=3413) enthusiastically participated in the programmesand between October 2022 to September 2023, 66nos. people awareness programme were organized at different locations and a fairly good no. (n=4798) of people participated (Fig. 206).

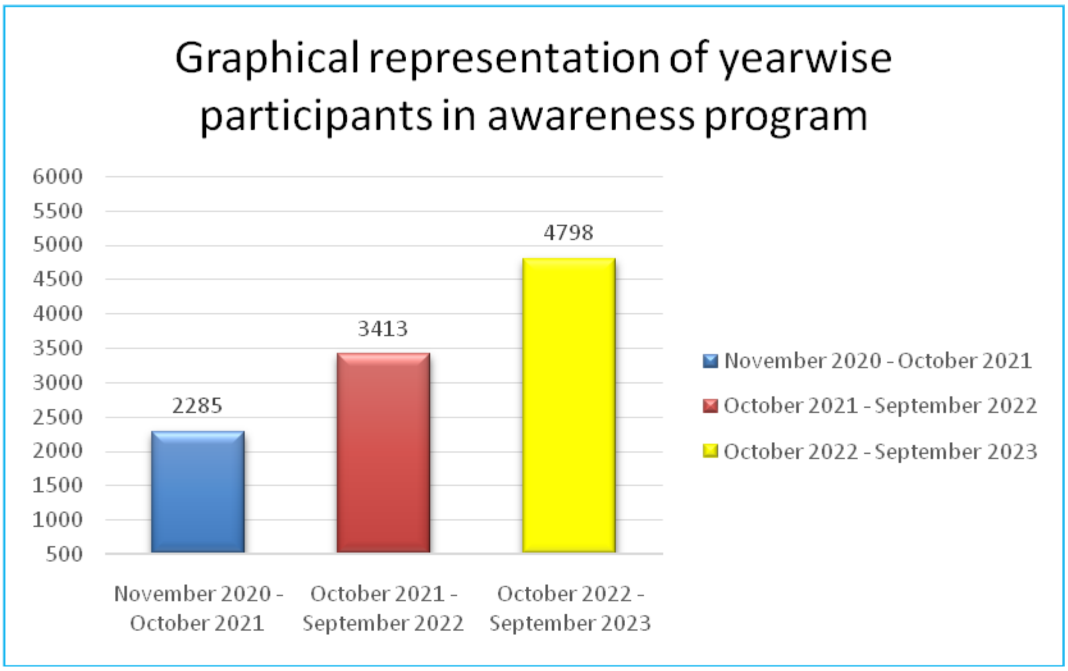


Fig. 206. Graphical representation of yearwise participants in awareness program

People awareness programme organized during the year 2020-2021 recorded less numbers of participants. The possible reason was the covid-19 pandemic was prevailed at that period. During the year 2021-2022 and 2022-2023 The number of participants increased significantly.

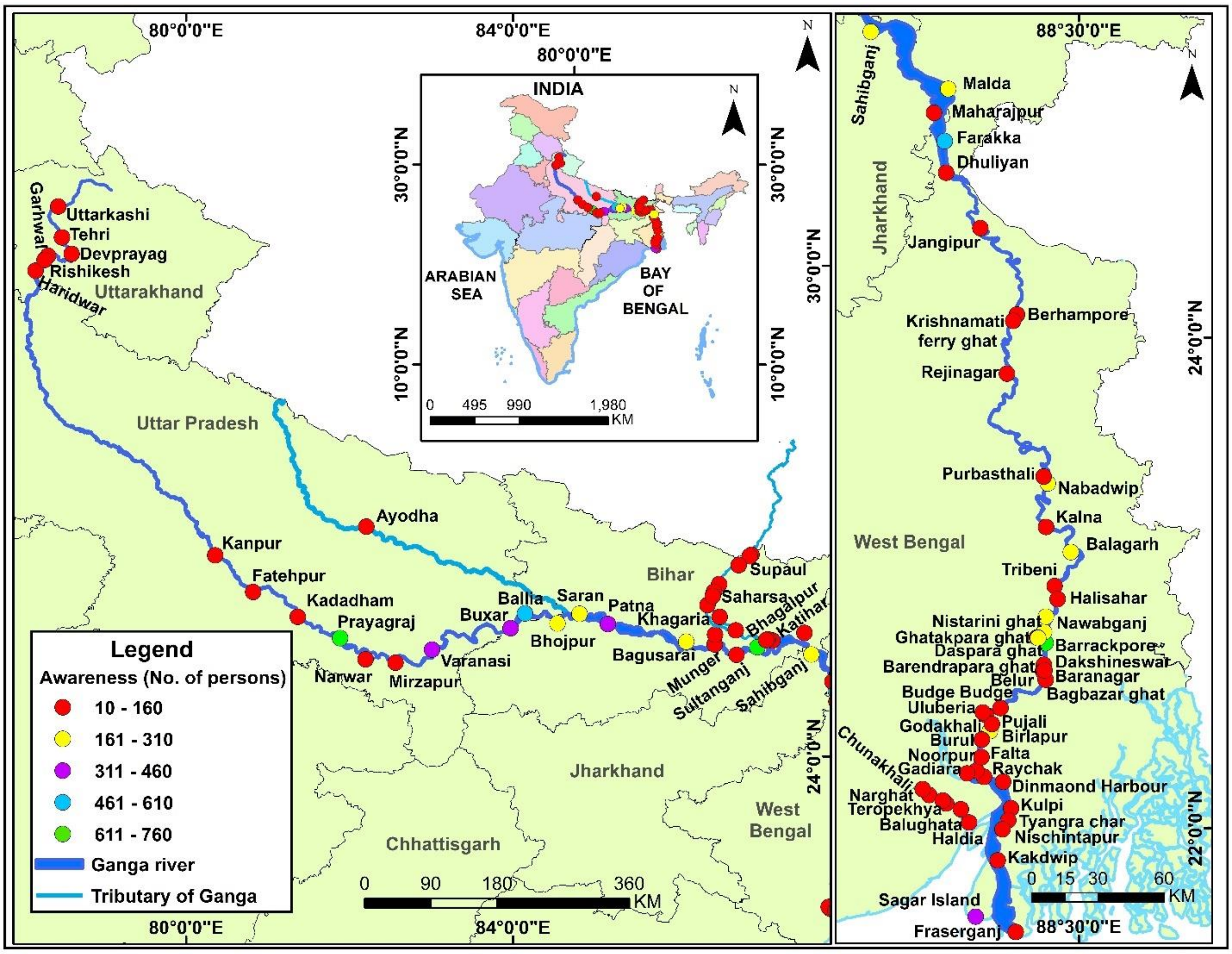


Fig. 207. GIS mapping of awareness programme (November 2020 to October 2023)

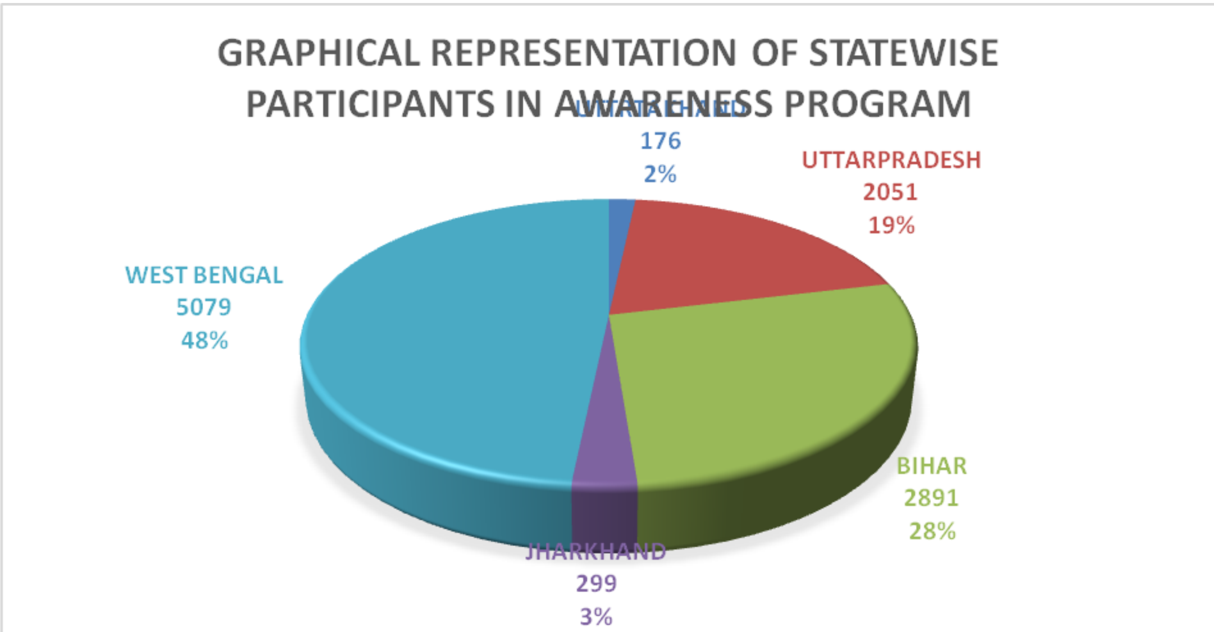


Fig.208 Graphical representation of state wise participants in awareness program (November 2020 – October 2023)

In the point of view statewise participants in awareness program during the project duration from November 2020 to September 2023, a total number of 10,496 local fishermen and entrepreneurs were participated in three years at different states like Uttarakhand, Uttar Pradesh, Bihar, Jharkhandand West Bengal. In Uttarakhand a total (n=176), Uttar Pradesh (n=2051), Bihar (n=2891),West Bengal (n=5079)local fishermen and entrepreneurs were participatedin awareness program.

Outcome of the awareness campaign

There was a mixed response from fishermen to the awareness campaign, while some of the fishermen listened intently as we explained to them on the need to protect and conserve endangered species, particularly IMC, brood fishes and dolphin there were others who went about their chores like repairing the nets as usual as they had nothing to do with the programme. Most of the fishermen realized the importance of fish conservation and the danger of over exploitation. The visiting team explained them how and why to save fish diversity for upcoming generation. They also agreed to conserve the Gangetic dolphins which is identified as national aquatic animal and agreed to release live into the river if they get caught accidentally in the net. They also agreed not to catch small fishes and gravid female fishes. They were advised not to catch the juveniles and brooders especially during breeding seasons for the conservation of fishes in river Ganga. During the awareness program the visiting team sensitized to common fishers regarding the importance of brood fishes and how to conserve them. Most of the people agreed on the issue. According to them few people not to follow up due to ignorance and poverty. They are very much aware of the consequences of wanton killing of brood fish particularly of IMC. They are also aware that occurrence of fish fauna greatly depends on the survival of brood fishes.The fishermen raised the issue of using fine mesh sized nets and demanded to ban as the nets are responsible for mortality of millions of fish seed causes drastically declining of riverine fishes. The detail site wise awareness programme carried out under the project is mentioned below.

Period 2020-2021

Table 14. Awareness programme towards sustainable fisheries during 2020-2021

Sl No.	Date	Place	Number of people awared
1.	03/11/2020	Sangam Nose	40
2.	04/11/2020	Gandhi Ghat, Barrackpore	50
3.	04/11/2020	Dasashwamedh Ghat,	50
4.	21/11/2020	Diha, Prayagraj	100
5.	21/11/2020	Chamba Block, Tehri	30
6.	21/01/2021	Balagarh	30
7.	26/01/2021	Barrackpore	40
8.	23/02/2021 to 24/02/2021	CIFRI, Barrackpore (sustainable fisheries, hilsa conservation and dolphin awareness)	200
9.	05/03/2021	Sangam Nose, Prayagraj	50
10.	08/03/2021	Raj Ghat, Varanasi	40
11.	12/03/2021	NarvarChaukhatta, Manda	70
12.	16/03/2021	Kadadham, Kaushambi	50
13.	17/03/2021	Daspara Ghat, Barrackpore	150
14.	18/03/2021	Ram Ghat, Prayagraj	100
15.	16/03/2021	**Ganga Swachhta Pakhwada (16 to 31)** ICAR-CIFRI, Barrackpore, WB	200
16.	17/03/2021	Daspara Ghat, Barrackpore, WB	50
17.	18/03/2021	Ghatakapara Ghat, Barrackpore, WB	150
18.	19/03/2021	Balagarh, Hooghly, WB	30
19.	20/03/2021	Arail Ghat, Prayagraj, Allahabad, Uttar Pradesh	30
20.	21/03/2021	Chhatnagghat, Prayagraj, Allahabad, Uttar Pradesh	20
21.	22/03/2021	Gaighat, Hanuman Ghat, Loharwa Ghat, Goswami Ghat Patna, Bihar	30
22.	23/03/2021	Hulor Ghat and SwarupgunjFerryghat, Nabadwip, Nadia, West Bengal.	40
23.	24/03/2021	Ramrekha Ghat (रामरेखाघाट), Buxar, Bihar	25
24.	25/03/2021	Tribeni Ghat, Bansberia, Hooghly, West Bengal.	25
25.	26/03/2021	Barari Ghat, Bhagalpur, Bihar	25
26.	27/03/2021	Ramprasad Ghat, Halisahar, 24PGS (N), West Bengal.	20
27.	28/03/2021	Nabajganjghat, Devitalaghat, Ichapore, WB.	80
28.	29/03/2021	Farakka, Murshidabad, WB	30
		Cont…..	
29.	30/03/2021	Bagbazar Ghat, Kolkata Barahanagar Ghat, Kolkata	40
30.	31/03/2021	Birlapur Ghat, Budge Budge and Godakhali 24 PGS (S), WB	100
31.	18/03/2021 to 02/04/2021	Tehri (Uttrakhand)	40
32.	03/04/2021	Diamond Harbour, West Bengal	17
33.	10/07/2021	Bichuli ghat, Nawabganj Ghat and Daspara Ghat, Barrackpore	80
34.	10/07/2021	Sangam nose, Parayagraj	50
35.	10/07/2021	Garhwal, Uttarakhand	20
36.	05/08/2021	Maharajpur	20
37.	05/08/2021	Sahebganj	35

38.	05/08/2021	Farakka	70
39.	05/08/2021	Jangipur	30
40.	05/08/2021	Berhampore	20
41.	06/09/2021	Patna, Bihar	8
		Total	**2285**

5.1. Awareness Programme at Dasashwamedh Ghat and Sangam Nose, Prayagraj, 3rd and 4th November 2020

ICAR-CIFRI, Prayagraj has organized two mass awareness programs at Sangam Nose and Dasashwamedh Ghat, Daraganj situated at the bank of River Ganga on 3rd November and 4th November on the occasion of Ganga Utsav-2020. The gathered audiences were sensitized about the importance of cleanliness of River Ganga and ranching of the fishes done by ICAR-CIFRI under *Namami Gange* program to conserve and restore important fishes of the River Ganga.

Fig. 209. Awareness programme during Ganga Utsav at Dasashwamedh Ghat, Prayagraj

Fig. 210. Awareness programme during Ganga Utsavat Sangam Nose, Prayagraj

5.2. Awareness Program at Gandhi Ghat, Barrackpore, 4th November 2020

On the eve of Ganga Utsav 2020 initiated by National Mission for Clean Ganga (NMCG), ICAR-Central Inland Fisheries Research Institute, Barrackpore organized an awareness program at Gandhi Ghat, Barrackpore, 4th November 2020. Fifty local people including the fisher participated in this event.

5.3. Awareness Program at Sangam nose, Prayagraj, 21st November 2020

A mass awareness program was organized by ICAR-CIFRI, Prayagraj to celebrate World Fisheries Day at Sangam nose, Prayagraj on 21st November 2020. The program was organized under the Namami Gange program to aware the fishermen about the fish & fishery of the Ganga River and to restore & conserve the depleting fish species. The gathered audience was explained the importance of World Fisheries Day for sustainable use of water resources and fish. It was suggested to the fishermen community not to catch the brooder of IMCs during the breeding season. The audience was sensitized about how they can maximize the benefit from the fishery along with the importance of conservation of fishes of river Ganga for the fishermen community.

Fig. 211. Mass awareness programme at Village-Diha, Prayagraj

5.4. Awareness Program at Chamba Block, New Tehri, 21st November 2020

ICAR-CIFRI has organised an awareness Programme on the occasion of World Fisheries Day, on 21 November 2020 at Chamba Block, New Tehri with the State Fisheries department of Uttarakhand. In this program, local people were sensitized about the conservation and restoration plan of Mahseer at an upper stretch of River Ganga.

5.5. Awareness Program at Balagarh, Hoogly, 21st January 2021

An awareness campaign was organized on 'Dolphin Conservation of river Ganga' at Balagarh, Hoogly on 21st January 2021 to sensitize local people including fishers about the importance of Dolphin as a national aquatic animal and not to harm their habitat in Ganga River stretch. A total of thirty people participated in the awareness program.

Fig. 212. Awareness campaign on 'Dolphin Conservation of River Ganga' at Balagarh, Hoogly on 21st January 2021

5.6. Awareness Program at Daspara Ghat, Barrackpore, 26th January 2021.

A mass awareness program was also executed towards the fisheries conservation of the Ganga River and national aquatic animal of our country at Daspara Ghat, Barrackpore on 26th January 2021. A total of 40 local people were sensitized about the importance of dolphins as a national aquatic animal and their habitat through this awareness program.

Fig. 213. Dolphin awareness program at Barrackpore on 26th January 2021

5.7. Creation of awareness among stakeholders regarding sustainable fisheries and Gangetic Dolphin at Barrackpore, 23rd to 24th February 2021

A two-days workshop was organized by ICAR-CIFRI at Barrackpore under NMCG project from 23rd to 24th February 2021 to create awareness regarding sustainable management of riverine fisheries among Ganga fishers. More than 200 fishers from the upper Hooghly estuaryactively participated in the program and were sensitized regarding Hilsa conservation as well as conservation of fish stocks of river Ganga. The awareness was also created among fishers regarding Dolphin conservation and the importance of the Dolphin as a national aquatic animal of river Ganga. Some of the issues faced by the fishers as mentioned by them are (i) presence of a large amount of plastic garbage in water column disturbing net operation, (ii) pollution especially presence of a layer of oil-like substances in the water surface, discharged by local industries, (iii) destruction of the fishing net by movement of ships/transport vessel (iv) presence of a large number of solid wastes on water surface especially dead body of animals, (v) harassment by police / local goons, (vi) lack of appropriate fishers specific identity cards, (vii) requirement of a dedicated contact number for communication with ICAR-CIFRI, (viii) application of pesticides/poison for fishing, (ix) use of unscientific fishing gears with low / zero mesh size destroying juvenile fishes, (x) lack of other better job during the seasons of low / nil fish catch, etc.

Fig. 214 A

Fig. 214B

Fig. 214C

Fig. 214D

Fig. 214(A-D). Awareness programme of Ganga fishermen on 23rd to 24th February 2021

5.8. Awareness Programmeme at Sangam, Prayagraj, 5th March 2021

An awareness programme was held on 5th March 2021 at Sangam Nose (Prayagraj). Mrs. Anamika Chaudhari (Province convenor, Ganga Vichar Manch) was present as a chief guest on this occasion, she described and advised the people how to improve the Ganga biodiversity and control the pollution in river Ganga.

Fig. 215. Awareness campaign at Sangam, Prayagraj, on 5th March 2021

5.9. Awareness Program at Raj Ghat (Varanasi), 8th March 2021

ICAR-CIFRI, Prayagraj Center organised a mass awareness programme on 8th March 2021 at Raj Ghat, Varanasi. On this occasion, Ravindra Prasad CEO of Fisheries Department, Varanasi was present as a chief guest and Ex P.S. Dr. B. K. Singh was a special guest, and they have advised fisher and other participants on how to maintain the Biodiversity of the Ganga River and also to improve the water quality.

Fig. 216. Awareness program at Prayagraj, 8th March 2021

5.10. Awareness Program at Manda (Prayagraj), 12th March 2021

A mass awareness program was held by ICAR-CIFRI, Prayagraj Center at Narvarchaukhatta, Manda on 12th March 2021. On this occasion, Ex-official of FCI Manvendra Singh was present as chief guest, and Rajesh Sharma (Member of Ganga Vichar Manch) as Special guest, he briefly described the importance of the river Ganga and how to keep clean and green Ganga River bank and also describe the importance of river Ranching.

Fig. 217. Awareness programme at Manda, Prayagraj, 12th March 2021

5.11. Awareness programme at Kada Dham (Kaushambi), 16th March 2021

Mass awareness programme was held on 16th March 2021 at Kada Dham (Kaushambi) to sensitize local people towards the fisheries conservation of Ganga River and Dolphin a national aquatic animalals. On this occasion, Shri Rajesh Sharma (Ganga Vichar Manch) was present as chief guest, he had described the importance of the Ganga River and also advised the fishers not to capture fish in the breeding season.

Fig. 218. Awareness programme at Kada Dham, Kaushambi, 16th March 2021

5.12. Awareness programme at Daspara Ghat, Barrackpore, 17th March 2021

The awareness programme was organised by ICAR-CIFRI under NMCG project on the occasion of the 75th (Platinum Jubilee) Foundation day of CIFRI at Daspara Ghat, Barrackpore on 17th March 2021. Awareness was created among local fishers regarding sustainable fisheries of river Ganga. More than 150 fishers have actively participated in this awareness program.

Fig. 219. Awareness programme at Barrackpore, 17th March 2021

5.13. Awareness program at Ram Ghat (Prayagraj), 18th March 2021

ICAR-CIFRI, Prayagraj Center organised a mass awareness programmeatRamghat (Prayagraj) on 18th March 2021. On this occasion, Shri Shekhar Kumar Yadav (Judge of High Court, Prayagraj UP) was present as a Chief Guest and he told about Indian culture and importance of women power in India as well as how to keep clean Ganga river and maintain their biodiversity Shri Rajesh Sharma (Member of Ganga Vichar Manch) and Suresh Chandra (head of Harihar Ganga Arti Samiti Prayagraj) were also advised to people how to decrease pollution in Ganga River.

Fig. 220. Awareness program at Ramghat (Prayagraj) on 18th March 2021

5.14. Celebration of 'Ganga Swachhta Pakhwada' from 16th to 31st March 2021

The objective of the Ganga Swachhta Pakhwada is to spread awareness and evoke active involvement of the masses through Ganga Swachhta Sankalp (Pledge) reiterating their commitment to Swachh Ganga. National Mission for Clean Ganga (NMCG) team, ICAR-CIFRI, Barrackpore had also started this mission from 16th to 31st March 2021 through a series of events like Ganga cleaning awareness, SwachhtaSankalp, etc. to develop a sense of pride and ownership among citizens to engender support for NamamiGangeprogramme. A total of 895 local people and fishermen were sensitized during **'Ganga Swachhta Pakhwada'.** The detailed report is tabulated below:

Table 15. Ganga Swachhta Pakhwada at different place/ghat along Ganga River bank

Date	Place	Activities	Numbers of people sensitized
16.03.2021	ICAR-CIFRI, Barrackpore, WB	Awareness among the fishermen	200
17.03.2021	Daspara Ghat, Barrackpore, WB	Awareness and Ranching	50
18.03.2021	Ghatakapara Ghat, Barrackpore, WB	Awareness and Ranching of indigenous fish	150
19.03.2021	Balagarh, Hooghly, WB	Ganga ghat cleaning and awareness	30

20.03.2021	Arail Ghat, Prayagraj, Allahabad, Uttar Pradesh	Ganga ghat cleaning, removal of used plastic and related items were carried out followed by poster hanging on Ganga Cleaning Awareness. Local people, priests near ghat, local shop-owners also became a part of the program.	30
21.03.2021	Chhatnagghat, Prayagraj, Allahabad, Uttar Pradesh	The team cleaned the ghat area and surroundings, posters were hanged on wall of the ghat and near the market area. Local people were made aware ofthe used plastic material and also make them understand the adverse effect on plastic in Ganga.	20
22.03.2021	Gaighat, Hanuman Ghat, Loharwa Ghat, Goswami Ghat Patna, Bihar	More than 30 local people presented and actively participated in the Cleanliness drive. Different Cleanliness activities as dustbin cleaning and removal of plastic from Ganga associates water body were performed during the program. Local people were sensitized through displaying of posters at nearby Ghat of Ganga River.	30
23.03.2021	Hulor Ghat and SwarupgunjFerryghat, Nabadwip, Nadia, West Bengal.	People using ferry services were made aware about the importance of keeping the Ganga clean and they were motivated not to throw used plastic items in the River. Ghat cleaning and poster hanging related to Ganga Cleaning Awareness carried out as a part of the program.	40
24.03.2021	Ramrekha Ghat (रामरेखाघाट), Buxar, Bihar	Local people were made aware about the cleanliness drive. Litter bin cleaning, removal of used plastic items from the bank of the River were carried out with the help of local people. Multiple posters related to Ganga cleaning awareness were introduced surrounding the ghat area.	25

Cont…

25.03.2021	Tribeni Ghat, Bansberia, Hooghly, West Bengal.	Local people who uses these ghats for day-to-day use for cleaning and bathing purpose were made aware about the importance of keeping the Ganga clean and they were motivated not to throw used plastic items ion the River. Ghat cleaning and poster hanging related to Ganga Cleaning Awareness carried out as a part of the program. 20-25 local people were present during the cleanliness observation including fishermen, boatmen and others.	25
26.03.2021	Barari Ghat, Bhagalpur, Bihar	Ghat cleaning and poster hanging related to Ganga Cleaning Awareness were carried out as a part of the program. The program was well supported by local residents, Bhagalpur Municipal Corporation, local representatives, priests and the nearby shopkeepers.	25

27.03.2021	Ramprasad Ghat, Halisahar, 24PGS (N), West Bengal.	This ghat is well known for holy bathing and people over there were made aware of the importance of keeping the Ganga clean. Several fishermen were made aware of the importance of small fishes in Ganga and why we should not catch them during fishing. Ghat cleaning and poster hanging related to Ganga Cleaning Awareness carried out as a part of the program.	20
28.03.2021	Nabajganjghat, Devitalaghat, Ichapore, WB.	Cleaning of ghat area, sticking banners around ghat and near the market area. The cleaning of the plastic material and also make them understand the adverse effect on plastic in Ganga. Further sensitized some local fishermen through awareness for clean Ganga and also Hilsa awareness, that not to catch very small size and matured Hilsa with full of egg and advised them not to catch this kind of Hilsa, if caught, it should be released again into the Ganga and make them complete their life cycle.	80
29.03.2021	Farakka, Murshidabad, WB	A cleanliness drive was carried atHilsa ranching station located on the bank of Ganga River. Mass awareness was carried out to sensitize the local fishers about the cleanliness of the river Ganga.	30
30.03.2021	Bagbazar Ghat, Kolkata Barranagar Ghat, Kolkata	SwachchataSankalp and mass awareness programwas carried out with local residents followed by thecleaning and awareness onHilsa fisheries and its conservation. A new inflated boat (Swacchta Boat) was introduced by ICAR-CIFRI at Daspara Ghat, Barrackpore to mark the Ganga Swacchta Observation week.	40
31.03.2021	Birlapur Ghat, Budge Budge and Godakhali 24 PGS (S), WB	The cleanliness drive was carried out on the bank of Ganga River. Awareness was carried out to sensitize the local people, fishermen about the cleanliness of the river Ganga.	100

Fig. 221a. Awareness at Gai Ghat, Patna, Bihar; Date: 22nd March 2021


Fig. 221 b Place: Ramrekha Ghat, Buxar, Bihar; Date: 23rd March 2021

Fig. 221 c Place: Hulor Ghat and Swarupganj Ferryghat, Nabadwip, West Bengal; Date: 23rd March 2021

Fig. 221(A-C). Different events performed in Bihar & West Bengal during Ganga Swacchta Pakhwada events

5.15. Creation of awareness among stakeholders regarding sustainable fisheries and Gangetic Dolphin at Tehri (Uttrakhand), 18th March to 2nd April 2021

Two days mass awareness programme on conservation of indigenous fish species as Mahseer and Snow trout was organized by ICAR-CIFRI at Koteshwar hatchery, Tehri (Uttarakhand) during 18th March to 2nd April 2021. More than 40 local fishers, villagers, children & women actively participated in this program. Dr. B. K. Das, Director ICAR-CIFRI and Garima Mishra, ADF, Department of Fisheries, Tehri addressed the participants through video call. They requested the fishers not to use mosquito nets for fishing and not to catch brooders and fingerlings of these species. Scientists & scholars of CIFRI and State fisheries department officials were also present in this program.

Fig. 222. Mass awareness programmeon Mahseer and Snow trout conservation at Tehri, Uttrakhand

Fig. 223. Participants taking the oath of Mahser and Snow Trout conservation

5.16. Awareness program at Diamond Harbour, South 24 parganas, 3rd April 2021

A Dolphin conservation awareness programme was organized at Diamond Harbour, South 24 Parganas on 3rdApril, 2021 to create awareness among local people including fishers. A total of 17 people were participated in the awareness programme. The people were sensitized about the importance of Dolphin as national aquatic organisms and requested not to kill dolphins and protect them.

Fig. 224. Awareness programme on Dolphin conservation at Diamond Harbour, 3rd April

2021

5.17. Creation of awareness among stakeholders regarding sustainable fisheries and Gangetic Dolphin at Bichuli Ghat, Nababganaj and Daspara ghat, Barrackpore, 10th July 2021

Three consecutive awareness programmes were arranged to celebrate '*Bharat Ki Azadi Ka Amrut Mahotsav*' by following Covid 19 protocol at Bichuli Ghat, Nababganj and Daspara ghat, Barrackpore on 10th July 2021. More than 80 local people along with fishers were aware regarding restoration and conservation of depleted fish stock as well as Gangetic Dolphin conservation in the river Ganga. Dr. Basanta Kumar Das, Director, ICAR-CIFRI interacted with fishermen and urged the fishermen community to attain sustainable development goals for improving the fish stocks of river Ganga which in turn could augment the fisheries production in future. He also created awareness regarding the importance of the Gangetic Dolphin as a National Aquatic Animal and explained the way fishers can contribute to conservation by their active participation and involvement. Masks were distributed among the local people during the awareness programme. Leaflets on IMC and Hilsa conservation were also distributed to create awareness among the local people.

Fig. 225A. Awareness programme at Bichuli Ghat, North 24 Pgs on 10th July 2021

Fig. 225B. Awareness programme at Nababganj Ghat, North 24 Pgs on 10th July 2021

Fig. 225C. Awareness programme at Daspara Ghat on 10th July 2021

5.18. Awareness programme at Sangam Nose, Ram Ghat and Dasasvamedh ghat (Daraganj) of Prayagraj, 10th July 2021

For celebrating the commemoration of 75 years of Indian independence (in the form of *Bharat Ki Azadi Ka Amrut Mahotsav*) a National campaign on "Ecosystem management for sustainable fisheries" and an awareness program on Fish and Dolphin conservation of river Ganga were celebrated at Sangam Nose, Ram Ghat and Dasasvamedh ghat (Daraganj) of Prayagraj. Priest, pilgrims, fishers and the local public present in the ghats were aware of the cleaning of river Ganga. They were requested not to throw religious waste, polybags, cloths, soaps wrapper, worship materials, etc. in the ghats of the Ganga. They were also aware of the conservation of fishes, dolphins, and other aquatic species. A total of 50 people were sensitized through this awareness campaign.

Fig. 226A. Awareness campaign at Ram Ghat, Prayagraj on 10th July 2021

Fig. 226B. Discussion was made with local people during awareness program at Daraganj, Prayagraj on 10th July 2021

Fig. 226C. Awareness campaign at Sangam nose, Prayagraj on 10th July 2021

Fig 226(A-C): Awareness campaigns at different ghats of Prayagraj, Uttar Pradesh

5.19. Awareness programme at Garhwal, Uttarakhand, 10th July 2021

Awareness programme was organized by ICAR-CIFRI, NMCG team in association with Fisheries Department, Tehri, at Garhwal, Uttarakhand on 10th July 2021 to sensitize local fishers for conservation of mahseer and snow trout fish species of river Ganga. More than 20 local people have actively participated in this programme.

Fig. 54 A Fig. 54 B

Fig. 227 (A-B). Awareness programme at Garhwal, Uttarakhand on 10th July 2021

5.20. Awareness programme at Maharajpur, Sahebganj, Farakka, Jangipur, and Berhampore covering Jharkhand and West Bengal States on 5th August 2021

Awareness was also conducted with ranching programme among stakeholders regarding sustainable fisheries at 5 different depleted Ganga River stretch like Maharajpur, Sahebganj, Farakka, Jangipur, and Berhampore covering Jharkhand and West Bengal States on 5th August 2021. This initiative was graced by General Manager, Farakka Barrage, Supritending Engineer, and other local dignitaries. The event was organized following the Covid-19 protocol at different ghats with the distribution of masks and sanitizers. Active participation was noticed among all the sections of the society including local fishers at different Ganga banks. A total of 175 people were sensitized through this awareness campaign. The awareness was created regarding the depleted fish stock of Ganga River along with the importance of Gangetic health required to sustain fishes and Dolphins as well as Hilsa fisheries. The programme was made a great success under the leadership of Dr. B. K. Das, Director, ICAR-CIFRI, and Principle Investigator of the NMCG project. ICAR-CIFRI scientists, H. S. Swain and M.H. Ramteke coordinated the ranching program.

Fig. 228A. Awareness pragramme at Farakka

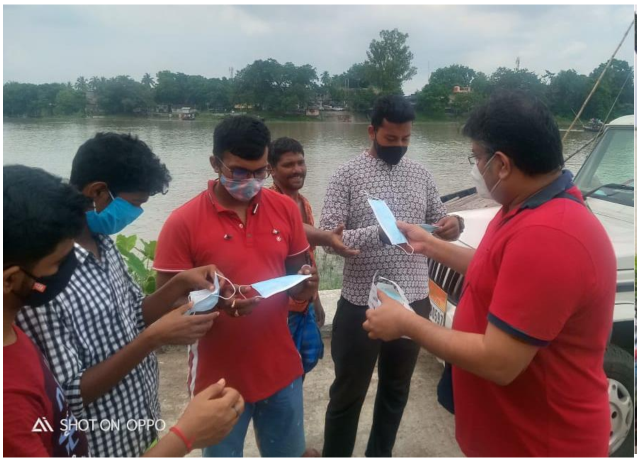


Fig. 228B. Awareness programme at Jangipur

Fig. 228C. Awareness programme at Sahebganj

Fig. 228 (A-C). Awareness at different sites of West Bengal and Jharkhand

5.21. Awareness programme at Patna, Bihar, 6th September 2021

Awareness was made among local fishers regarding sustainable fisheries of river Ganga along with Dolphin conservation at Patna, Bihar on 6th September 2021. Dr. Basanta Kumar Das, Director, ICAR-CIFRI interacted with local fishermen and create awareness regarding the importance of the National Aquatic Animal, and explained the way fishers can contribute to conservation by their active participation and involvement. Active participation was noticed among the local fishers at Ganga banks.

Fig. 229. Awareness at Patna, Bihar on 6th September 2021

Period 2021-2022

During the project's duration October 2021- September 2022, ICAR-CIFRI carried out 58 awareness programmes under this activity (Table 16.). A total of 3413 fishermen were made aware of the negative effects of destructive fishing techniques, such as the use of toxic chemicals or poisoning, through an awareness campaign in five states, including Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal. They were also advised not to catch juveniles and brooders, especially during the breeding seasons (June to August) for their eggs. Local fishermen have taken notice of CIFRI's initiative to restore the prized fishes of the Ganga under the project. At several ghats, an awareness programme was held while adhering to the Covid-19 procedure, and masks and hand sanitizer were distributed. All social groups, including neighborhood fishermen, actively participated at various Ganga banks. The locals were also instructed to pursue sustainable development objectives to increase the Ganga River's fish supplies, which might later increase fisheries production.

Table 16. List of awareness program conducted during the year (November 2021- September 2022)

Sl No.	Date	Place	State	Number of people awared
1.	01/11/2021	Barendrapara Ghat, Belur Math, Howrah	West Bengal	98
2.	02/11/2021	Nawabganj Ghat, Icchapur	West Bengal	102
3.	02/11/2021	Near Chandannagar, Hooghly	West Bengal	200
4.	03/11/2021	Minto Park, Prayagraj	Uttar Pradesh	100

5.	10/11/2021	Krishnagar and Jibontala, Sagar Island, South 24 Pgs	West Bengal	350
6.	15/11/2021	Sangam nose, Prayagraj	Uttar Pradesh	100
7.	17/11/2021	Balagarh, Hooghy	West Bengal	50
8.	23/11/2021	Gandhi Ghat, Barrackpore	West Bengal	42
9.	22/12/2021	Nistarini Ganga Ghat, Sheoraphuly	West Bengal	156
10.	06/03/2022	Barari Ghat Bhagalpur	Bihar	52
11.	07/03/2022	Loharwa Ghat, Patna	Bihar	26
12.	07/03/2022	Kuntighat, Tribeni	West Bengal	15
13.	07/03/2022	Godakhali	West Bengal	18
14.	08/03/2022	Hanuman Ghat, Patna	Bihar	22
15.	08/03/2022	SwarupgunjGhat, Nabadwip	West Bengal	28
16.	08/03/2022	Diamond Harbour	West Bengal	36
17.	08/03/2022	TaltalaGhatFarakka	West Bengal	28
18.	09/03/2022	Beniagram, Farakka	West Bengal	34
19.	09/03/2022	Jail Road, Buxar	Bihar	31
20.	10/03/2022	Balia	Uttar Pradesh	30
21.	10/03/2022	MilandeepGhat, Balagarh	West Bengal	39
22.	17/03/2022	ArailGhat, Prayagraj	Uttar Pradesh	76
23.	28/03/2022	Sangam, Prayagraj	Uttar Pradesh	54
24.	14/05/2022	Gandhi Ghat, Barrackpore	West Bengal	57
25.	17/05/2022	Ayodhya	Uttar Pradesh	96
26.	25/05/2022	TaltalaGhat, Farakka	West Bengal	236
27.	26/05/2022	RanirGhat, Nabadwip	West Bengal	43
28.	31/05/2022	Dakshineswar	West Bengal	22
29.	02/06/2022	Sultanganj, Bhagalpu	Bihar	84
30.	03/06/2022	Patna	Bihar	112
31.	04/06/2022	Sarai Kota village, Ballia	Uttar Pradesh	10
32.	05/06/2022	Narayanpurghat, Ballia	Uttar Pradesh	12
33.	06/06/2022	Nasirpur math village, Ballia	Uttar Pradesh	20
34.	07/06/2022	Kali Ganga ghat, kotwa village	Bihar	05
35.	08/06/2022	Narwatpur village, Buxar	Bihar	05
36.	08/07/2022	Godakhali, South 24 Pgs	West Bengal	28
37.	08/07/2022	Fraserganj, South 24 Pgs	West Bengal	32
38.	02/08/2022	Mukteshwar Ghat, Sahibganj	Jharkhand	100

39.	19/08/2022	Assi ghat, Varanasi	Uttar Pradesh	250
40.	07/09/2022	Durgamandir Ghat, Tribeni	West Bengal	12
41.	08/09/2022	Milandwip Ghat, Balagarh	West Bengal	15
42.	12/09/2022	Godakhali, South 24 Pgs.	West Bengal	15
43.	13/09/2022	Fraserganj, South 24 Pgs.	West Bengal	12
44.	13/09/2022	Rajghat, Patna	Bihar	30
45.	13/09/2022	Gosaighat, Patna	Bihar	47
46.	14/09/2022	Bazar samiti, Rajendranagar, Patna	Bihar	38
47.	14/09/2022	Rajghat, Patna	Bihar	24
48.	15/09/2022	Kotowa ghat, Buxar	Bihar	48
49.	15/09/2022	Nasirpur (Mathia), Buxar	Bihar	52
50.	16/09/2022	Ahirouli, Buxar	Bihar	51
51.	16/09/2022	Barari Ghat, Bhagalpur	Bihar	20
52.	16/09/2022	Jahanwi Ghat, Bhagalpur	Bihar	62
53.	20/09/2022	Farakka, Murshidabad	West Bengal	48
54.	21/09/2022	Par Lalpur Ghat, Dhuliyan	West Bengal	35
55.	21/09/2022	Gandhi colony, Berhampore	West Bengal	10
56.	21/09/2022	Krishnamati Ghat, Berhampore	West Bengal	28
57.	22/09/2022	Rejinagar, Berhampore	West Bengal	55
58.	23/09/2022	Shakuntala Ghat, Sahibganj	Jharkhand	12
		Total		**3413**

5.22. Awareness campaign at Barendrapara ghat, Nawabganj ghat and Chandanagar Jetty ghat, 1st to 3rd November 2021

The CIFRI-NMCG team conducted an awareness programme at different ghat viz. Barendrapara ghat, Nawabganj ghat and Chandanagar Jetty ghat of Ganga bank from 1st to 3rd November 2021 and around 400 people were sensitized for the conservation of Gangetic fish, hilsa and dolphins in the Ganga River.

5.23. Awareness programme at Minto Park, Prayagraj, 3rd November 2021

Ganga gothic (conference) was organized at Minto Park, Prayagraj on 3rd November 2021 to sensitize the people to keep Ganga clean and unpolluted. The whole event was organized with the collaboration of NamamiGange, Ganga Vichar Manch, District Ganga Samiti, Ganga Task Force, and the Forest Department of Uttar Pradesh. Different speakers addressed the gathered mass on the occasion.

5.24 Awareness session at Krishnagar and Jibontala, Sagar Island, 10th November 2021

A mass awareness programme was organized at Krishnagar and Jibontala, Sagar Island, South 24 Pgs, West Bengal on 10th November 2021 towards the conservation of indigenous fish species of Ganga, hilsa and dolphin as well as Ganga resources. A total of 350 people participated in the programme.

Fig. 230. Glimpses of awareness at **A-B)** Barendrapara Ghat, Belur Math, Howrah; **C-D)** Nawabganj Ghat, Icchapur on 02.11.2021, **E)** Ganga conference at Minto Park, Prayagraj on 03.11.2021 **F)** Krishnagar and Jibontala, Sagar Island, West Bengal on 10.11.2021

5.25. Awareness programme at Sangam Nose, Prayagraj, 15th November 2021

At the holy confluence of Sangam, Prayagraj, a mass awareness programme was organised by ICAR-CIFRI, Prayagraj Center on 15th November 2021. Dr. J. K. Jena, hon'ble DDG (Fisheries Science, ICAR) was the Chief Guest of the occasion, and he explained the importance of conserving resources of river Ganga and ways to increase the livelihood of fishermen. Twenty cast nets were distributed among the fishers to encourage them for fishing. Social worker, Smt. Kavita Tripathi participated in the program as a special guest. She called upon the gathered public to keep Ganga clean and conservation of biodiversity. The bulletins, booklets and leaflets published by the institute were released on this occasion. Convenor, Ganga Vichar Manch, Member from NMCG and more than 100 fishers participated in the programme. Rajesh Sharma administered an oath towards the audience to keep the Ganga clean.

5.26. Awareness programme at Balagarh, Hooghly, 17th November 2021

An awareness programme was organized at Balagarh on 17th November 2021 to create awareness among local people including fishers along the Ganga River stretch regarding the conservation of indigenous fish species of Ganga, hilsa and dolphin as well as Ganga resources. A total of 50 local people participated in this awareness programme.

5.27. Awareness campaign at Gandhi Ghat, Barrackpore, 23rd November 2021

On ‘Ganga Mashaal Yatra’, an awareness campaign programme by the ICAR-CIFRI team at Gandhi Ghat, Barrackpore on 23rd November 2021. More than 42 local people were sensitized towards sustainable fisheries, hilsa and dolphin conservation.

5.28. Awareness session at Nistarini Ganga Ghat, Sheoraphuli, 22nd December 2021

On the occasion of Akhuratha Sankashti Chaturthi, an awareness programme was organized by ICAR-CIFRI under the NMCG project at Nistarini Ganga Ghat, Sheoraphuli on 22nd December 2021. Awareness was created towards enhancing the indigenous germplasm conservation, conservation of aquatic biodiversity, sustainable fisheries, and Ganga River health. Awareness also created among fishers regarding Dolphin conservation and the importance of Dolphin as a national aquatic animal of River Ganga. Dr. B. K. Das, Director, ICAR-CIFRI in his address, emphasized the rejuvenation of the river Ganga through the ranching of indigenous fish species towards enhancing the indigenous germplasm conservation. Active participation of more than 150 of local people including fishers was noticed in this awareness programme.

Fig. 231. Glimpses of awareness at **G)** Sangam Nose (Prayagraj, U.P.) on 15.11.2021; **H)** Participants at Sangam, Prayagraj **I)** Balagarh, Hooghly on 17.11.2021 **J)** Nistarini Ganga Ghat, Seoraphully on 22nd December 2021

5.29. Awareness programme at Arail Ghat, Prayagraj, 17th March 2022

To celebrate the 76th foundation day of ICAR-CIFRI, a mass awareness program was organized by the CIFRI Prayagraj center under the NMCG project at Arail Ghat (Prayagraj) on 17th March 2022. Dr. Sunanda Chaturvedi (Principal, H.N.B.P.G. College, Naini, Prayagraj) sensitized the local gathered towards the conservation of depleted fish stock of river Ganga and Dr. Awadesh Kumar Jha (Professor) stated the importance of Ganga for human civilization. The Convenor, Ganga Vichar Manch, and NMCG, Mr. Rajesh Sharma administrated the oath to students and gathered an audience during the programme. A total of 76 local people including fishers participated in the awareness programme.

5.30. Awareness campaign at Sangam, Prayagraj, 28th March 2022

ICAR-CIFRI, Prayagraj center organized a Holy ranching cum awareness campaign at Sangam, Prayagraj on 28th March 2022 towards the conservation of indigenous fish of river Ganga as well as Dolphin conservation. Mahanth Balbir Giriji Maharaj, the Head of the Baghambari Gaddi Math was the chief guest of this program. While addressing the function, he explained the importance of the river Ganga for human civilization, and culture and called for keeping it clean. Mr. Rajesh Sharma, Convenor, Ganga VicharManch, and NMCG, briefed about the importance of River Ganga and urged to save it. On this occasion, social workers namely Rajendra Kumar Tiwari (Dukanji), Narendra Nath Upadhyay Vyas, and Ranjan Sharma also expressed their views on keeping a clean and continuous flow of River Ganga. Several pilgrims, fishers, priests, and the public participated in this program. Around 54 local people including fishers were present and sensitized through this awareness programme.

5.31. Multiple awareness session at Buxar, Patna and Bhagalpur, Bihar, 6th to 10th March 2022

A total of three multiple awareness campaigns were organized by ICAR-CIFRI under the NMCG project at Bhagalpur, Patna, and Buxar stretch of river Ganga from 6th to 10th March 2022 for creating awareness of local people including fishers towards the conservation of depleted fish stock of Ganga River along with conservation of Gangetic Dolphins as well as hilsa fisheries. A total of 161 people were sensitized through this awareness programme.

Fig. 232 **K)** Arail Ghat, Prayagraj on 17th March 2022; **L)** Sangam, Prayagraj on 28th March 2022 **M)** Bararighat, Bhagalpur 06.03.2022 **N)** Loharwaghat, Patna 07.03.2022 **O)** Hanuman ghat, Bihar 08.03.2022 **P)** Balia, UP, 10.03.22

5.32. Awareness session at Farakka, West Bengal, 8th to 9th March 2022

In line with fish and dolphin conservation, two awareness programs were organized by ICAR-CIFRI under the NMCG project at Farakka, West Bengal on 8th and 9th March 2022. Local fishers were sensitized about holistic fisheries and biodiversity conservation of river Ganga. A total of 62 people participated in this awareness programme.

5.33. Multiple awareness programme at Nabadwip, Balagarh and Tribeni, West Bengal, 7th to 10th March 2022

From 7–10th March 2022, a multiple awareness workshop at Tribeni, Nabadwip, and Balagarh, was hosted by the ICAR-CIFRI NMCG team to create sensitization among fishermen about IMCs, hilsa, and dolphin conservation in the River Ganga. The importance of Indian major carp to fishermen's livelihood was brought up, and it was advised not to catch the young fish until they reached a size that would make them viable. Along with steps for Dolphin Conservation taken by the Institute, current activities on improving hilsa production in the Ganga were highlighted in detail. 82 neighborhood residents took part in the awareness campaign in all.

5.34. Series of awareness programme at Godakhali, Diamond Harbour, West Bengal, 7th to 8th March 2022

On March 7th to 8th, 2022, ICAR-CIFRI organized three consecutive awareness events at Godakhali, Diamond Harbour. All social groups, including local fishermen, showed active engagement at the ranching ghat. The Ganga River's declining fish population and the significance of Ganges' health in maintaining fish, dolphins, and hilsa fisheries were made public. 54 neighborhood residents in all took part in this awareness event.

Fig. 233. Glimpses of awareness at **Q)** Taltala Ghat, Farakka on Fish diversity conservation 08.03.2022; **R)** Beniagram, Farakka on Dolphin conservation 09.03.2022 **S)** Kuntighat, Tribeni on 7th March 2022 **T)** Swarupgunj Ghat, Nabadwip on 8th March 2022**U)** Milandeep Ghat, Balagarh on 10th March 2022 **V)** Godakhali on 7th March 2022 **X)** Diamond Harbour on 8th March 2022

5.35. Awareness programme at Gandhi Ghat, Barrackpore, West Bengal, 14th May 2022

As a part of the "***National Ranching Program-2022***" an awareness program was held at Gandhi Ghat in Barrackpore, West Bengal on May 14th, 2022, in the honourable presence of Mr. Shri G Asok Kumar, IAS, Director General of the NMCG and PD of the NRCD. Local fishermen were made aware of the necessity of Gangetic health for the survival of fish and dolphins by Shri G Asok Kumar and Dr. B. K. Das, Director, ICAR-CIFRI. 57 local fishers in all took part in this activity.

5.36. Awareness programme at Ayodhya, Uttar Pradesh, 17th May 2022

On May 17, 2022, ICAR-CIFRI and CIFRI Prayagraj Regional Center held an awareness session near the bank of the Saryu River in Ayodhya, Uttar Pradesh, as part of the "***National Ranching Programme-2022***." Local fishermen were made aware of the need to conserve Gangetic resources and dolphins during the event, which was attended by Dr. B. K. Das, Director of ICAR-CIFRI, Shri Ved Prakash Gupta, Hon'ble MLA, Ayodhya, and Shri Nitish Kumar, DM, Ayodhya. 96 residents from the nearby area actively participated in this event.

5.37. Awareness programme at Gandhi Ghat, Farakka, West Bengal, 25th May 2022

The third awareness programme for the "***National Ranching Program-2022***" was held by ICAR-CIFRI on May 25, 2022, in Taltala Ghat, Farakka, West Bengal. Amalendu Barman, ADF, Junaid Ahmed, BDO, Naresh Talwar, SP, and Dr. B. K. Das, Director of ICAR-CIFRI and Principal Investigator of the project, were among the dignitaries who attended the programme. They educated the local fishing community about the need to conserve the hilsa and dolphin populations as well as local fish populations. 236 locals, including fishermen, were sensitized because of this campaign.

5.38. Awareness programme at Ranir Ghat, Nabadwip, West Bengal, 26th May 2022

As part of the "***National Ranching Program-2022***," ICAR-CIFRI held an awareness programme in Ranir Ghat in Nabadwip, West Bengal, on May 26, 2022. Along with other distinguished visitors, the programme was attended by Dr. B. K. Das, Director of ICAR-CIFRI, District Fishery Officer of Nadia District, Mr. Ramesh Chanrda Biswas, and Mr. Dhiren Murmu. 43 locals in all were sensitized as a result of this campaign.

Fig. 234. Glimpses of awareness at **Y)** Gandhi Ghat, Barrackpore, West Bengal on 14th May 2022 **R)** Beniagram, Farakka on Dolphin conservation 09.03.2022 **Z)** Ayodhya, Uttar Pradesh on 17th May 2022 **AA)** Gandhi Ghat, Farakka, West Bengal on 25th May 2022 **AB)** Ranir Ghat, Nabadwip, West Bengal on 26th May 2022

5.39. Holy awareness programme at Dakshineswar, West Bengal, 31st May 2022

In continuation of the event, the 5th awareness programme was organized by ICAR-CIFRI at the Holy Kali temple spot at Dakshineswar, West Bengal on 31st May 2022, where more than 22 local fishers were sensitized. The event was graced by Mr. Brijesh Sikka, Senior Consultant, NMCG , and Dr. Sandeep Behera, Consultant, NMCG. The dignitaries highlighted the significance of riverine resources and fish diversity of river Ganga and made awareness towards hilsa and dolphin conservation among the fishers. People were also sensitized about the use of non-conventional fishing methods such as poisoning and zero mesh size nets.

5.40. Awareness campaign at Sultanganj, Bhagalpur, Bihar, 2nd June 2022

As a part of ***'National Ranching Programme-2022'***, an awareness campaign was conducted at Sultanganj, Bhagalpur, Bihar on 2nd June, 2022. A total of 84 local people were sensitized and highlighted the importance of Gangetic health required to sustain fish and Dolphins. They also sensitized about the use of non-conventional fishing methods such as poisoning and zero mesh size nets.

5.41. Awareness session at Patna, Bihar, 3rd June 2022

An awareness programme was conducted towards the conservation of Ganga fisheries, hilsa and dolphins at Patna, Bihar on 3rd June, 2022. Total of 112 local people was sensitized through this programme. The dignitaries highlighted the significance of riverine resources and fish diversity of river Ganga and made awareness for hilsa and dolphin conservation among the fishers. They also sensitized about the use of non-conventional fishing methods such as poisoning and zero mesh size nets.

5.42. Awareness programme at Ballia, Uttar Pradesh, 4th to 6th June 2022

A series of awareness was conducted at Sarai Kota village, Narayanpur ghat and Nasirpur math village in Ballia, Uttar Pradesh from 4th to 6th June, 2022 where more than 40 fishers were sensitized towards conservation of indigenous fish stock, hilsa and dolphin in the river Ganga.

5.43. Awareness campaign at Buxar, Bihar, 7th and 8th June 2022

Multiple awareness campaign was conducted at Kali Ganga ghat and Narwatpur village in Buxar, Bihar on 7th and 8th June, 2022 and 10 fishers were sensitized towards the conservation of indigenous fish stock, hilsa and dolphin in the river Ganga.

Fig. 235. Glimpses of awareness at **AC)** Dakshineswar, West Bengal on 31st May 2022 A**D)** Sultanganj, Bhagalpur, Bihar on 2nd June 2022 **AE)** Patna, Bihar on 3rd June 2022 **AA)** Gandhi Ghat, Farakka, West Bengal on 25th May 2022 **AF)** Nasirpur math village, Ballia, Uttar Pradesh on 6th June 2022 **AG)** Narwatpur village, Buxar, Bihar on 8th June 2022 **AH)** Nasirpur village, Ballia, Uttar Pradesh on 10th June 2022

5.44. Awareness session at Godakhali, South 24 Pgs, West Bengal, 8th July 2022

A mass awareness campaign was organized at Godakhali towards the conservation of indigenous fishes including hilsa and dolphins in the river Ganga. Approximately 28 local fishermen participated enthusiastically. There was a mixed response from fishermen in the awareness campaign conducted by the visiting team. The local people and fishers were sensitized to protect and conserve endangered fish species including hilsa and dolphins. Most of the fishermen realized the importance of fish conservation and the negative impact of overexploitation. They were also sensitized towards adopting eco-friendly fishing methods for developing sustainable fisheries. They were also informed about the ongoing activities of ICAR-CIFRI under the NMCG project and initiatives towards replenishing and recouping the fish germplasm in river Ganga by river ranching and mass awareness programme.

5.45. Awareness programme at Fraserganj, South 24 Pgs, West Bengal, 8th July 2022

To create awareness among local people towards the conservation of indigenous fish species including hilsa and dolphin. An awareness programme was conducted at Fraserganj Jetty Ghat, West Bengal Active participation of 32 local people was observed during the programme. A discussion was also made with fishers regarding their sustainability issues related to fishing and livelihood.

Fig. 236A. Awareness programme at Godakhali, South 24 Pgs, 8th July 2022

Fig.236B Awareness programme at Fraserganj, South 24 Pgs, 8th July 2022

5.46. Awareness programme at Sahibganj, Jharkhand, 2nd August 2022

ICAR-CIFRI NMCG team conducted an awareness campaign at Mukteshwar Ghat, Sahibganj, Jharkhand towards the conservation of indigenous fishes including dolphins in the river Ganga. In this programme more than 100 local fishermen from a local cooperative society participated. Further conservation stride toward hilsa restoration by ICAR-CIFRI was also discussed. Shri Ramniwas Yadav (IAS) took active participation in the programme and sensitized local fishermen to protect and conserve endangered fish species including dolphins in the region. A meeting was also held between Dr. B.K. Das, Director, ICAR-CIFRI with Mr. Ashok Choudhary, Chairman of Jharkhand Eastern Gangetic Fishermen Cooperative Society Limited regarding fish diversity conservation of river Ganga in the stretch.

5.47. Awareness programme at Varanasi, Uttar Pradesh, 19th August, 2022

A mass awareness programme related to sustainable fisheries of river Ganga was conducted at Assi ghat, Varanasi, Uttar Pradesh under the 'NamamiGange' programme. Hon'ble Union

Minister of Fisheries, Animal Husbandry and Dairying, Shri. ParshottamRupala, Dr. J.K. Jena (DDG, Fy.Sc), ICAR, Dr. Sandeep Kumar Behera (Consultant, Biodiversity Programme, NMCG), Prime Minister Swachata Messenger Mr. Darshan Nishad, Mr. Sunil Bhai Ojha (social activist) and other Govt. officials from Department of Fisheries, Uttar Pradesh took active participation in the event along with 250 including fishermen, Ganga praharis and local people.

5.48. Estuarine awareness programme at Godakhali & Fraserganj, West Bengal 12th to 13th September, 2022

A series of the awareness campaign was organized at Godakhali (12.09.2022) and Fraserganj (13.09.2022) towards the conservation of hilsa and dolphin in the river Ganga. Around 35 local fishermen participated in the awareness programme enthusiastically. There was a mixed response from fishermen in the awareness campaign conducted by the visiting team. The fishermen listened intently as the team members explained to them on the need to protect and conserve endangered fish species, particularly of hilsa fishery. Most of them realized the importance of fish conservation and the danger of over-exploitation. They agreed to release live small fishes and gravid hilsa fishes which might entangle in their nets accidentally. Few fishermen pointed out the use of illegal trawl net deep sea fishing practices for catching hilsa in marine waters.

5.49. Series of awareness programme at Patna, Buxar & Bhagalpur, Bihar, 13th to 16th September, 2022

During the present period, a total of 4 awareness campaigns were organized at Patna during 13.9.2022 to 14.9.2022, 3 at Buxar site between 15.9.2022 to 16.9.2022 and 2 at Bhagalpur on 16.09.2022. In each programme a fairly good number of local fishermen and entrepreneurs (54, 47 and 38 at Patna and 48, 52 and 51 at Buxar respectively) participated in the programme enthusiastically. Apart from the above people awareness programme the visiting team interacted with state fisheries officials and informed them how ICAR-CIFRI takes initiative towards recruitment of hilsa fishes at upstream of Farakka. The team also visited to fish market for the exchange of views in connection with the availability of hilsa and IMC in river Ganga.

5.50. Multiple awareness programme at Jangipore, Lalgola& Berhampore, West Bengal, 21st to 22nd September, 2022

Another awareness programme was conducted at three different sites namely Jangipore, Lalgola & Berhampore, West Bengal to create awareness among local people towards the conservation of indigenous fish species including hilsa and dolphins. Active participation of 140 local fishermen and people was observed during the awareness programme. Discussion was also made with fishers regarding their sustainability issues related to fishing and conservation of Dolphin.

5.51. Continuation of multiple awareness programme at Sahibganj, Farakka, Balagarh, Tribeni, Godakhali & Fraserganj, West Bengal, 7th to 23th September, 2022

Awareness programme at both lower and estuarine sites was performed during the period. An awareness campaign was organized at Balagarh, Tribeni, Godakhali and Fraserganj towards the conservation of hilsa, dolphin and holistic sustainable fisheries in the river Ganga. In this programme a fairly good number of local fishermen participated enthusiastically. There was a mixed response from fishermen in the awareness campaign conducted by the visiting team. The fishermen listened intently as the team members explained to them on the need to protect and conserve endangered fish species.

Fig. 237. Glimpses of awareness at **AI)** Sahibganj, Jharkhand, 2nd August 2022 A**J)** Sultanganj, Bhagalpur, Bihar on 2nd June 2022 **AK)** Patna, Bihar on 3rdJune 2022 **AL)** Buxar, Bihar **AM)** Bhagalpur, Barari Ghat **AN)** Narwatpur village, Buxar, Bihar on 8th June 2022 AO) Nasirpur village, Ballia, Uttar Pradesh on 10th June 2022 **AP)** Sahibganj Farakka **AQ)** Balagarh, West Bengal

Fig. 238. A Awareness program at Tribeni, West Bengal

Fig. 238B. Awareness program at Patna, Bihar

Fig. 238C. Awareness program at Haldar paraghat ,Berhampore

5.52. Awareness session on Mahseer conservation at the Upper Stretch of the river

An awareness program on Mahseer conservation near Nayar River dated 19th October 2021 was organized along with the Uttrakhand state fisheries department, in which the works done by NMCG-CIFRI for the conservation of Mahseer were highlighted.

Fig. 239. Awareness program near Nayar River, Uttarakhand on 19th October 2021

5.53. Celebration of World Fisheries Day

On 21st November 2021, World Fisheries Day was celebrated. To celebrate the occasion, 1000 Mahseer fingerlings were released in the Ganga River at Shivpuri, Rishikesh under the CIFRI-NMCG project.

Fig. 240. Celebration of World Fisheries Day at Ganga River at Shivpuri Rishikesh

5.53. Awareness meeting with ADF and CDO Tehri, Uttrakhand regarding Mahseer conservation

An awareness meeting on Mahseer and snow trout fish conservation was conducted on August 2022. The Chief Developmental Officer, Tehri was the chief guest of the meeting. The awareness campaign highlighted various aspects of Mahseer conservation and points were raised on the present status of the fish.

Fig. 241. Meeting with ADF and CDO Tehri, Uttarakahand on 19th October, 2021

5.54. Awareness session on fish conservation in Koteshwar Hatchery on 10th October 2022

One day Awareness session was held at Koteshwar Hatchery on 10th October 2022. The General Manager of Koteshwar Hydropower project was the chief guest of the program

Fig. 242. Awareness at Koteshwar Hatchery, Uttarakhand on 10th October 2022

Period 2022-2023.

To raise awareness of conservation and the development of sustainable fisheries among local fishermen and other stakeholders in various Ganga River segments that have been depleted, massive awareness campaigns have been organized.

During the project's duration from October2022- October2023, ICAR-CIFRI carried out 66 awareness programmes under this activity (Table 17). A total of 4798 fishermen were made aware of the negative effects of destructive fishing techniques, such as the use of toxic chemicals or poisoning, through an awareness campaign in five states, including Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and West Bengal. They were also advised not to catch juveniles and brooders, especially during the breeding seasons (June to August) for their eggs. Local fishermen have taken notice of CIFRI's initiative to restore the prized fishes of the Ganga under the project. All social groups, including neighborhood fishermen, actively participated at various Ganga banks.The locals were also instructed to pursue sustainable development objectives to increase the Ganga River's fish supplies, which might later increase fisheries production.

Table 17. List of awareness program conducted during the year (October 2022- October 2023)

Sl No.	Month/Date	Place	State	Number of people awared
1.	20.10.2022	Assi Ghat, Varanasi	Uttar Pradesh	36
2.	22.10.2022	TaltolaGhat,Farakka	West Bengal	58
3.	11.11.2022	Har Ki Pauri, Haridwar	Uttarakhand	21
4.	12.11.2022	Uttarkashi	Uttarakhand	11
5.	16.11.2022	Satrughan Ghat, Rishikesh	Uttarakhand	14
6.	06.12.2022	Balagarh, Hooghly	West Bengal	33
7.	24.01.2023	Balughata, Haldia	West Bengal	12
8.	24.01.2023	Teropekhya, Haldia	West Bengal	24
9.	25.01.2023	Narghat Rail Bridge, Haldia	West Bengal	22
10.	25.01.2023	Chunakhali Ganga Temple ,Haldia	West Bengal	16
11.	25.01.2023	Haldia ferry ghat, Haldia	West Bengal	21
12.	21.02.2023	Milakighat, Naugachia, Bhagalpur	Bihar	65
13.	22.02.2023	Sahora, Naugachia,Bhagalpur	Bihar	30
14.	22.02.2023	Nawada, Naugachia, Bhagalpur	Bihar	50
15.	23.02.2023	Saheban, Supaul	Bihar	40
16.	23.02.2023	PiprahipattiGolari, Supaul	Bihar	80
17.	24.02.2023	Kaleanpur, Supaul	Bihar	35
18.	24.02.2023	Basbitti,Supaul	Bihar	100
19.	25.02.2023	Nauhatta, Saharsa	Bihar	40
20.	25.02.2023	Akardh, Saharsa	Bihar	32
21.	26.02.2023	Gonghepur, Saharsa	Bihar	51
22.	26.02.2023	Basahi, Saharsa	Bihar	35
23.	27.02.2023	Dumrighat, Sonbarsah, Khagaria	Bihar	30
24.	February 2023	Prayagraj	Uttar Pradesh	40

25.	January 2023	East Midnapore	West Bengal	30
26.	February 2023	Buxar	Bihar	198
27.	February 2023	Bhojpur	Bihar	182
28.	February 2023	Saran	Bihar	306
29.	February 2023	Patna	Bihar	35
30.	February 2023	Begusar	Bihar	231
31.	February 2023	Munger	Bihar	108
32.	February 2023	Bhagalpur	Bihar	145
33.	February 2023	Katihar	Bihar	112
34.	February 2023	Khagaria	Bihar	49
35.	February 2023	Sahibganj	Jharkhand	80
36.	February 2023	Murshidabad &Malda	West Bengal	303
37.	February 2023	Nadia, West Bengal	West Bengal	88
38.	February 2023	East Burdwan	West Bengal	94
39.	February 2023	Hooghly	West Bengal	32
40.	February 2023	North 24 Parganas	West Bengal	28
41.	20.10.2022	Assi Ghat, Varanasi	Uttar Pradesh	36
42.	22.10.2022	TaltolaGhat,Farakka	West Bengal	58
43.	11.11.2022	Har Ki Pauri, Haridwar	Uttarakhand	21
44.	12.11.2022	Uttarkashi	Uttarakhand	11
45.	16.11.2022	Satrughan Ghat, Rishikesh	Uttarakhand	14
46.	06.12.2022	Balagarh, Hooghly	West Bengal	33
47.	24.01.2023	Balughata, Haldia	West Bengal	12
48.	24.01.2023	Teropekhya, Haldia	West Bengal	24
49.	25.01.2023	Narghat Rail Bridge, Haldia	West Bengal	22
50.	25.01.2023	Chunakhali Ganga Temple ,Haldia	West Bengal	16
51.	25.01.2023	Haldia ferry ghat, Haldia	West Bengal	21
52.	21.02.2023	Milakighat, Naugachia, Bhagalpur	Bihar	65
53.	22.02.2023	Sahora, Naugachia,Bhagalpur	Bihar	30
54.	22.02.2023	Nawada, Naugachia, Bhagalpur	Bihar	50
55.	23.02.2023	Saheban, Supaul	Bihar	40
56.	23.02.2023	PiprahipattiGolari, Supaul	Bihar	80
57.	24.02.2023	Kaleanpur, Supaul	Bihar	35
58.	24.02.2023	Basbitti,Supaul	Bihar	100
59.	25.02.2023	Nauhatta, Saharsa	Bihar	40
60.	25.02.2023	Akardh, Saharsa	Bihar	32
61.	26.02.2023	Gonghepur, Saharsa	Bihar	51
62.	26.02.2023	Basahi, Saharsa	Bihar	35
63.	27.02.2023	Dumrighat, Sonbarsah, Khagaria	Bihar	30
64.	February 2023	Prayagraj	Uttar Pradesh	40
65.	January 2023	East Midnapore	West Bengal	30
66.	February 2023	Buxar	Bihar	198
67.	February 2023	Bhojpur	Bihar	182
68.	February 2023	Saran	Bihar	306
69.	February 2023	Patna	Bihar	35
70.	February 2023	Begusar	Bihar	231
71.	February 2023	Munger	Bihar	108
72.	February 2023	Bhagalpur	Bihar	145
73.	February 2023	Katihar	Bihar	112
74.	February 2023	Khagaria	Bihar	49
75.	February 2023	Sahibganj	Jharkhand	80
76.	February 2023	Murshidabad &Malda	West Bengal	303
77.	February 2023	Nadia, West Bengal	West Bengal	88
78.	February 2023	East Burdwan	West Bengal	94
79.	February 2023	Hooghly	West Bengal	32
80.	February 2023	North 24 Parganas	West Bengal	28
81.	February 2023	Howrah	West Bengal	88
82.	February 2023	East Midnapur	West Bengal	62
83.	February 2023	South 24 Pargana	West Bengal	270

84.	02.04.2023	Fatehpur	Uttar Pradesh	45
85.	05.04.2023	Nabadwip	West Bengal	78
86.	11.04.2023	Mirzapur	Uttar Pradesh	42
87.	17.04.2023	Kanpur	Uttar Pradesh	36
88.	19.04.2023	Varanasi	Uttar Pradesh	48
89.	25.04.2023	Farakka	West Bengal	64
90.	26.04.2023	Sahibganj	Jharkhand	52
91.	05.05.2023	Barrackpore	West Bengal	20
92.	06.05.2023	Belur	West Bengal	52
93.	09.05.2023	Balagarh	West Bengal	60
94.	09.05.2023	Tribeni	WestBengal	43
95.	23.05.2023	Bhagalpur	Bihar	84
96.	16.06.2023	Devprayag	Uttarakhand	40
97.	30.06.2023	Patna	Bihar	56
98.	01.07.2023	Ballia	Uttar Pradesh	456
99.	23.08.2023	Kalna	West Bengal	58
100.	25.08.2023	Farakka	West Bengal	21
101.	05.09.2023	Balughata, Haldi	West Bengal	12
102.	06.09.2023	Narghat Rail Bridge, Haldia	West Bengal	19
103.	06.09.2023	Teropekhya, Haldia	West Bengal	33
104.	06.09.2023	Teroparalock gate, Haldia	West Bengal	15
105.	06.09.2023	Haldia ferry ghat, Haldia	West Bengal	27
106.	05.10.2023	Dasparaghat, Barrackpore	West Bengal	100
			Total	**4798**

5.55. Awareness program at Assi Ghat, Varanasi, Uttar Pradesh

An awareness programwas conducted as a part of *'National Ranching Programme-2022'*at Assi Ghat, Varanasi, Uttar Pradeshunder the gracious presence of Hon'ble Director General NMCG & PD, NRCD, Mr. Shri G Asok Kumar, IAS in20thOctober 2022 and Dr. Sandeep Behera (Consultant, NMCG). The program was attended by officials from State NMCG-UP, Forest Department of Uttar Pradesh, Ganga Task Force, Ganga VicharManch, staff of ICAR-CIFRI, Prayagraj, and local people living on the banks of the Ganga River.

5.56. Awareness program at Farakka, West Bengal

Anawarenessprogrammeatthe bank of River Ganga at Farakka was conducted on 22nd October 2022. The event was graced by several dignitaries like Mr. R.D. Deshpandey, GM FarakkaBarrage, Mr. Abhijeet Kumar DGM, NTPC, Mr. Sandeep Kumar, Supt. Engg (Farakka) and Mr. Deepak Nayak (CISH, Malda).Dr.Basanta Kumar Das, Director, CIFRI. Sensitized local fishers towards the conservation of Gangetic resources anddolphins.Active participation of 58 nos. of local people was observed in this event.

5.57. Awareness program at different sites of Uttarakhand

ICAR-CIFRI organized five different awareness programs towards the conservation of indigenous fish and dolphins of the river Ganga from 10th to 18th November 2022 in different sites of Uttarakhand viz. Haridwar (HarkiPauri Ghat), Tehri, Rishikesh, and Uttar Kashi. In this Programme, a fairly good number of local people participated enthusiastically.

Fig. 243. Glimpses of awareness at various sites of Uttarakhand **A.)** Haridwar (HarkiPauri) **B.)** Tehri lake **C.)** Uttar Kashi **D.)**Satrughan Ghat, Rishikesh

5.58. Awareness program at Balagarh, West Bengal

As apart of theconservation of indigenous fish and dolphins of the river Ganga, ICAR-CIFRI organized one awareness campaignon 6th December 2022 in the river Ganga at Balagarh, West Bengal. The fishermen were sensitized about the need for conservation and protection of Ganga biodiversity with special emphasis on hilsa and dolphin conservation in the area.In this program, a fairly good number of local fishermen and fisherwomen participated enthusiastically.

Fig. 244/ Awareness on sustainable fisheries of river Ganga at Balgarh, Hooghly, West Bengal

5.53. CIFRI-NMCG Exhibition Kultoli, Sunderban 2022

ICAR-CIFRI, Barrackpore has participated in the "26th SundarbanKrishti Mela O LokoSanskritiUtsav" under the NMCG project entitled '*Fish Stock Enhancement including Hilsa and Livelihood Improvement for Sustainable Fisheries and Conservation in River Ganga*', from 20th to 29th December 2022 at Kultoli, Sundarban, West Bengal. The CIFRI-NMCG pavilion was awarded second prize at the event. The exhibition pavilion included various publications of NMCG describing overall activities by NMCG to make the river Ganga clean. Former minister for Sports, Youth Welfare, and Sundarbans Development, Government of West Bengal, Mr.KantiGanguly visited the exhibition stall and appreciated the works of the CIFRI-NMCG project.The exhibition witnessed the participation of several local dignitaries, school students, and local people including fishermen communities. Around 1000 to 1200 visitors were observed per day at the NMCG pavilion.

Fig. 245A. CIFRI-NMCG pavilion at Sunderban Mela 2022

Fig. 245B..Mr.KantiGanguly at the CIFRI-NMCG pavilion

Fig 245C. Visitors at CIFRI-NMCG pavilion at Sunderban Mela 2022

Fig. 245D. Second Prize awarded toCIFRI-NMCG pavilion at Sunderban Mela 2022

5.54. Awareness program at Haldi river (Tributary of river Hooghly), West Bengal

A total of 5 number of mass awareness program was conducted at Haldia township ferry ghat, Balughata, Teropekhya, Narghat rail bridge and Chunakhali Ganga Temple from 23^{rd} to25^{th} January, 2023 under NMCG (National Mission for Clean Ganga) project to aware the total 95 nos. of local fishermen and native villagers at the Haldiriver. The purpose of the program was to create awareness among local people including fishers on the detrimental effects of destructive fishing methods like use of zero-meshed net etc. They were also advised not to catch the juveniles and brooders especially during breeding seasons for the conservation of fishes in HaldiRiver.

Fig. 246. Awareness program at Haldia Township Ferry Ghat, Haldia, West Bengal

5.55. Awareness program at Koshi river (Tributary of river Ganga), Bihar

The NMCG team of ICAR-CIFRI conducted 12 mass awareness campaign was organized on'Fish and Dolphin Conservation of river Koshi' covered a 4 District (Bhagalpur, Supaul, Saharsa and Khagaria) at Bihar from 20^{th} February to 1^{st} March 2023 to sensitize.A total of 588 numbers of local people including fishers, women and childare participated in the awareness program about the importance of Dolphin as a national aquatic animal and not to harm their habitat in Koshi River stretch.

Fig. 247. People awareness programme at different stretches of Koshi River

5.56. Awareness Program at Milakighat, Nawada (Naugachia) and Sahora, Bhagalpur, from 21st to 22nd February 2023

A 2 numbers of massawareness campaign was organized on ‘Fish and Dolphin Conservation of river Koshi’ at Malaki, Naugachia, Bhagalpur on 21st to 22nd February 2023 to sensitize local people including fishers about the importance of Dolphin as a national aquatic animal and not to harm their habitat in Koshi River stretch. A total of 145 numbers of local fisherman, women and child are participated in the awareness program.

Fig. 248/ People awareness programme at MilakighatNawada, Naugachia, (Bhagalpur).

5.57. Awareness Program at Saheban, PiprahipattiGolari, Basbitti, and Kaleanpur Supaul 23rd to 24th February 2023

A four numbers of awareness campaign was organized on 'Fish and Dolphin Conservation of river Koshi' Saheban, PiprahipattiGolari, Basbitti, and KaleanpurSupaul 23rd to 24th February 2023to sensitize local people including fishers about the importance of Dolphin as a national aquatic animal and not to harm their habitat in Koshi River stretch. A total of 255 numbers of local fisherman, women and child are participated in the awareness program.

5.58. Awareness Program atNauhatta, Akardh, Gonghepur and Basahi, Saharsa 25thto 26th February 2023

A 4 numbers of awareness campaign was organized on 'Fish and Dolphin Conservation of river Koshi' paharpurNauhatta, Akardh, Gonghepur and Basahi, Saharsa25th to 26th February 2023to sensitize local people including fishers about the importance of Dolphin as a national aquatic animal and not to harm their habitat in Koshi River stretch. A total of 158 numbers of local fisherman, women and child are participated in the awareness program.

5.59. Awareness Program at Dumri ghat, Sonbarsah, Khagaria 27th February 2023

A awareness campaign was organized on 'Fish and Dolphin Conservation of river Koshi' Dumri ghat, Sonbarsah, Khagaria, 27th February 2023 to sensitize local people including fishers about the importance of Dolphin as a national aquatic animal and not to harm their habitat in Koshi River stretch. A total of 30 numbers of local fisherman, women and child are participated in the awareness program.

5.60. Massive mass awareness Program at 4 states of river Ganga

ICAR-CIFRI has organized 20 awareness programs, one exhibition, and one seminar towards the sustainable fisheries of river Ganga and dolphin conservation during the quarterly period. A total 2481 nos. of fisher folks were sensitized covering 241 villages across 20 different districts of 4 states (Uttar Pradesh, Bihar, Jharkhand and West Bengal)

Fig. 249A. Awareness in Saran district, Bihar

Fig. 249B. Awareness at a school (Patna district, Bihar)

Fig. 249C. Awareness at Begusarai district, Bihar

Fig. 249D. Awareness at DFO office Munger district, Bihar

Fig. 249E. Awareness at Bhagalpur district, Bihar

Fig. 249F. Awareness at Sultanganj (Bhagalpur district, Bihar)

Fig. 249G. Awareness at Katwa (E. Burdwan district, West Bengal)

Fig. 249H. Awareness in school at Barrackpore (North 24 Pgs district, West Bengal)

Fig. 249 I Awareness at Godkhali (S.24 Pgs district, West Bengal)

Fig. 249 JAwareness at a school in Fraserganj (S.24 Pgs district, West Bengal)

Fig. 249K. People awareness programme at East Midanapur, West Bengal

Fig. 249(A-K): People awareness programme at various sites of river Ganga

5.61. Mass awareness program at 14 areas under 5 states of river Ganga

ICAR-CIFRI has organized 14 awareness programs towards the sustainable fisheries of river Ganga and dolphin conservation during the quarterly period. A totalof 720 numbers of fisher folks were sensitized covering 14 areas under 5 states (Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal).


A
NATIONAL RANCHING PROGRAM


B
NATIONAL RIVER RANCHING PROGRAM 2023


C


D
NATIONAL RANCHING PROGRAM


E
NATIONAL RIVER RANCHING PROGRAM 2023


F
NATIONAL RIVER RANCHING PROGRAM 2023
Shot on OnePlus

Fig. 250. (A-K). Awareness at different sites of West Bengal, Bihar, Jharkhand and Uttar Pradesh

Fig. 251 (A-B). Awareness at different sites of Uttarakhand & Bihar

The NMCG team of ICAR-CIFRI, Barrackpore, conducted two mass awareness programmes during the month covering **517** numbers of local fishermen, women and nearby residents.

Fig. 252 (A-B). Awareness and distribution of fishing nets at Ballia, Uttar Pradesh; (C-D) Awareness at Tehri, Uttarakhand

5.62. Mass awareness program at Kalna, Burdwan, West Bengal

The NMCG team of ICAR-CIFRI, Barrackpore, conducted a mass awareness programmes at Kalna (East Burdwan District), West Bengal. The awareness programme was conducted covering **58** numbers of local fishermen, women and nearby residents.

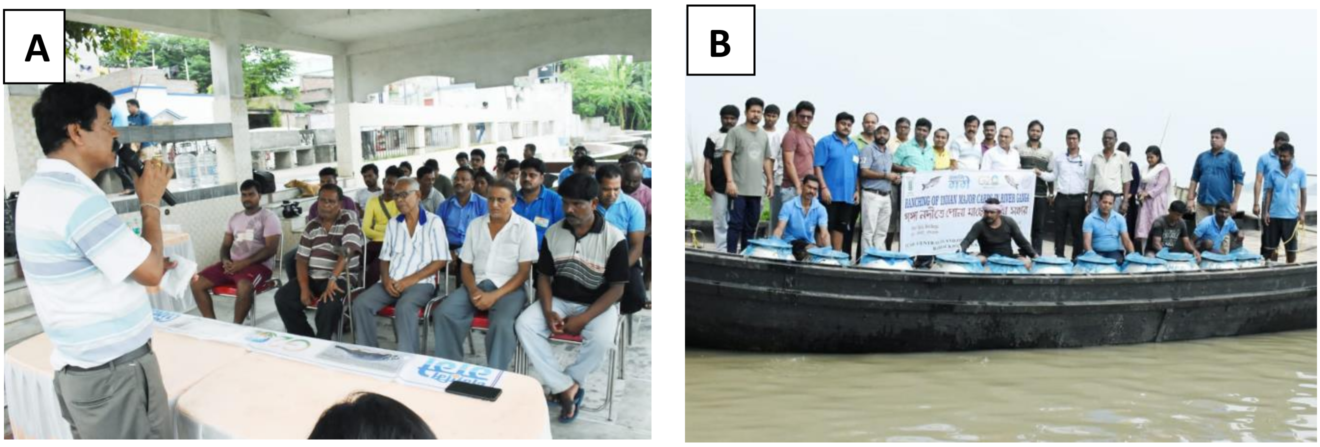


Fig. 253. (A-B). A- Awareness at Kalna (East Burdwan District), West Bengal

5.63. Mass awareness program at Farakka, West Bengal

The NMCG team of ICAR-CIFRI, Barrackpore, conducted 2 awareness programmes at Farakka feeder canal and surrounding areas (Murshidabad District), West Bengal. The awareness programmes was conducted covering 21 number of local fishermen, women and nearby residents.

Fig. 254. Awareness Programmes at Feeder Canal Farakka

5.64. Awareness program at Haldia, West Bengal

Mass awareness program was conducted at Haldia township ferry ghat, Balughata, Teropekhya, Narghat rail bridge and Teroparalock ghat from 5th to7th September, 2023 under NMCG (National Mission for Clean Ganga) project to aware the total 106 numbers of local fishermen and native villagers at the Haldiriver. The purpose of the program was to create awareness among local people including fishers on the detrimental effects of destructive fishing methods like use of zero-meshed net etc. They were also advised not to catch the juveniles and brooders especially during breeding seasons for the conservation of fishes in Haldi River.

Fig. 255. Awareness at Narghat Rail Bridge in Haldi River (East Midnapur), West Bengal

5.65. Awareness program on "National Dolphin Day" at Barrackpore, West Bengal

The NMCG team of ICAR-CIFRI, Barrackpore, conducted awareness programmes on '**National Dolphin Day**' on **October 5, 2023**, at Sheorapally Ghat on the bank of the river Hooghly under the NamamiGange Program. On this occasion, more than 100 personnel, including active fishermen, social activities, and students residing on the banks of the river, participated and were aware of the day.

Fig. 256. Awareness Programme, at Sheorapally Ghat on National Dolphin Day

OBJECTIVE IV: TO PRODUCE SEED OF SELECTED FISHES (IMC AND MAHSEER) OF RIVER GANGA USING RIVERINE GERMPLASM

Restoring indigenous fish species in depleted areas can serve as an effective strategy for reviving fish populations in their natural habitats. River ranching is considered a highly effective approach to achieve this goal. This is particularly relevant in the ongoing project, where enhancing fish stocks in the Ganga River is a crucial aspect. In order to implement river ranching, it is important to engage in the production of seeds for selected fish species.For the Indian major Carp (*Labeo rohita*, *Labeo catla* and *Cirrhinus mrigala*) seed raising and river ranching activities following steps have been followed:

Collection of Live brood fishes from river Ganga → Brood stock Management for better breeding performance → Induced breeding of collected wild IMC fishes → Rearing of produced IMC seed → River ranching of IMC fish seed in depleted stretches of river Ganga

6.1. Brooder Collection

The wild IMC fishes were obtained from several sections of the Ganga River, spanning across Nabadwip, Nadia, to Balagarh and Somra Bazaar, Hooghly, in West Bengal. Theneighboring river-connected or seasonally-connected floodplain wetlands were also included in the collection process. The *Charaganga*oxbow lake, which is connected to the river in the Nabadwip area, has been identified as a potential location for gathering live Indian Major Carps (IMC). In this project period, the quantity of live fish collected was more than 1000 kg (Male and Female), in which almost 860 kg of fish matured at the breeding season from 2021 to 2023.

Fig. 257. Brood fish collection from river Ganga

6.2. Brood stock Management

The captured live fish were stocked into the broodstock pond in Balagarh, located in the Hooghly district in West Bengal of sizes ranging from 0.2-0.5 ha. The fish were brought up in the broodstock ponds until they had reached their full maturity and were prepared for hypophysation. Besides maintaining optimal water quality, the broodstocks comprising of the IMC were fed with high protein rich brood diet (33%) to acquire fast gonadal development and higher reproductive performance, better egg quality, fertilization rate, and hatching percentage. This was done in order to enhance the spawning perentage of the prospective spawners.

Fig. 258. Broodstock Management of IMC

6.3. Induced Breeding of Indian Major Carp (IMC)

The ICAR-Central Inland Fisheries Research Institute carried out an induced breeding programme of IMC (*L.rohita, L. catla, C. mrigala*) as part of this ongoing project for the restoration of indigenous prized IMCs of the Ganga River through ex-situ conservation at Balagarh, Hooghly during each year of the project period (2021-2023) (Table 18.). The three separate breeding programmes between 2021 and 2023 produced a combined total of 227 lakhs IMC spawn (Table 19).

Table 18. Total numbers (no.) & weight (wt.) of IMC brooders used in breeding in 2021-2023

	2021				**2022**				**2023**			
	Male		**Female**		**Male**		**Female**		**Male**		**Female**	
Species	No.	wt (kg)	No.	wt (kg)	No.	wt (kg)	No.	wt (kg)	No.	wt (kg)	No.	wt (kg)
Labeorohita	39	23.5	61	34	11	8.9	48	21	28	24	45	41.4
Labeocatla	2	3	2	3.1	9	21.7	12	38.4	9	27.2	16	49.4
Cirrhinusmrigala	40	17.4	60	28.9	36	22.7	45	32.8	54	29.5	53	26.5

Table 19. Year wise IMC spawn production for raising of fish seed

Year	**2021**	**2022**	**2023**
Spawn production (in lakh)	75.00	75.00	77.00

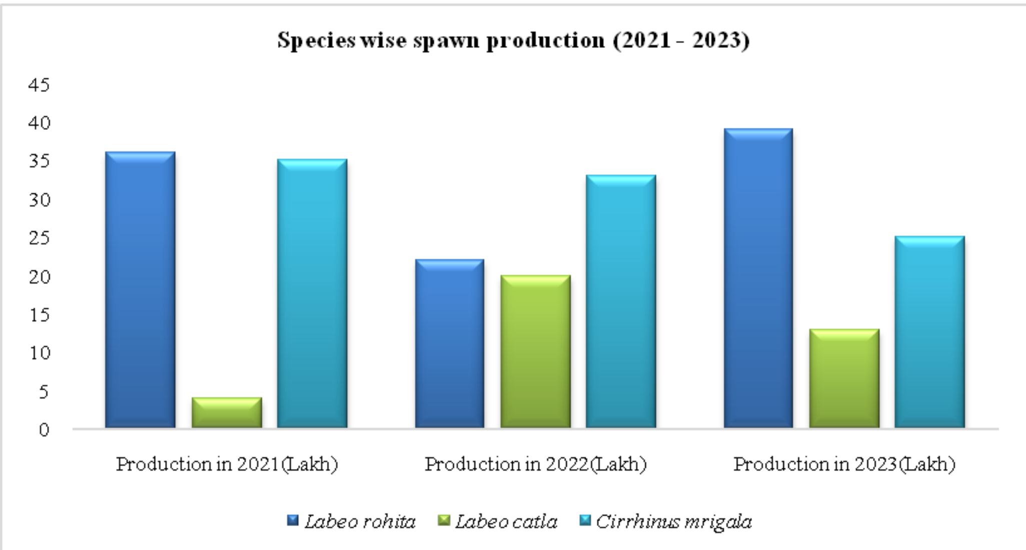


Fig. 259. Species-wise IMC spawn production (2021 – 2023)

A B C D E F

Fig. 260 (A- F). Different activities of artificial breeding of Gangetic IMC (2021-22)

Fig. 261(A-C). Artificial hypophysation and striping of wild matured IMC during 2022-23

6.4. Nursery rearing of IMC

Prior to fish stocking in the rearing ponds, the soil and water quality were ensured to be at the appropriate standard level. This was done in order to make it easier for a sufficient number of natural fish food organisms to grow there. The natural feed is essential for the growth of spawn, and as a result, the ponds must be regularly manured to preserve the nutrient richness of the environment. The spawn produced was distributed throughout the many ponds at Balagarh that were used for rearing juvenile fish. The fish were reared in ponds until they reached the fingerling stage (>10 cm in length). The fingerlings that reached this stage are ranched in different depleted stretches of river Ganga through river ranching programme.

A B

Fig. 262 (A-B). Stocking and Size growth of IMC fry

6.5. Mahseer collection and rearing

The wild stock of mahseer fingerlings is being raised in captivity to breed them and release their offspring into the depleted river sections along the Ganga River. A total of 27000 Mahseer fingerlings ranging in size from 2 to 5 centimetres were collected from several tributaries of the upper stretch of river Ganga and then transported with great care to rearing ponds in the city of Koteshwar, Uttarakhand during the period 2021-2023 (Table 20). The fingerlings that were caught were reared in captivity, were allowed to mature and be released into the river Ganga. The remaining fingerlings, which number around 2000, will be allowed to continue developing until they reach adulthood.

For brooder collection, fishing was done frequently in Nayar River, Tehri and Koteshwar reservoir with the help of local and departmental fishermen. More than 127 live Mahseer unripe brooders (300 g to 450 g) were collected during the sampling, and were stocked in Koteswar, Uttarakhand for attaining maturity.

Table 20. Year-wise Mahseer fingerling and brooder collection chart

Year	Mahseer fingerling collection (No.)	Mahseer brood fish collection (No.)
2021	6000	40
2022	8000	55
2023	13000	32

Fig. 263. Collection of fry and fingerlings from Hewal River and Tehri Reservoir of Uttarakhand

Fig. 264. Mahseer fingerlings conditioning in Happa

Fig. 265. Fry conditioning in Happa

Fig. 266. Netting for Mahseer brooder collection

Fig. 267. Collected Mahseer brooder

6.6. Striping of Mahseer from different tributaries of Ganga River on the spot:

During breeding seasons, the striping of Mahseer (*Tor putitora*) was carried out on the spot where there is a natural breeding ground of Mahseer (near the banks of Nayar and Heval river). Fertilized eggs were transported to the hatchery after striping.

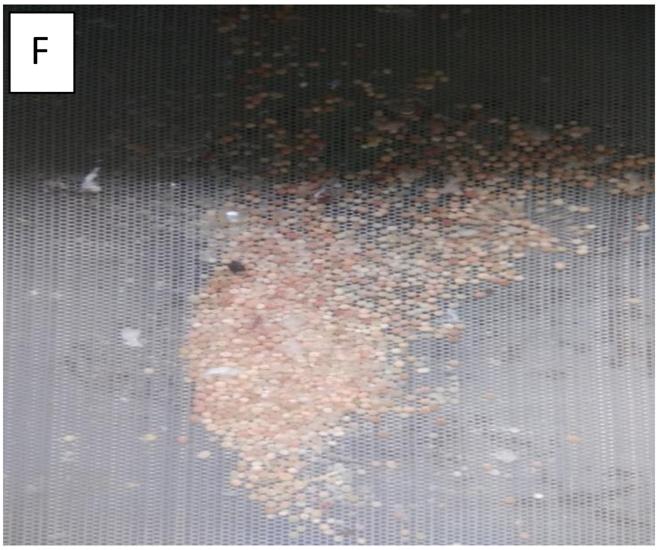


Fig. 268 (A-F). Striping & Fertilization of Mahseer eggs in different river

OBJECTIVE V: TO IDENTIFY THE KEY RIVERINE STRETCH/WETLANDS IMPORTANT WITH RESPECT TOFISH CONSERVATION

7. Mapping of wetlands associated with Ganga River in the state of West Bengal

Floodplain wetlands are natural low lying areas bordering large rivers that are seasonally inundated by overflow from main river system and retaining their riverine connection for a reasonably long period of time are relatively free from weeds and are open wetlands. The floodplain wetlands which have lost their riverine connection and are choked with weeds are closed. They are an important resource for fish production and livelihood besides rendering other numerous ecological goods and services. India is endowed with enormous floodplain wetland resources, defined as low-lying areas bordering large rivers, which are seasonally inundated by overspill from the main river channel (Sugunan et al. 2000). These wetlands include ox-bow lakes, sloughs, meanderscroll depressions, swamps, residual channels or tectonic depressions. These are widely recognized as one of the most potential inland open water fisheries resourcesof India, especially in the eastern and north-eastern states, and are mainlyassociated with the Ganga and Brahmaputra river systems, locally known as *beel* (Assam, West Bengal, Tripura), *maun*, *chaur*, *dhal* (Bihar), *jheel* (Uttar Pradesh) and *pat* (Manipur) (Das et al. 2017). These vary widely in area, shape, depth, and extentof the riverine connection. The floodplain wetlands have tremendous potential forthe development of capture, culture, and culture-based fisheries.

The largest riverine wetland system in India is the Gangetic Wetlands (WWF, 2019) found in the states through which river Ganga flows, Uttarakhand, Uttar Pradesh, Bihar,Jharkhand, and West Bengal, where there is an abundance of wetlands. To initiate the mapping of floodplain wetlands associated with the Ganga River, the state of West Bengal has been selected for mapping and subsequently the other Gangetic states will be mapped.

Mapping was done to identify how many wetlands associated with the Ganga River are still connected with the main river channel and how their connectivity with the main river channel and the area of wetlands is changing over time. The study would support the identification of the suitability of the wetland as a breeding ground and subsequently as a fish nursery ground during monsoon.Wetlands have been used to study fish recruitment andthe development of fish communities (Langston and Kent 1997; Graff and Middleton 2001; Prusty 2011; Kar 2019).

For mapping, the wetlands have been identified from Sentinel imagery which has been subsequently processed by image processing algorithms to extract the wetland area. Mapping of wetlands was done for the pre-monsoon season (February, March, April and May) and post-monsoon season (October, November, December and January).From the present study, 46 wetlands which were situated close to the main river channel have been identified (Table 1)and were selected from the total layer of generated wetlands, based on their proximity and connectivity to the main river Hooghly. Each wetland was identified in Google Map and their name was included from there. Their seasonal changes in the area were observed from satellite imagery and water spread area was retrieved from image analysis. Their connectivity with the main channel was considered after observations were made from these imageries as well as from Google Earth after refering to historical imagery available in Google Earth itself.

In all 46 wetlands (from North to South) close to the main channel (River Hooghly) have been identified and analyzed according to their seasonal spread of water area as listed in the Table 21. The Northernmost wetland is that of Sheal and is close to Farakka, belonging to Suti-I block of Murshidabad district. The Southernmost Wetland is that of Rabindra Sarovar and is within the city of Kolkata. The North-South coverage of all the wetlands together is more than 200 kilometers and all of them are within 5 kilometers of the main river (River Hooghly) approximately. Among the 46 wetlands studied, 4 have retained their connection to the main river and therefore are open wetlands while the rest of the 42 have lost their connection with the main river and therefore can be categorized as closed wetlands. Based on the Google Earth image of these wetlands in the year 2020-21, the maximum area for each wetland has been derived from the post-monsoon season images while the minimum area for each wetland has been derived from pre-monsoon images, from which the the average area for each wetland has been calculated. Considering the average area the largest wetland is that of East Kolkata Wetlands (EKW) (1011.36 hectares) and the smallest wetland is that of Krishna Sali (3.88 hectares). The highest seasonal change for 2021 has occurred for Biltelkar (239.93 hectares) and the lowest for Krishna Sali (033 hectares).

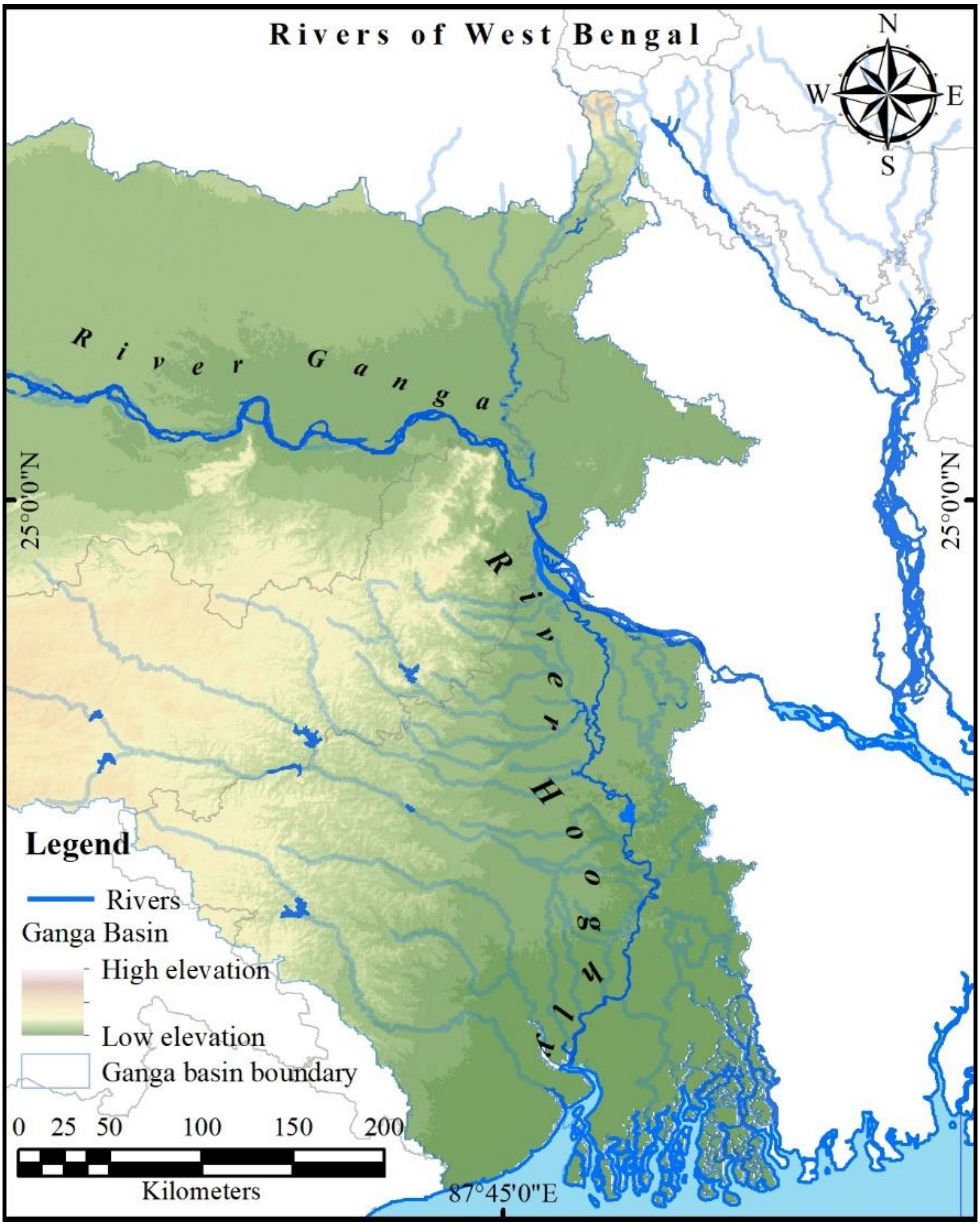


Fig. 269. Rivers of West Bengal

Table 21. List of identified floodplain wetlands along with its average, maximum and minimum area of expansion in the state of West Bengal through mapping

Sl No	Name	Open/Closed	Latitude	Longitude	Dist	Block	Max Area (Ha)	Min Area (Ha)	Avg Area (Ha)
1	Sheeal	Closed	24.47032	88.00271981	Murshidabad	Suti-I	457.26	434.01	445.635
2	Krishna Sali	Closed	24.44213	88.15268384	Murshidabad	Raghunathganj-IIi	4.04	3.71	3.875
3	JhauDanga	Closed	24.37177	88.18089379	Murshidabad	Lalgola	59.01	21.9	40.455
4	Uladanga	Open	24.33323	88.18565307	Murshidabad	Sagardighi	107.73	98.66	103.195
5	Bilgobra	Closed	24.27999	88.28038904	Murshidabad	Bhagabangola-II	32.19	17.73	24.96
6	Motijhil	Closed	24.1582	88.28056338	Murshidabad	Murshidabad-Jiagunj	69.36	49.91	59.635
7	Kati Ganga	Closed	24.12775	88.27895486	Murshidabad	Berhampore	16.41	11.3	13.855
8	Bishnupur	Closed	24.11008	88.26395823	Murshidabad	Berhampore	33.09	31.51	32.3
9	Biltelkar	Closed	24.10863	88.19513517	Murshidabad	Nabagram	325.01	85.08	205.045
10	Chaltia	Closed	24.07175	88.2534265	Murshidabad	Berhampore	49.2	35.58	42.39
11	Bilchauti	Closed	24.05271	88.19190066	Murshidabad	Berhampore	22.43	15.93	19.18
12	Pratappur-Chandpara	Closed	24.01899	88.19718574	Murshidabad	Baharampur	26.45	13.44	19.945
13	Halapur	Closed	24.01569	88.22914059	Murshidabad	Beldanga-I	68.43	61.11	64.77
14	Balidhowra	Closed	23.99755	88.19083755	Murshidabad	Beldanga-I	22.18	10.37	16.275
15	Sujapur	Closed	23.9819	88.22232122	Murshidabad	Beldanga-I	50.39	12.37	31.38
16	Kuthipara	Closed	23.96902	88.21324467	Murshidabad	Beldanga-I	10.39	5.39	7.89
17	Meliani	Closed	23.92933	88.21816981	Murshidabad	Beldanga-I	27.09	17.26	22.175
18	Sadtapur	Closed	23.88501	88.23487386	Murshidabad	Beldanga-II	60.82	43.9	52.36
19	Rampara Ox Bow	Closed	23.85802	88.22524834	Murshidabad	Beldanga-II	39.59	16.34	27.965
20	Rampara	Closed	23.85342	88.23049336	Murshidabad	Beldanga-II	7.49	5.39	6.44
21	ChhotaKulberia	Closed	23.76348	88.24831294	Nadia	Kaliganj	50.22	34.83	42.525
22	Narayanpur	Closed	23.74398	88.23485011	Nadia	Kaliganj	17.59	7.23	12.41
23	Bhansuni	Closed	23.65249	88.29034172	Nadia	Kaliganj	251.46	90.48	170.97
24	Khalsi	Open	23.64229	88.23874055	Nadia	Kaliganj	321.69	252.19	286.94
25	Akandanga	Closed	23.62032	88.27688831	Nadia	Nakashipara	7.42	1.03	4.225
26	Kalo Baur	Closed	23.61299	88.18387664	Barddhaman	Katwa-II	25.31	19.58	22.445
27	Karajgram	Closed	23.57843	88.13368412	Nadia	Katwa-I	56.82	52.06	54.44
28	Kamalnagar	Closed	23.50993	88.34517421	Nadia	Purbasthali-II	89.87	22.39	56.13
29	Sartola	Closed	23.51507	88.40125779	Nadia	Krishnagar-II	28.97	7.24	18.105

30	Bargara	Closed	23.50219	88.4009276	Nadia	Krishnagar-II	29.38	17.63	#REF!
31	Battala	Closed	23.46191	88.40215116	Nadia	Krishnagar-Ii	134.37	50.1	76
32	Chhara Ganga	Open	23.44676	88.34518858	Barddhaman	Kalna	388.7	195.13	291.915
33	Udayan	Closed	23.41631	88.37099226	Nadia	Nabadwip	7.08	5.39	6.235
34	Koblar	Closed	23.38822	88.33588014	Barddhaman	Purbasthali-I	26.64	6.7	16.67
35	Bhaluka	Closed	23.35345	88.39817147	Nadia	Krishnagar-I	29.1	23.5	26.3
36	Panchpota_Kursi_Kundapara	Closed	23.31309	88.40606072	Nadia	Krishnagar-I	74.06	54.36	64.21
37	Panpara	Open	23.26353	88.36891276	Nadia	Santipur	455	224.15	339.575
38	Neelkuri	Closed	23.24521	88.39721985	Nadia	Santipur	22.43	15.93	19.18
39	Ichhapura	Closed	23.18883	88.39092753	Hugli	Balagarh	76.09	51.97	64.03
40	Gazipur	Closed	23.18377	88.51209979	Nadia	Ranaghat-I	68.43	61.11	64.77
41	GayeshpurKulia	Closed	22.95968	88.4692342	Nadia	Kalyani	133.24	58.99	96.115
42	Mathura	Closed	22.94184	88.48522283	Nadia	Kalyani	122.6	43.89	83.245
43	Jhakari-Madpur-Bangihati	Closed	22.73802	88.29485419	Hugli	Singur	89.72	21.06	55.39
44	Natagrah	Closed	22.71591	88.40587081	North 24 Parganas	Barrackpur-II	35.21	33.26	34.235
45	EKW-1	Closed	22.53917	88.43739436	South 24 Parganas	Rajarhat	1065.78	956.93	1011.355
46	R Sarovar	Closed	22.51099	88.35714897	Kolkata	Kolkata	25.2	23.41	24.305

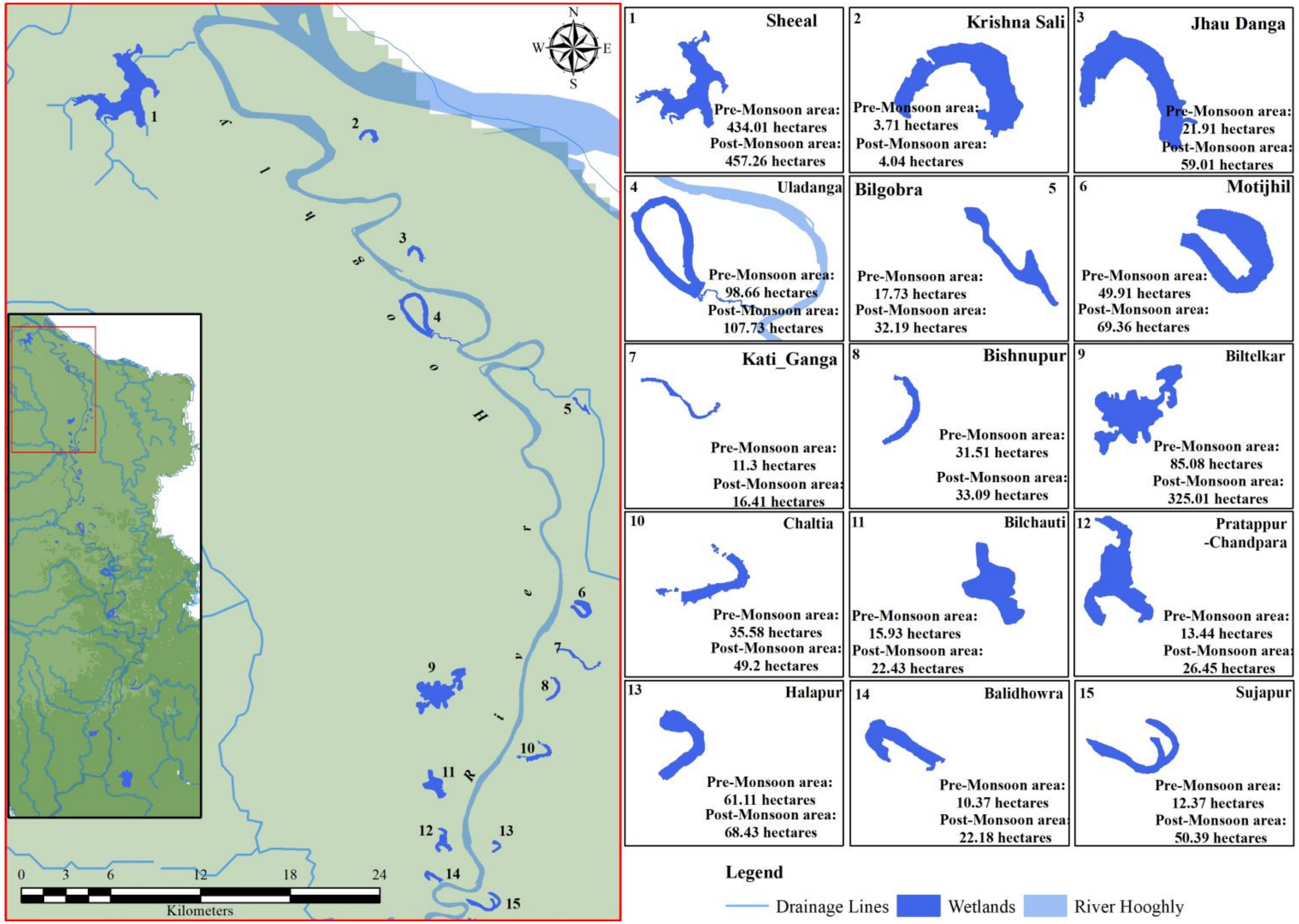


Fig. 270. Mapping of floodplain wetlands (1-15) associated with Ganga River in the state of West Bengal

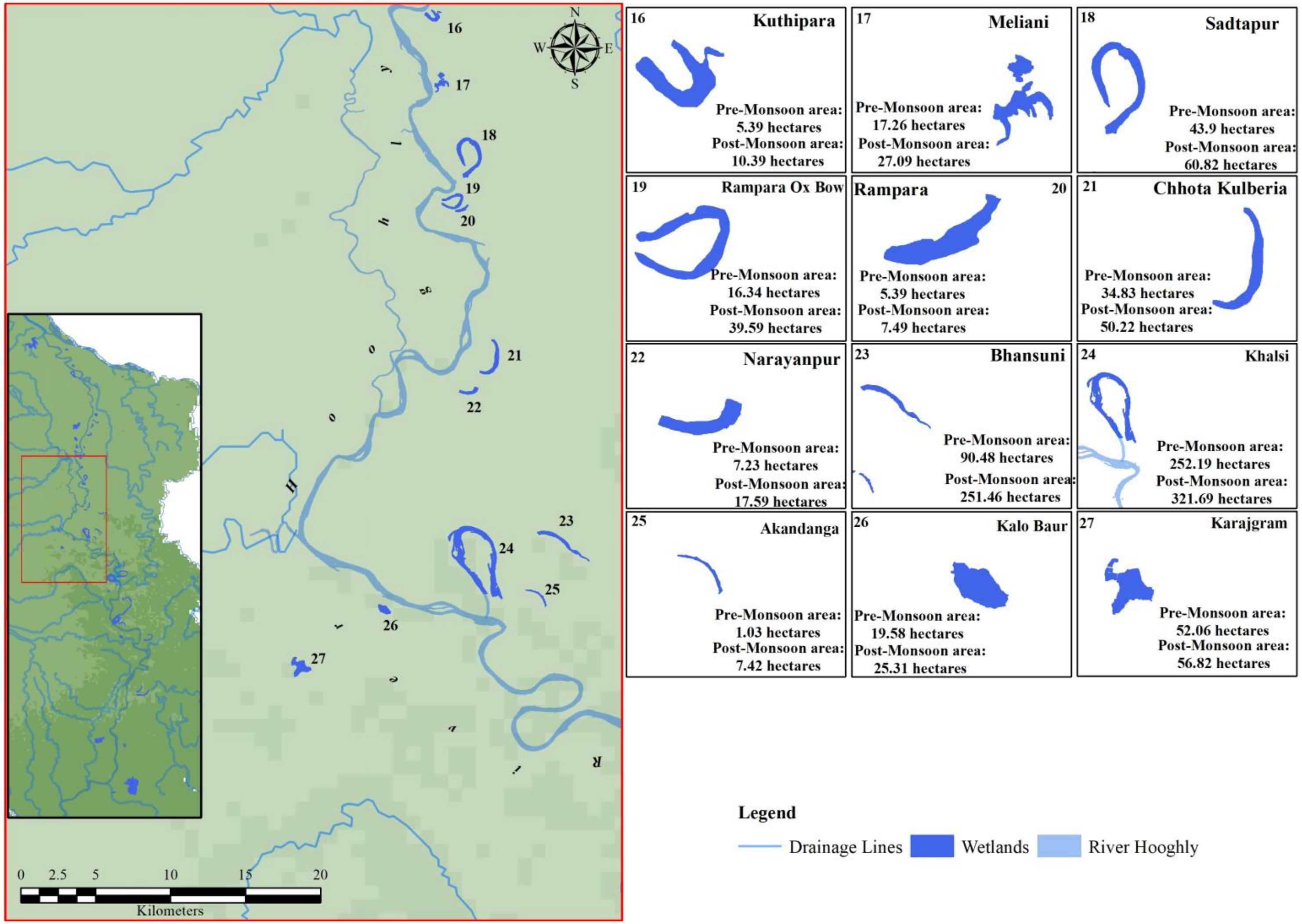


Fig. 271. Mapping of floodplain wetlands (16-27) associated with Ganga River in the state of West Bengal

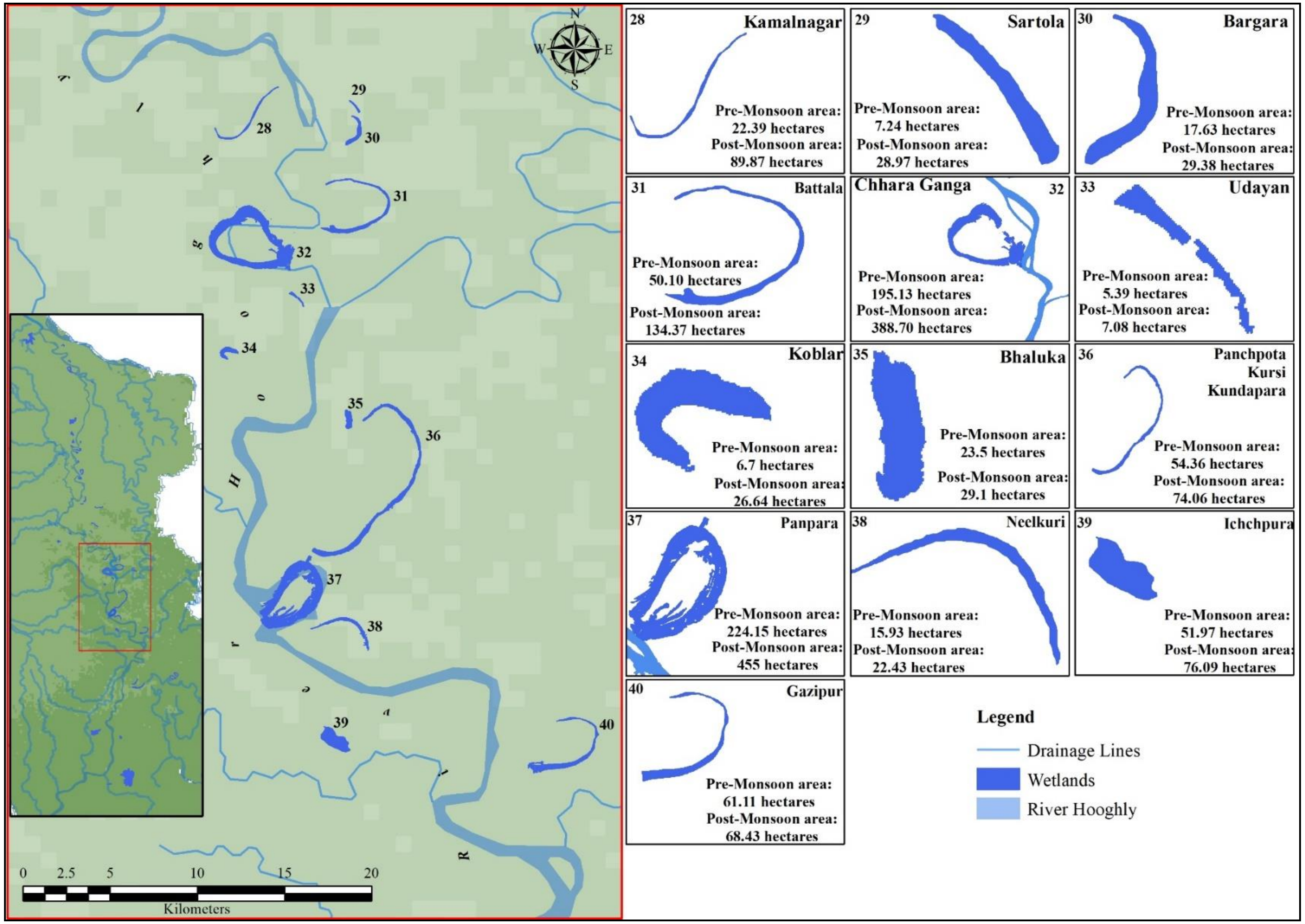


Fig. 272. Mapping of floodplain wetlands (28-39) associated with Ganga River in the state of West Bengal

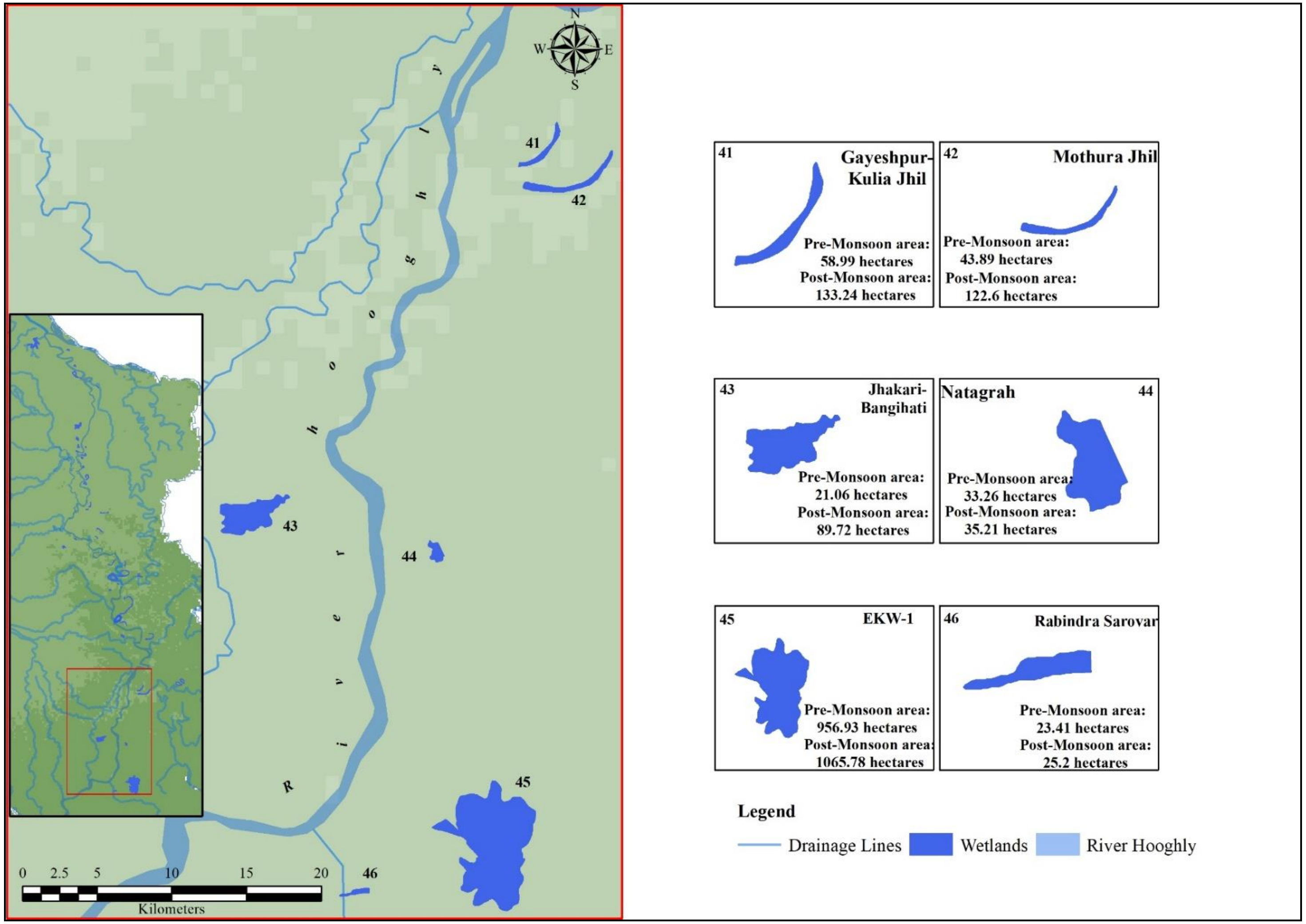


Fig. 273. Mapping of floodplain wetlands (40-46) associated with Ganga River in the state of West Bengal

7.1. Identification of potential area for designation of 'Fish Protection Site' (Based on the findings of Phase I Report)

The frequency of fish juvenile recruitment is crucial for sustaining the diversity of the fish fauna in any natural system. The presence of fish juveniles in rivers is an indication of the presence of active fish spawning grounds in the area or river stretch. Hence, it is important to study or identify the breeding/spawning ground of fishes in the river stretch or wetlands associated with the Ganga River for the designation of a Fish Protection Site. The objective of this study was to determine the location of fish spawning sites, in the free stretch of the Ganga River and also in its floodplain wetlands, the preservation of which seems fundamental to the maintenance of indigenous fish stocks and regional biodiversity. To maintain fish stocks, it is essential to maintain the integrity of spawning areas, which are responsible for the dispersion of eggs and larvae to feeding and development sites, making satisfactory recruitment possible. Precise identification of these areas is fundamental to measures for the protection of the ichthyofauna, and management of fisheries. Based on length-frequency data, the spatial distribution of juvenile fish of the Ganga River was assessed in the current study. The study revealed that high abundance of juveniles in Kanpur (34.69%) and Bijnor (30.88%) stations (Table 22). Considering the observed abundance of fish juveniles in the Bijnor stretch during the study period as well as its proximity to the Hastinapur Wildlife Sanctuary and the prevailing suitable habitat of fish juveniles, this stretch may be recognized as a "Fish Protection Site" of "Fish Sanctuary".

Table 22. Fish juvenile of important fishes recorded from the different station of Ganga stretch

Sl. No.	Sites	% of fish juvenile	Important fishes
1.	Bijnor	30.88	IMCs, *A. mola, M. armatus, Channa punctata, C. marulius,* etc.
2.	Kanpur	34.69	IMC, *Wallago attu*, *Sperata* sp., *Channa* sp., etc.
3.	Prayagraj	26.42	IMC, *C. reba*, *Sperata* sp., *W. attu*, etc.
4.	Varanasi	27.0	IMC, *Anabas testudineus, S. seenghala, G. giuris, G. manmina,* etc.
5.	Buxar	36.56	IMC, *W. attu*, *C. marulius*, *G. giuris*, *G .chapra*, etc.
6.	Patna	36.30	IMC, *R. corsula*, *G. chapra*, *M. armatus*, *J. coitor*, etc.
7.	Bhagalpur	32.87	IMC, *W. attu*, *C. marulius*, *G. giuris*, *S. aor*, etc.
8.	Farakka	29.84	IMC, Minor carp, small and large catfishes
9.	Balagarh	29.82	IMC, Minor carp, Murrels Small and Large catfishes
10.	Godakhali	45.37	*Tenualosa ilisha*

7.2. Importance of wetlands at Ganga River stretch in respect to fish conservation

Wetlands are regarded as the world's richest ecosystem (Hazarika, 2013), are frequently referred to as ecologically sensitive places, and are crucial in maintaining the recruitment process in the environment. As a result, protecting wetlands has grown to be a major priority on a global scale (Bobbinket al., 2006; Singh et al., 2009; Bordoloi, 2014).

The majority of small native fish populations are found in open wetlands connected to the Ganga basin, which are generally thought of as the spawning and rearing grounds for these fish species. As per the earlier study of (Phase-I) Chharaganga Beel, (23°26'50.08''N, 88°19'41.80''E) located in Purba Bardhaman and Nadia district, West Bengal which has a perennial connection with the river Ganga, was selected as a suitable fish conservation site in the earlier study. During the study period, a total number of 45 fish species under 23 families were found in three different samplings in pre monsoon, monsoon, and post monsoon season. The Cyprinidae (10 nos.) and Danionidae (6 nos) were found as the most species rich families during the study period.

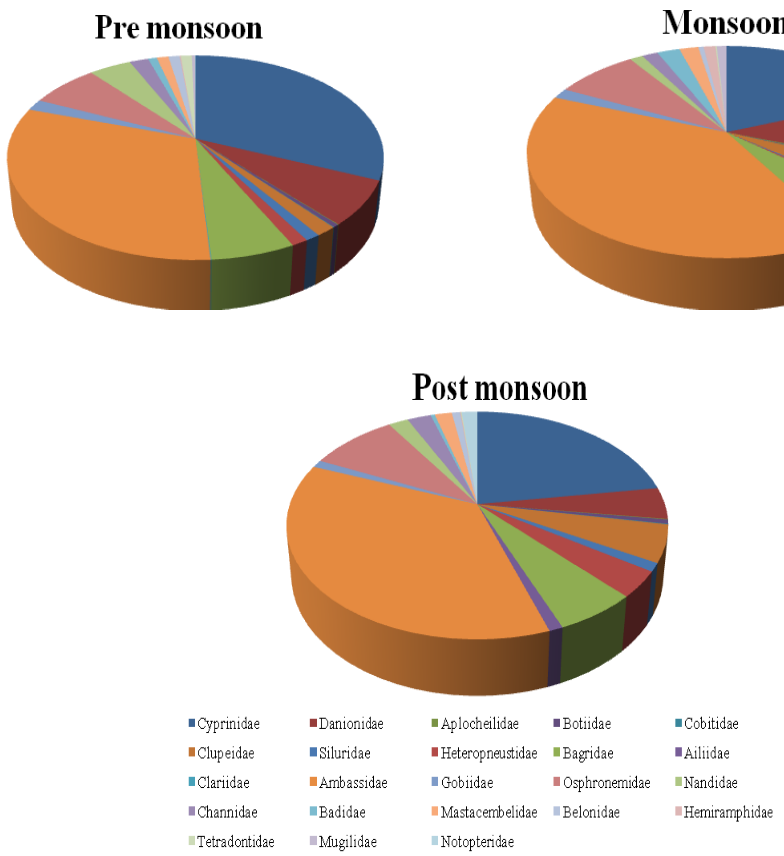


Fig. 274. Seasonal variation of piscine families in the studied open wetland

The most number of fish species were recorded in pre-monsoon sampling (n=40) followed by monsoon (n=37) and post-monsoon (n=36). The Simpson index showed higher value in pre-monsoon (0.9275) followed by monsoon (0.9206) and post-monsoon (0.9172) seasons. Similarly, the Shanon index reflected a higher level of value in monsoon (2.926) and followed by pre-monsoon (2.899) and post-monsoon (2.894). Maximum evenness was depicted during monsoon (0.504) followed by post-monsoon (0.5018) and pre-monsoon (0.454).

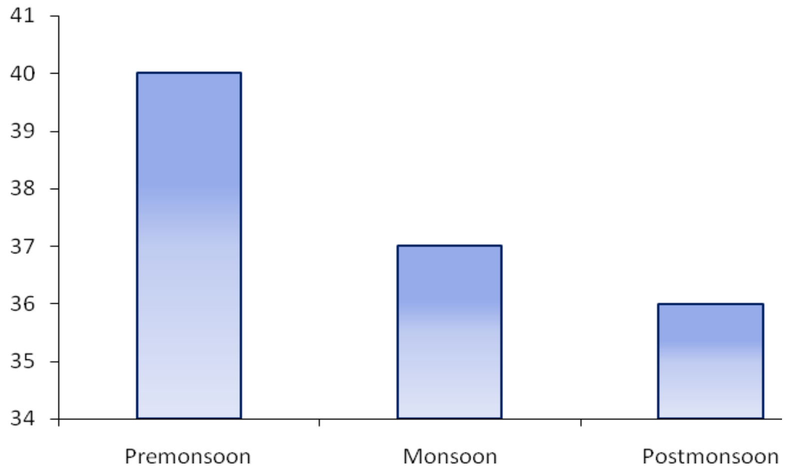


Fig. 275 Number of taxa found in different sampling season of wetland

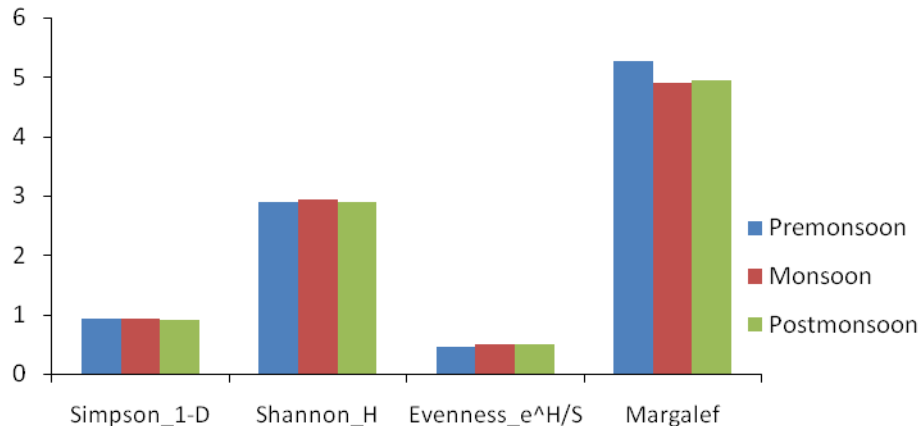


Fig. 276. Different diversity indices showing fish diversity during sampling

7.3. Status of Benthic fauna in Wetland

The results of the current study showed that the ecosystem of the chosen wetlands of both types is impacted by the status of benthic fauna. Although the macrobenthic diversity was the same in both wetlands, the open wetland had a greater diversity of fish species and plankton species. Due to hydrological exchanges, the linking channel improved the open wetland's fresh environment, making the ecosystem more productive. The present study was conducted in an open beel (23°26'50.08"N, 88°19'41.80"E), situated at Purba Bardhaman and Nadia district, West Bengal, India, and a closed beel (23°36'45.75" N, 88°10'56.68" E) at Purba Bardhaman district, West Bengal on the bank of river Ganga in same agro-climatic region.

7.4. Study between open vs closed wetland

A total of 12 macro benthic species belong to 5 orders and 7 families were reported from both the wetlands. Family Viviparidae was found most dominant in both the wetlands as it contributes 39.0% and 31.0% of the total diversity in open beel and closed beel, respectively. Other dominant families were Thiaridae (19.38%), followed by Planorbidae (16.11%) in open beel whereas, Planorbidae contributed 14.19% as the second-dominated family, followed by Thiaridae (10.60%) in closed beel. The abundance in the open and closed wetlands was recorded highest during pre-monsoon while lowest was recorded during monsoon.

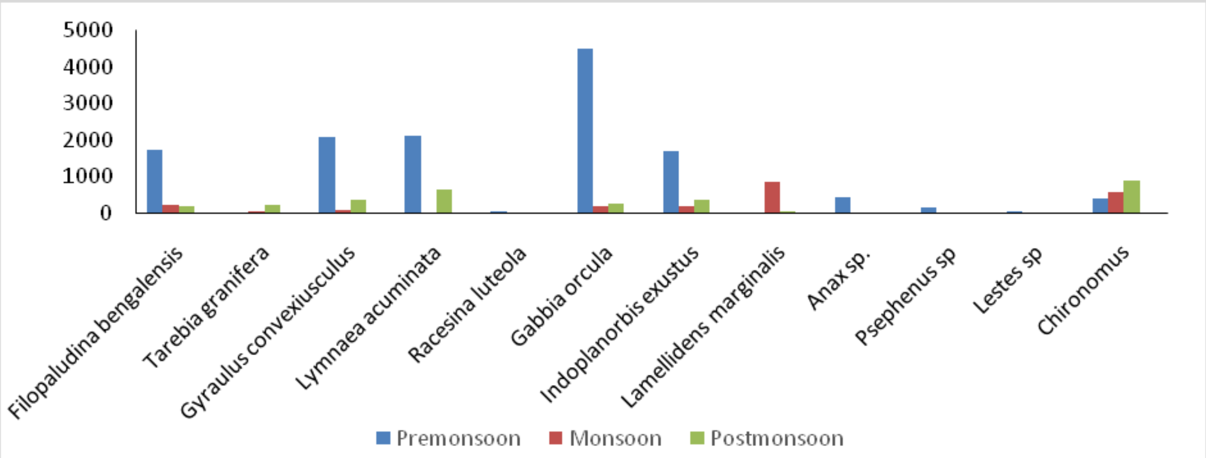


Fig. 277. Seasonal abundance of benthic species in open wetland

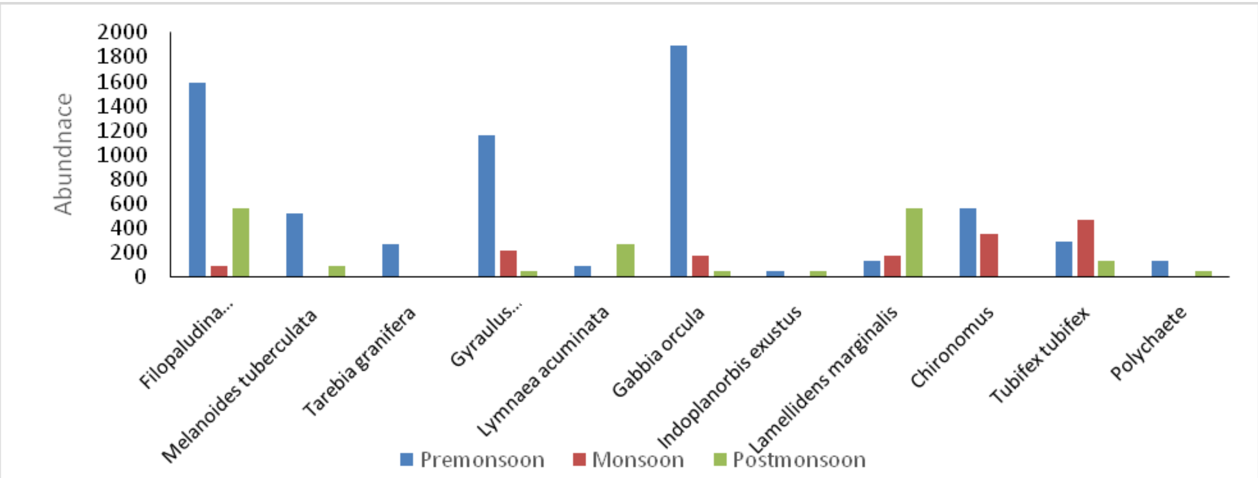


Fig. 278. Abundance of benthic fauna in closed wetland

7.5. Changes in Diversity Indices of benthic communities in wetlands

Family Bithyniidae was found dominant in pre-monsoon (1891 units/m^2) whereas, Viviparidae was dominant in monsoon (1591 units/ m^2) as well as pre-monsoon (286 units/ m^2). Species such as *Tubifex tubifex* was found dominant in monsoon (467 units/m^2) and pre-monsoon (279 units/m^2) but *Lamellidens marginalis* was found dominant in post-monsoon (559 units/m^2). Study revealed that the Shannon diversity index (*H'*) was maximum at open wetlands while it decreased during post-monsoon at closed wetlands. Simpson diversity index (1-*D*) and Equitability index (*J'*) were lowered in open beel than in closed beel. However, Margalef species richness index (*d'*) was found high in closed beel.

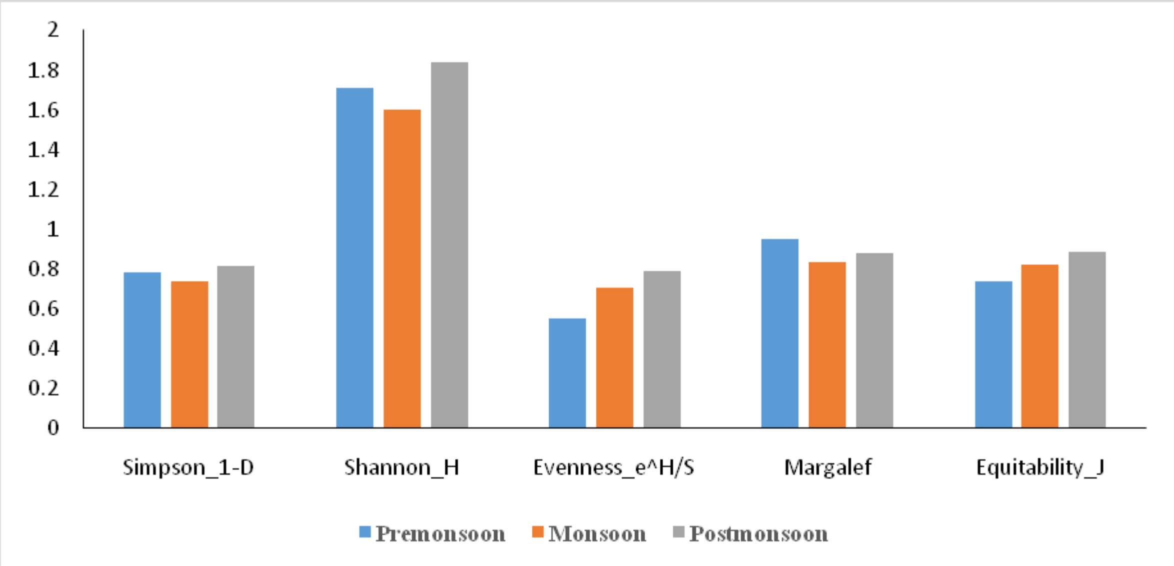


Fig. 279. Seasonal changes of abundance of Benthic fauna in open wetland

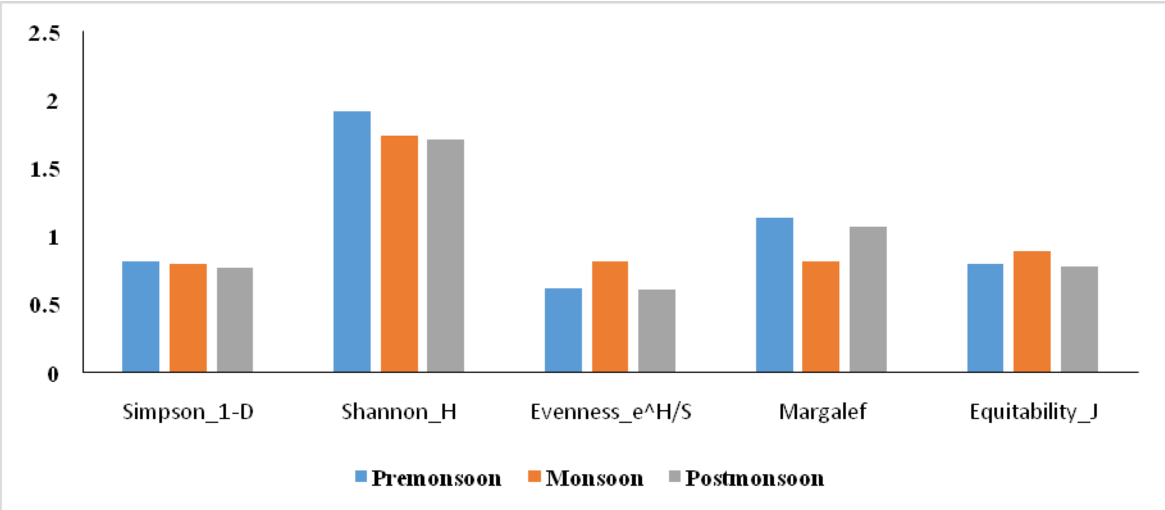


Fig. 280. Seasonal changes of abundance of Benthic fauna in closed wetland

7.6. Gangetic benthic species as bioindicators

Freshwater riverine systems are facing series of stress due to different anthropogenic activities, eutrophication and geomorphological alterations. Pollution is the current ecological hazard leading to the deterioration in river water quality and thereby modification of the quantitative distribution of the inhabiting organisms. River Ganga, flowing through a vast stretch of land from Uttrakhand to West Bengal in India, receives an ample amount of inorganic and organic wastes due to sewage, industrial and agricultural disposal. The benthic organisms settled at the bottom of the aquatic ecosystem are one of the prime species affected by the increase in pollution.

In the present study, four major eco-physicochemical parameters are selected to correlate with the available benthic species distributed in the entire stretch of river Ganga. Species like *Filopaludina bengalensis* and *Physella acuta* are marked as potent bioindicators of heavy metal contamination like copper, lead and cadmium. These organisms also indicate the presence of pesticides and poly aromatic hydrocarbons (PAH). They detect the hazard in the past and are recorded as a source of surveillance of the present riverine condition. Gastropod like (*Physella acuta* and *Mekongia crassa*) and Bivalvia (*Parreysia corrugata*); seven species belong to class Insecta (*Anax* sp. and Dragonfly Nymph), *Notonecta* sp., *Caenis* sp., *Rhyacophila* sp., *Philopotamus* sp. and Chironomus larvae); and two species belong to class Clitellata (*Tubifex tubifex and Lumbriculus variegatus*) are considered as indicator species. The present study can conclude that these identified benthic species can be used as bioindicator organisms for pollution monitoring and riverine health.

7.7. Health card of Ganga River

Benthic organisms are affected by the chemical, physical, and biological conditions of a water body. Their limited mobility does not allow them to escape the pollution and show effects from long- and short-term pollution events. One can use benthic macroinvertebrates organism as indicators of water pollution, which react quickly to environmental changes; hence, they are known as biological indicators. Their quantity can abruptly increase or decrease, and very sensitive ones can totally disappear. Benthic invertebrates that have long life cycles are most suitable as biological indicators. Therefore, using the diversity of benthic macroinvertebrate as health indicators of the selected river stretch in the present study, a health report card of the river Ganga is developed based on Central Pollution Control Board Report 2017. The Ganga River Health Report Card is an evaluation and communication tool based on Gangetic benthos population especially molluscs, to monitor community development, coordinate partners and initiatives, and spur change that enhances the health of the river and its watershed while safeguarding the local economy and livelihood. The report card was developed based on sampling points distributed among four stretches namely upper stretch, middle stretch, lower stretch and estuarine zone. The availability of molluscan species has been included in the health card and based on their assessment; the health card has been developed.

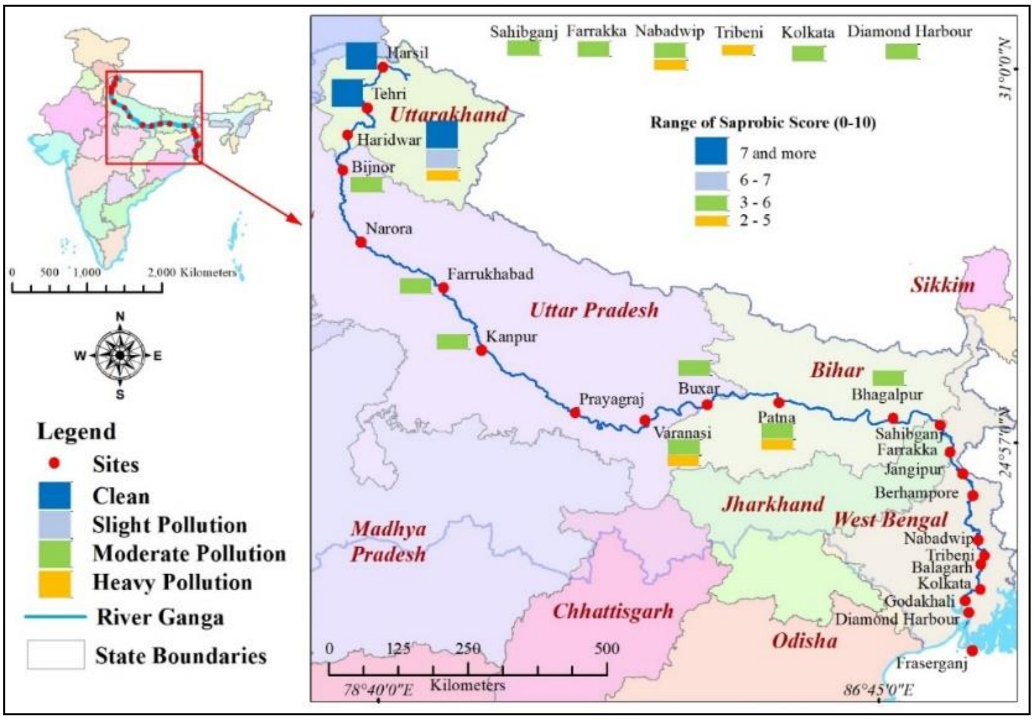


Fig. 281. Pollution levels at different stretches of river Ganga

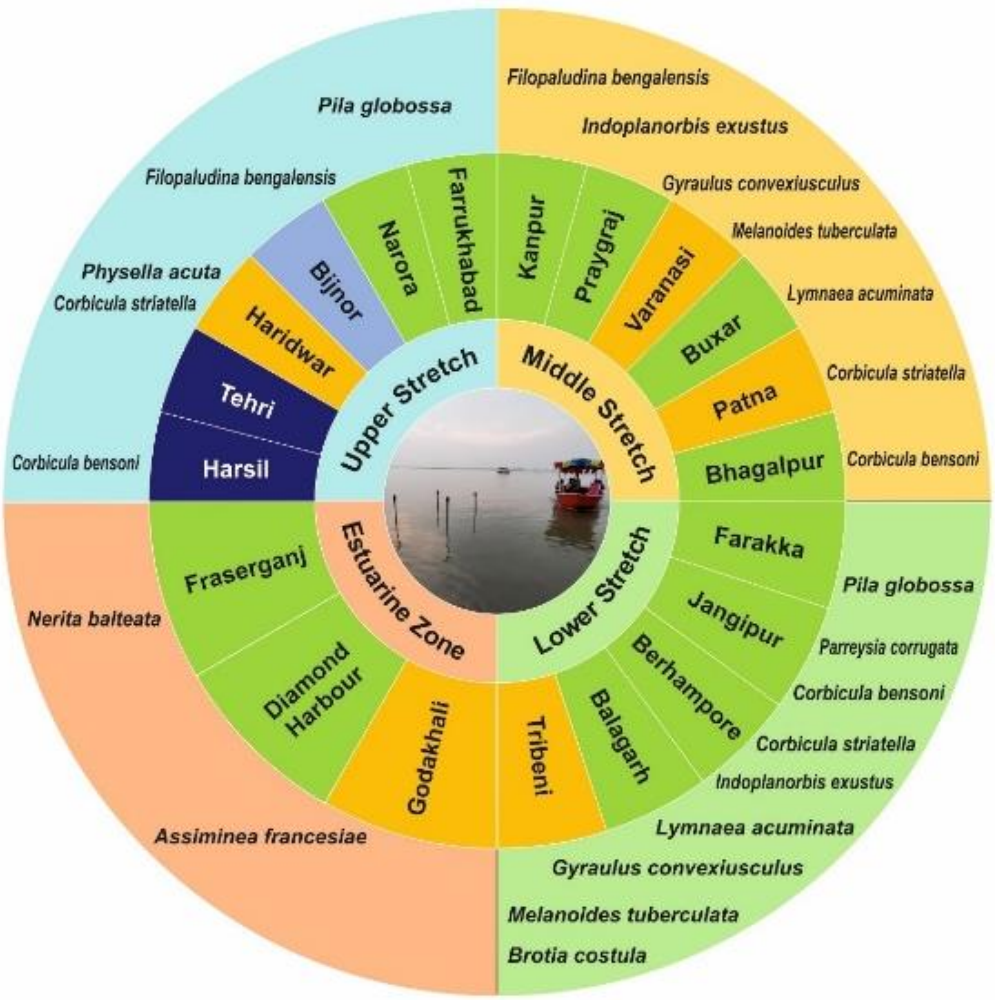


Fig. 282. Health card of riverine pollution as per benthic organisms in river Ganga

7.8. Heavy metal contamination in Gangetic molluscs

Various anthropogenic and religious activities, industrial effluents, sewage pollution, and agricultural runoff, are the primary source of pollution in the Ganga River. Metallic accumulation is a common phenomenon due to waste disposal directly in the river. The benthic macroinvertebrates of a water body are more likely to be impacted by metal accumulation in their living body. Hence, the study aimed at observing the level of accumulation of metals in the edible molluscan species of river Ganga. The concentration of metals (Cd, Co, Cr, Li, Pb) were analyzed in soft tissues of the molluscs from selected stations of middle comprising of Buxar, Patna and Bhagalpur; lower consisting of Farakka, Jangipur, Berhampore, Balagarh and Tribeni whereas estuarine stretch of river Ganga covers Godakhali, Diamond harbour and Fraserganj. The present study observed that the molluscan species collected from the middle stretch of the river had the highest metal concentration of . Bivalves like *Parreysia corrugata* are dominant at Buxar and Tribeni comprising 80% of the population. The metal concentration in the molluscs collected from Buxar to Bhagalpur were observed in the order of Cr > Cd > Pb > Co > Li; from Farakka to Tribeni Cr > Co > Pb > Li > Cd and at Fraserganj Cr > Li > Cd > Co >Pb. It was observed that the accumulation of cadmium (11.07 - 5.26 µg/g) and chromium (10.98 – 1.45 µg/g) was reported to be more in bivalves than in gastropods.

Among the selected molluscan species, the maximum accumulation of cadmium was (26.67 – 1.76 µg/g) while chromium (3.33 – 1.08 µg/g) accumulation was recorded maximum in bivalve especially *Parreysia corrugata. Filopaludina bengalensis* was also found contaminated with lead (6.69 µg/g). It was observed that *Lymnaea acuminata* was one of the species which was highly contaminated with all the selected heavy metals (Cr 26.67 µg/g, Pb: 5.9 µg/g, Li: 3.74 µg/g, Co: 5.4 µg/g and Cd: 1.08 µg/g) during the study period in middle as well as lower stretch.

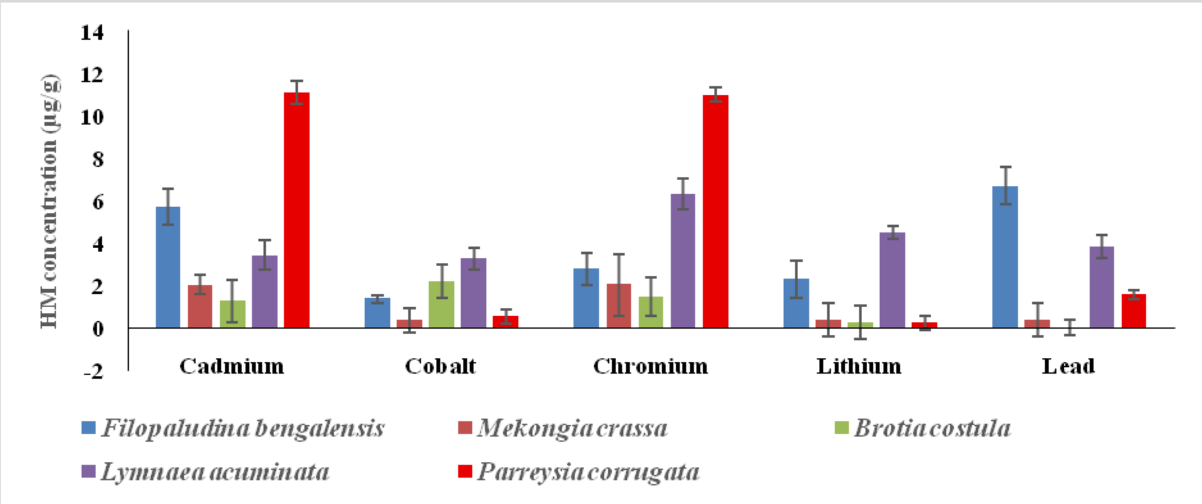


Fig. 283. Accumulation of heavy metals in the soft tissues of benthic molluscan species

The metal concentration of river Ganga showed a dominance of chromium over other metals. The species *Lymnaea acuminata* was observed to have higher concentrations of all the five mentioned heavy metals. *Parreysia corrugate* was highly contaminated with cadmium concentration (3.44 µg/g). *Tarebia granifera*, the dominant species in the lower stretch was observed to be contaminated by Cr> Co> Cd >Li > Pd.

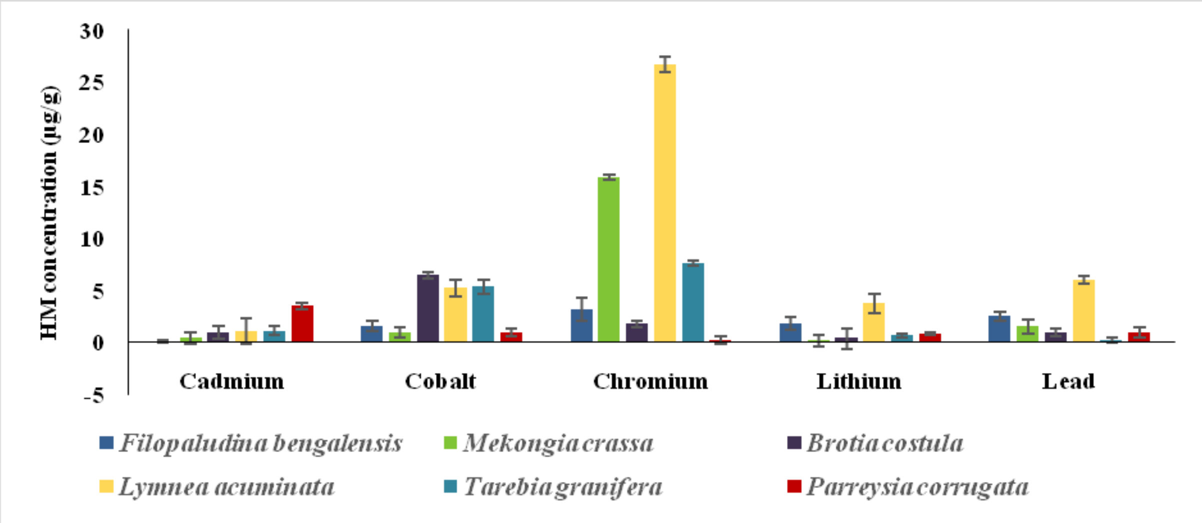


Fig. 284. Metal accumulation in the wet mass of macroinvertebrates

The concentration of heavy metal at Fraserganj was observed to be less than in the middle and lower stretch of river Ganga. The most common estuarine species *Telescopium telescopium* recorded maximum accumulation of Cr, followed by Cd, Li, Co, and Pb.

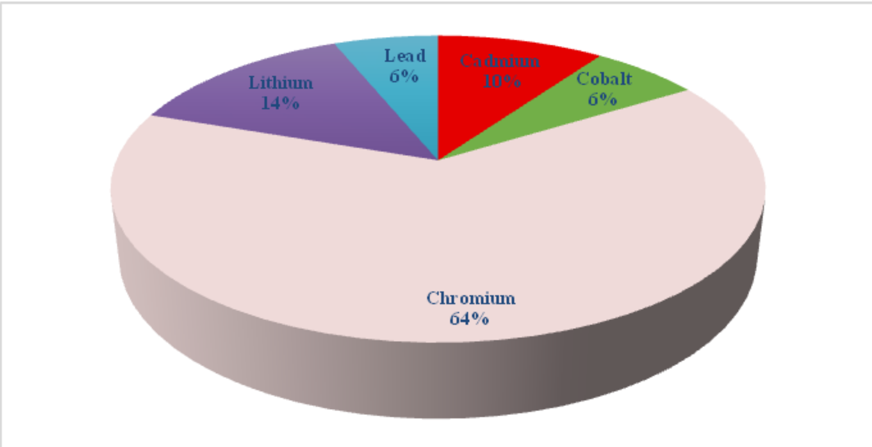


Fig. 285. Metal accumulation in the body of estuarine gastropod (*Telescopium telescopium*)

7.9. *Seasonal changes of abundance of phytoplankton communities in wetlands*

Seasonal changes of abundance of phytoplankton group were studied in Chharaganga beel (Fig. 166). Cyanophyceae was the most dominant group whereas Diatom was found second dominant group throughout the season. Among the Diatom *Navicula* sp., *Fragilaria* sp., *Synedra* sp., *Aulacoseira* sp. were found dominant genus. In group Chlorophyceae *Volvox* sp., and *Pediastrum* sp. were found dominant genus and found highest during post-monsoon. Species like *Spirogyra* sp. and *Mougeotia* sp. were found dominant in the group Zygnematophyceae and found maximum during pre-monsoon. Among the group

Euglenophyceae *Euglena* sp. was dominant during post-monsoon. *Anabaena* sp. was highest among the Cyanophyceae. Dinophyceae, Xanthophyceae, Chrysophyceae were found dominant during post-monsoon.

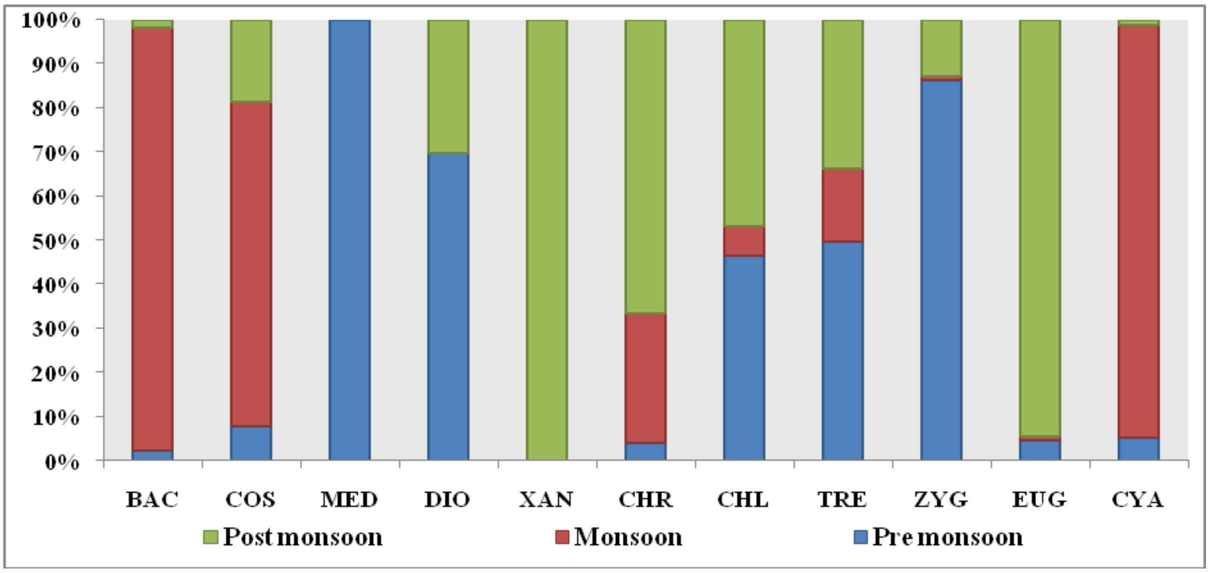


Fig. 286. Seasonal changes of abundance of phytoplankton communities in an open wetland

Seasonal changes of abundance of phytoplankton group were also studied in closed beel (Fig. 167). Cyanophyceae was found dominant during pre-monsoon and monsoon. Trebouxiophyceae was found to be dominant during post-monsoon followed by Euglenophyceae. Among the Diatom, *Aulacoseira* sp. was found dominant followed by *Nitzschia* sp.; and *Synedra* sp. and the group found highest during pre-monsoon. In Chlorophyceae *Volvox* sp. was found dominant during monsoon. Among group Cyanophyceae *Phormidium* sp. was dominant. *Euglena* sp. among the Euglenophyceae was found dominant in monsoon. The group Zygnematophyceae was found maximum during post-monsoon and the dominant genus was *Closterium* sp. Chrysophyceae was found only during post-monsoon.

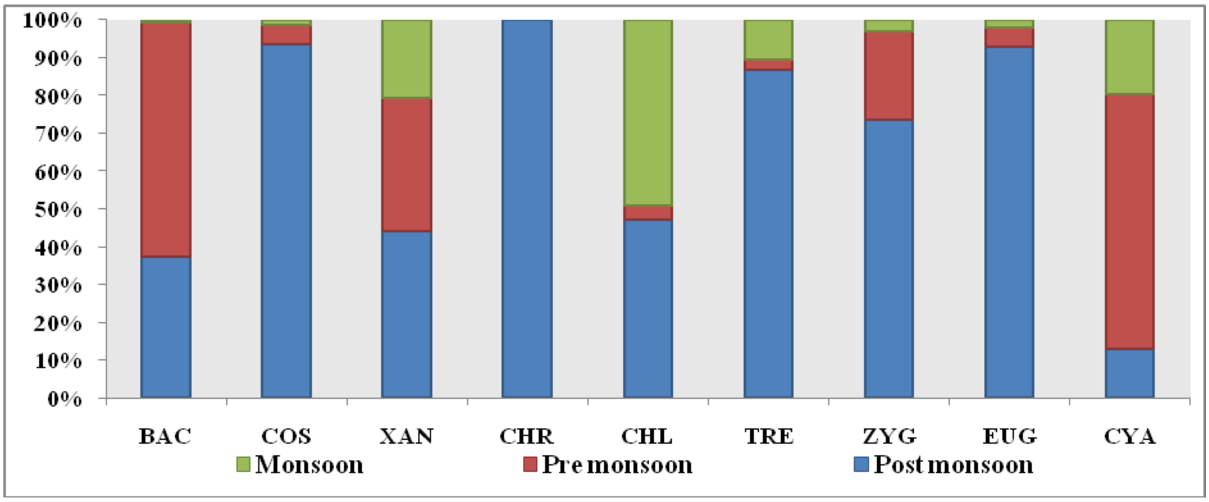
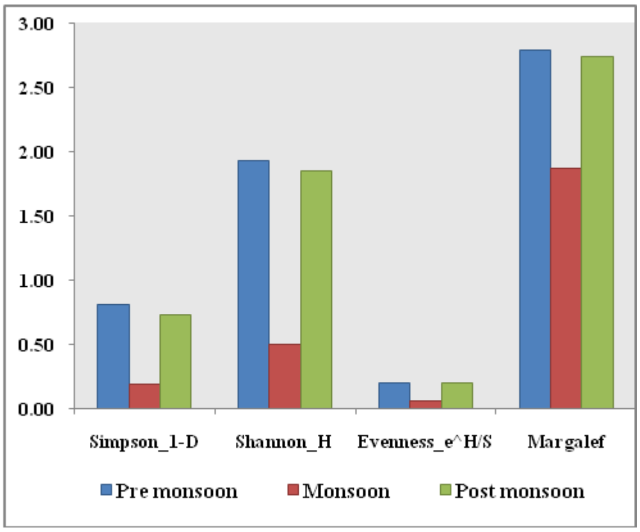


Fig. 290. Seasonal changes of abundance of phytoplankton communities in a closed wetland

In open ecosystem Simpson (0.81), Shannon (1.93), Margalef (2.79) indices were found high during pre-monsoon while Evenness index (0.20) was found high during post-monsoon. All the indices were found low during monsoon.

In close ecosystem Simpson (0.83), Shannon (2.23), Evenness (0.27) indices were found high during post-monsoon while Margalef index (2.63) was found high during pre-monsoon. Simpson (0.68), Shannon (1.50) and Margalef indices (2.10) were found low during monsoon. Evenness index (0.16) was found minimum during pre-monsoon.



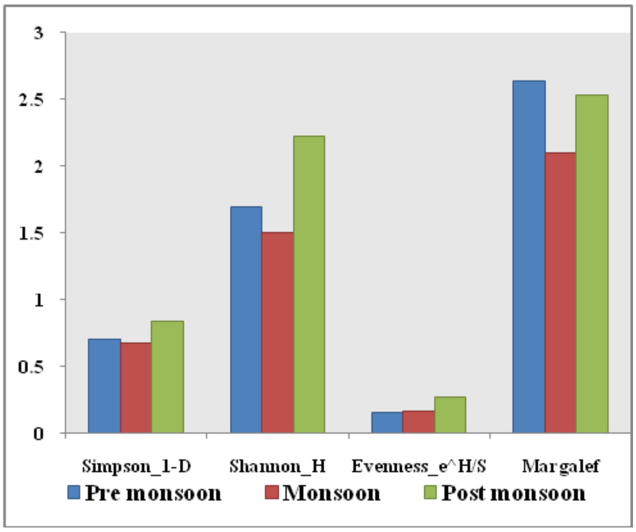
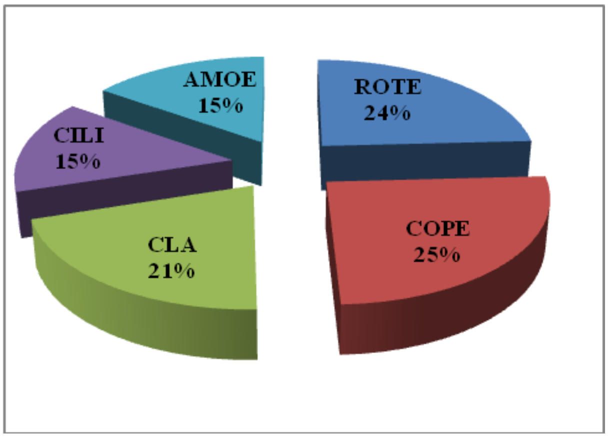


Fig. 291. Diversity indices of phytoplankton in the studied wetlands (open and closed wetland)

7.10. Status of zooplankton in the studied beel

Seasonal changes of abundance as well as diversity of zooplankton were also studied along with phytoplankton community in the studied beel. A total of 26 genera of zooplankton belonging to 5 phyla were recorded from the open beel, with dominant of copepoda. The study revealed that, highest abundance of zooplankton was observed in the open beel during monsoon (17197 ind l^{-1}) and lowest during pre-monsoon (6285 ind l^{-1}).

While in the close beel, 19 genera belonging to 5 phyla were recorded from the closed beel, with dominance of Rotifera. In the close beel maximum density of zooplankton was found during post-monsoon (78229 ind l^{-1}) and minimum during pre-monsoon (4684 ind l^{-1}). The percentage of abundance of different groups of zooplankton of the studied beel is described in Fig. 292 A & B.



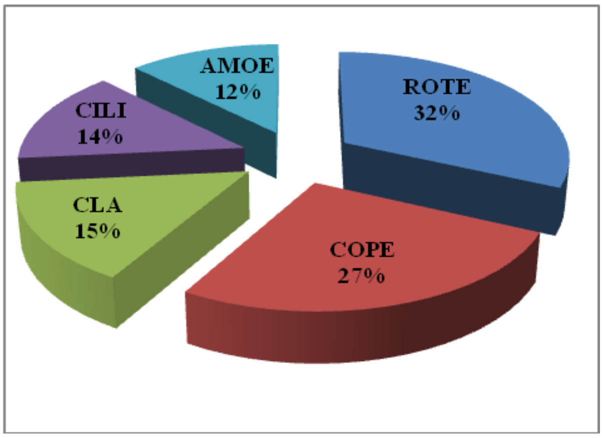


Fig. 292A. Percentage of abundance of different group of zooplankton in open beel

Fig. 292B. Percentage of abundance of different group of zooplankton in Closed beel

7.11. Seasonal changes of abundance of zooplankton communities in wetlands

Seasonal changes of zooplankton community abundance were also studied along with phytoplankton in the open beel (Fig. 293). Rotifera *Brachionus* sp. and *Keratella* sp. were found dominant, and their abundances were recorded maximum during post-monsoon. Copepoda was found maximum during monsoon seasons with *Nauplii* being the dominant genus. Cladocera abundance was found maximum during post-monsoon, and Ciliophora and Amoebozoa were found highest during the monsoon season.

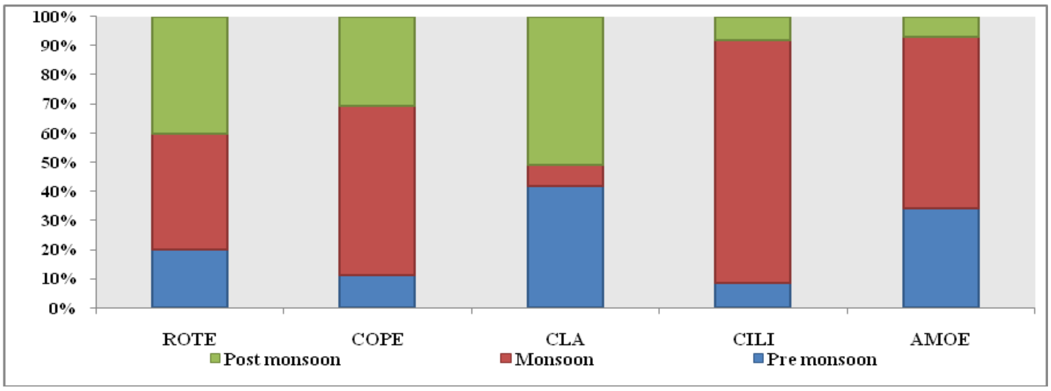


Fig. 293. Seasonal changes of abundance of zooplankton in open wetland

Seasonal changes of zooplankton density at closed beel are depicted in Fig 294. Among Rotifera, *Brachionus* sp. and *Keratella* sp. were found dominant during post-monsoon. While Copepoda was found dominant during post-monsoon, and Nauplii was the dominant genus. Cladocera abundance was found maximum during post-monsoon, and Ciliophora and Amoebozoa were found highest during post- monsoon season.

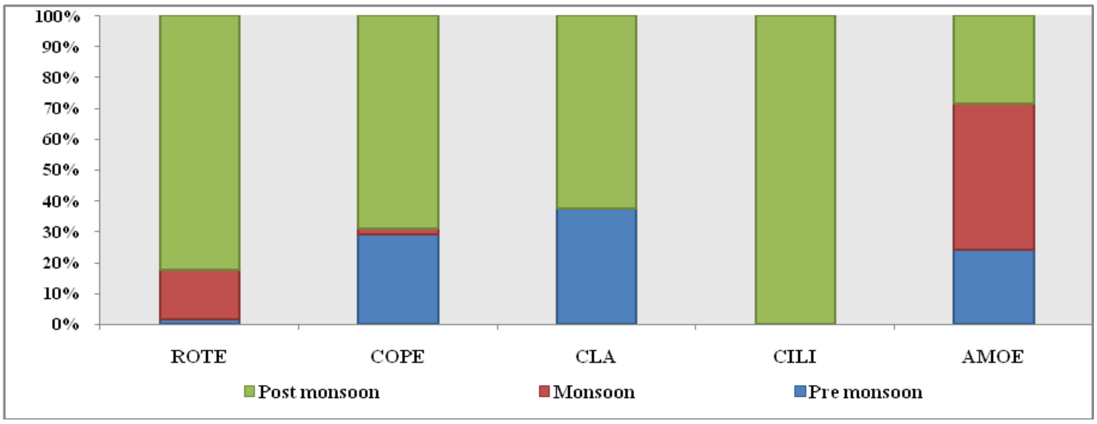


Fig. 294. Seasonal changes of abundance of zooplankton in closed wetland

In the open system, Simpson (0.82), Shannon (2.10), Margalef (2.06), and Evenness (0.43) indices were found maximum during the post-monsoon season. While the minimum values of Simpson (0.71), Shannon (1.56) and Margalef (1.27) were found during monsoon and Evenness index (0.28) during pre-monsoon. In the close system, Simpson (0.73), Shannon (1.58), Evenness (0.40) indices were found highest during monsoon, and Margalef index (1.54) during pre-monsoon. The minimum values of Simpson (0.59), Shannon (1.40) Evenness (0.29) was found lowest during pre-monsoon, and Margalef index (1.07) was found during post-monsoon. Diversity indices of zooplankton in the studied wetlands are given in Fig. 295.

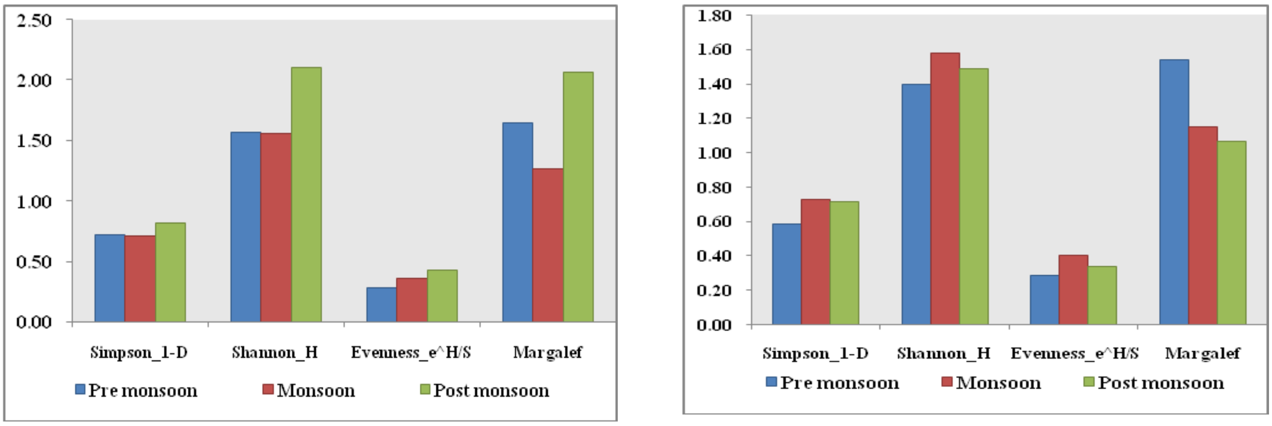
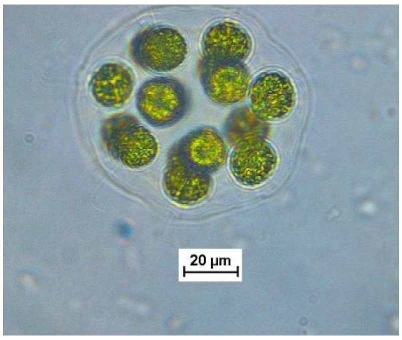
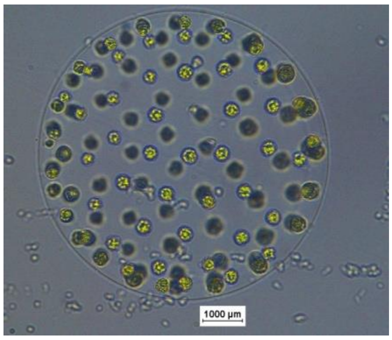


Fig. 295. Diversity indices of zooplankton in the studied wetlands

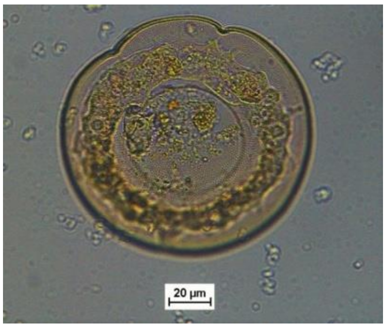
Pandorina sp.



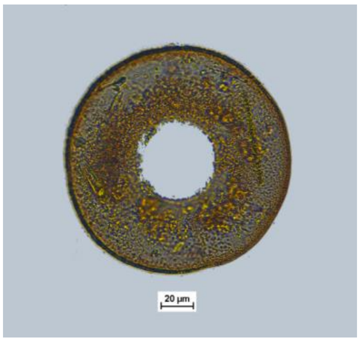
Eudorina sp.



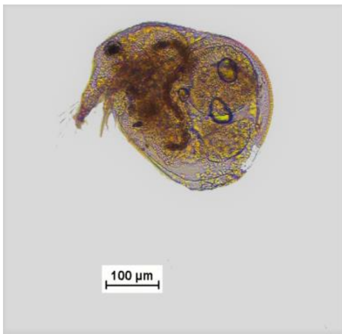
Volvox sp.



Centropyxis sp.



Arcella sp.



Bosmina sp.

Fig. 296. Photomicrograph of some common planktons at studied wetlands

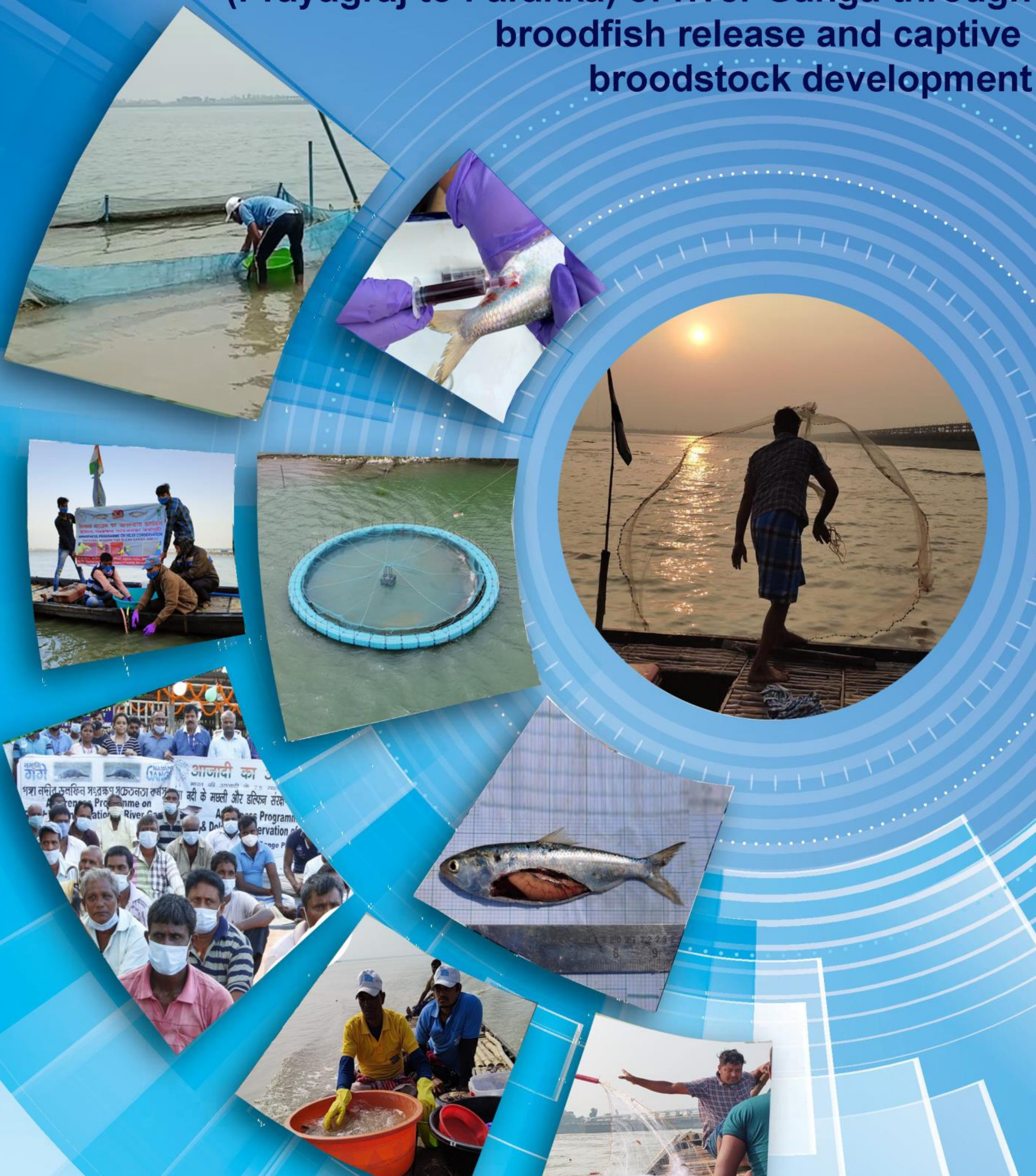
7.12. Identification of breeding and nursery requirement of fish species in the studied wetlands

Open floodplain wetlands usually act as spawning and rearing grounds for the small native fish species. Small indigenous species such as *Gudusia chapra*, *Ailia coila*, *Botia dario*, *Botia lohachata*, and *Rasbora daniconius*, were recorded from such wetlands were caught mainly in juvenile stages (<11.00 cm in total length), specifically during monsoon and post-monsoon season. Henceforth, the wetland associated nursery ground needs to be protected, especially during the breeding grounds for self-reproduction, and sustainable management of those commercially important small indigenous species.

The study also indicated that, in the enclosed type of wetland at Purba Bardhaman district (23°36'45.75" N, 88°10'56.68" E) of West Bengal supports a total of 21 fish species, including 1 species of the Near-threatened and 1 as Vulnerable categories as per IUCN Red List status. Such wetlands gradually detached from the Ganga River due to anthropogenic activities, and restoration of such wetlands is needed.

Component-II

Hilsa fisheries improvement in the middle stretch (Prayagraj to Farakka) of river Ganga through broodfish release and captive broodstock development



Tenualosa ilisha, commonly known as Hilsa or Ilish, commercial and culturally significant fish species, is known for its remarkable anadromous migration - it travels from the sea to freshwater rivers to breed for reproduce their offspring. The migration of Hilsa is a crucial natural phenomenon that plays a pivotal role in their life cycle and is essential for the livelihoods of many coastal communities. This anadromous fish migrate thousands of kilometers, often crossing international borders, in search of suitable breeding grounds. The Hilsa migration is vital for both the fish's life cycle and the livelihoods of coastal communities dependent on it. In the Ganges River, Hilsa fish typically begin their upstream migration from July, continuing through November. Conversely, downstream migration occurs from January to March. The peak of upstream migration coincides with the onset of the South-West monsoon, starting in July and extending through November. Interestingly, the migration period appears to extend, with a minor migratory presence continuing until March. The construction of the Farakka Barrage in 1975 on the Ganges River in India had profound and complex effects on the Hilsa migration in the upstream region of the Farakka Barrage.

However, the Farakka Barrage has disrupted this natural phenomenon in several ways. Firstly, the diversion of water from the Ganges into the Hooghly River for maintaining navigability and preventing sedimentation in the Kolkata Port has altered the flow dynamics of the river. This alteration affects the timing and duration of the Hilsa migration window. Secondly, the Farakka Barrage acts as a physical barrier to fish movement. Although fish ladders were later added to facilitate migration, their effectiveness remains a subject of debate. Furthermore, changes in water temperature and salinity downstream of the barrage, caused by reduced flow and increased sedimentation, can influence Hilsa migration patterns and food availability. As a result of these disruptions, Hilsa populations have faced declines in the upstream regions of the Farakka Barrage. The middle stretches of the Ganga River have experienced a severe depletion in the Hilsa fish population. Hilsa landings have seen a dramatic decline, ranging from 83.1% to 98.6%, in the middle stretch of the river (1995-2015), spanning from the Farakka Barrage to Prayagraj. Interestingly, downstream of the barrage, there has been an increase in Hilsa landings.

As a solution, a plan was formulated to engage in Hilsa ranching, primarily involving the collection of adult Hilsa from downstream areas and their subsequent release into the upstream region of the barrage. Hilsa ranching encompasses various crucial elements, notably the transportation of these fish, all aimed at bolstering the Hilsa population upstream of the barrage, particularly in the middle stretch of the Ganga River.

OBJECTIVE VI: TO INCREASE THE NATURAL STOCK OF HILSA IN RIVER GANGA (UPSTREAM OF FARRAKA BARRAGE) THROUGH RANCHING OF WILD COLLECTED HILSA SEED/JUVENILES

8. Transportation of live hilsa

One of the most significant commercial fishes in the Indo-Pacific is the Hilsa shad, (*Tenualosa ilisha*). Now a days Hilsa has been declining, therefore, to increase the Hilsa population in upstream of the Farakka barrage, the study was carried out with major objective to increase the natural stock of Hilsa in river Ganga (upstream of Farraka barrage) through ranching of wild-collected Hilsa seed/juveniles to monitor the migration of Hilsa and life history through Floy tagging and advanced techniques through tags.

Hilsa, collected in live conditions from downstream of the Farakka barrage, were transported upstream to increase their population in the middle stretch of the river Ganga. Various fishing methods, such as experimental hand nets, contemporary lift nets, and gill nets, were employed to capture hilsa from the downstream area of the Farakka barrage, as depicted in Fig. 297; Fig. 298 & Fig. 299. Notably, lift nets demonstrated a higher survivability rate when compared to other net types. This observation underscored the importance of recognizing that hilsa, known for their fast swimming and migratory nature; require elevated oxygen levels to endure extended transportation periods.

Fig. 297 A, B & C) Hand nets operation for live Hilsa catch from downstream of Farakka Barrage. D) Length-Weight recorded and released in to tubs for transportation

Fig. 298. Gill net operation at Farakka for Hilsa fishing

Fig. 299 A) Collection & transportation of live Hilsa from fisherman to the river bank side; B & C) Collected live Hilsa acclimatized into FRP tubs and manually transportation

To enhance the transportation duration, experiments were conducted, which included the utilization of coated oxygen tablets and sedatives. The sedative chemical developed by ICAR-CIFRI was successfully employed to transport live hilsa, yielding favorable results in terms of survivability rates. Prior to transportation, the length and weight of each hilsa specimen were meticulously recorded. It was noted that hilsa within the size range of 100-350 grams exhibited a significantly higher survival rate compared to those weighing over 350 grams. The hilsa transportation procedure was executed with a focus on ensuring the well-being and minimal stress for the fish during transit. To facilitate the transport of hilsa within the desired weight range, a range of 10-52 kilometers upstream of the Farakka barrage was established, thanks to the indigenous fish transport system developed by ICAR-CIFRI, utilizing waterways for this purpose.

Fig. 300. A) Oxygen generation through vigorously water churning during open transportation of live Hilsa; B&C) Hilsa transport crossing the railway track; D-F) Live hilsa transportation through Battery operated vehicle to Hilsa ranching station

The hilsa transportation procedure was executed with a focus on ensuring the well-being and minimal stress for the fish during transit. To facilitate the transport of hilsa within the desired weight range, a range of 10-52 kilometers upstream of the Farakka barrage was established, thanks to the indigenous fish transport system developed by ICAR-CIFRI, utilizing waterways for this purpose.

8.1. Expression kinetic study of HSP70 gene associated transportation stress of *T. ilisha*

This study investigates the impact of transport stress on hepatic heat shock proteins (HSPs) in *Tenualosa ilisha*, a popular fish species in India. Transport stress, including pre- and post-transport procedures, can cause fish growth suppression, high mortality, disease susceptibility, and increased rearing costs. HSPs, a group of conserved proteins, regulate cellular protein structure, act as housekeeping and cytoprotective functions, and play a crucial role in cellular homeostasis under environmental fluctuations. HSPs families include HSP70 and HSP90, which regulate protein folding and aggregation. However, studies on the effect of transport stress on HSPs in Hilsa are limited. This study aims to understand the physiological responses of Hilsa, suffering from transport stress, and improve fish welfare.

8.2. Methodology

During the transport of the adult Hilsa fish (100-200 g) an average length of 15.98±1.52 from downstream to upstream of the Farakka barrage (Lat. 20°1'06 "- 20°11.45" N long, 80°50'52 " - 85°51'35``E) for the ranching program. Fish were subjected to netting, handling, and grading before the transport process, thereafter split into two groups. One was the control group (the non-transported fish) which was kept in normal condition and at a density of three fish per tank (330L). Another group of fish was exposed to the transport stress (the treatment group) The sample was collected during transport at different distance intervals (i.e., 0 km, 1 km, 2 km, 3 km, 4 km, 5 km, 6 km, 7 km, and 10 km) and euthanized with MS-222 immediately before dissection. Brain samples were collected from each fish, quickly store in RNA later. After that RNA and DNA was isolated and ratio was calculated than primer was design against Stress gene (*HSP70) and* amplify the HSP70 gene using PCR. the intensity of HSP70 gene signals was measured by image analysis (Gene Genius Bio Imaging System, SynGene), and divided by the intensity of the respective β-actin signals to give a ratio of HSP70: β -actin signal strength for each sample. Semi-quantitative analysis of the HSP70 gene and the reference gene β-actin was performed in Quantitative RT thermal cycler (RT-PCR) (Applied Biosystems, USA).

Table 23. Primer used in the study of expression kinetic study of HSP70 gene of Hilsa

Gene	Orientation	Primer	Len	T_m	Product size
HSP70	Forward	GGCACCACCTACTCCTGTGT	20	58-60	688bp
	Reverse	AGTGACTAACCAGGCGGTTG	20	58-60	
β-actin	Forward	TTCGAGCAGGAGATGGGCACTG	22	55-65	254bp
	Reverse	GCATCCTGTCAGCAATGCCA	20	55-65	

8.3. Result

Hsp70 Expression in different brain tissue with respect to different distance interval

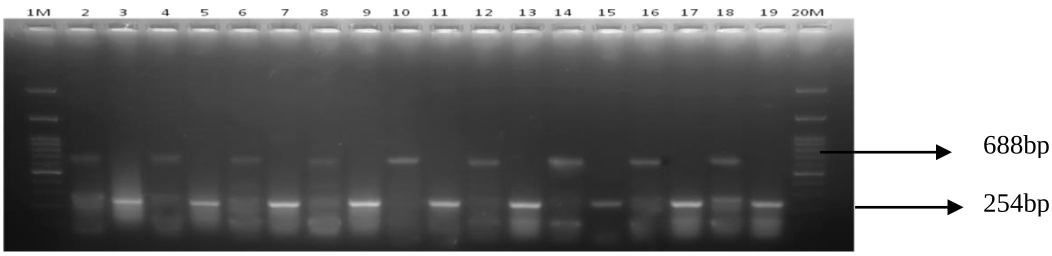


Fig. 301. HSP70 and β-actin expression in the Hilsa brain tissues

Table 24. Results of expression kinetic study of HSP70 gene of Hilsa

L1	100bp Marker	L5	β-actin-1h	L9	β-actin-3h	L13	β-actin-5h	L17	β-actin-7h
L2	HSP70-0h	L6	HSP70-2h	L10	HSP70-4h	L14	HSP70-6h	L18	HSP70-10h
L3	β-actin-0h	L7	β-actin-2h	L11	β-actin-4h	L15	β-actin-6h	L19	β-actin-10h
L4	HSP70-1h	L8	HSP70-3h	L12	HSP70-5h	L16	HSP70-7h	L20	100bp Marker

Control fish (0 km) show weak Hsp70 expression (ratio 0.85), while on the other hand a mean value of the Hsp70 and β-actin ratio of 1.16-3.6 is present in the different distance interval.

8.4. RNA, DNA and RNA/DNA ratio

The DNA quality did not vary significantly between the different groups. However, the RNA quality varied significantly in the range of 1.20 ± 0.11 µg / mg to 1.80 ± 0.11. The RNA: DNA ratio decreased significantly due to the high labeling stress.

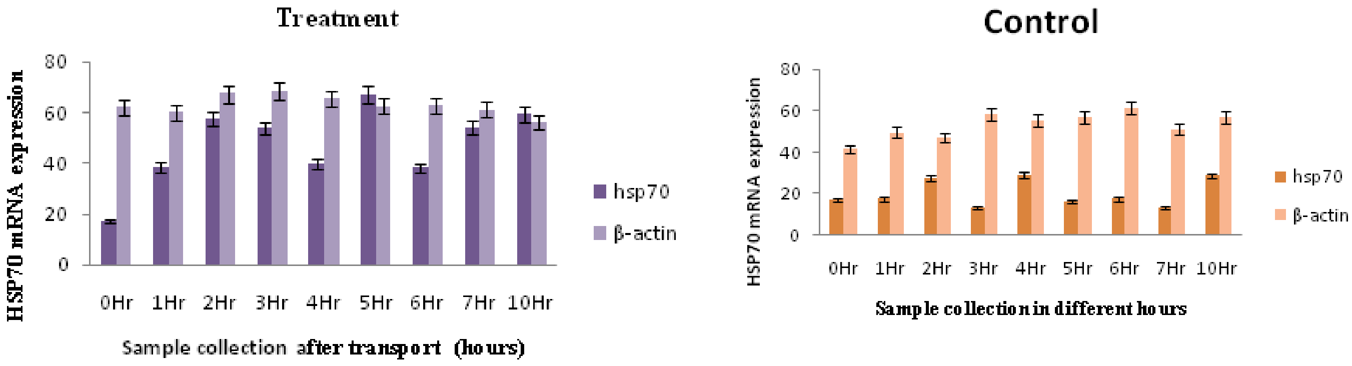


Fig.302 HSp70 mRNA Expression with compare β-actin in Hilsa, during transportation

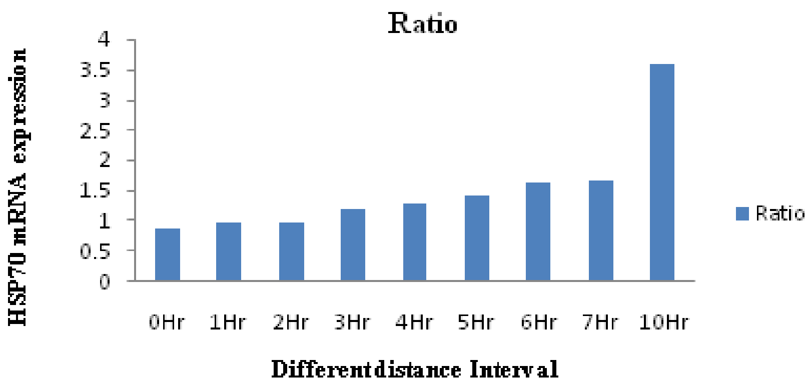


Fig. 303 Hsp70 ratio showing HSp70 expression at different distance intervals during transportation

8.5. Conclusion

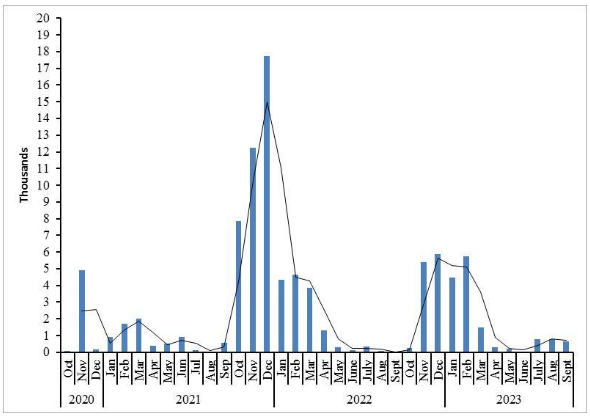
During the transport of Hilsa fish, the HSP70 gene stimulates and expresses different trends depending on the distance. This can be due to a lack of oxygen or modulation of disruption of ionic balance; cellular responses to stress are expected to be activated. This is an area that needs more attention from researchers for standardizing the transportation of hilsa fish for the ranching program.

A total of 91,588 Hilsa brood fish were released in upstream of the Farakka barrage during the period of these, a total 15,100 no. of Hilsa in the year 2020-2021 and 50,055 in year 2021-2022 and 26,433 in 2022-2023 respectively. The average length and weight of the ranched fishes were 26.37±4.17 cm and 263.51±18.97 g. The number of ranched Hilsa was almost 3.3 times higher during the second year compared to the 1st year of the phase II project but in the third year it 1.7 times. A good monsoon found to be the favorable condition of Hilsa migration during the 2nd year, which resulted in higher numbers of Hilsa ranching.

Table 25 . Yearly ranching of Hilsa above Farakka Barrage in the river Ganga (2020-2023)

Sl. No.	Year	Ranching
1.	2020-2021	15,100
2.	2021-2022	50,055
3.	2022-2023	26,433
	Total	**91,588**

Fig. 304. A&B) Transporting the live hilsa (Indigenous hilsa transport system developed by ICAR-CIFRI) by boat for ranching 5-8km distance from Farakka Barrage in upstream. C- E) Ranching of Hilsa to the upstream of Farakka Barrage in the river Ganga.



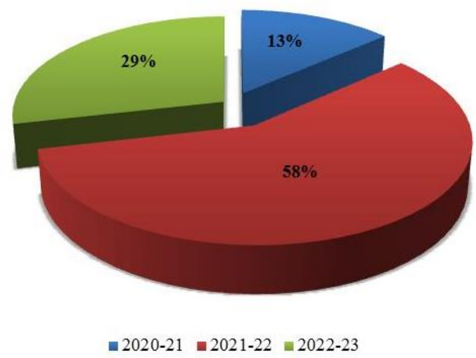


Fig. 305. Monthly ranching of adult Hilsa at upstream of Farakka Barrage, river Ganga

Fig. 306. Year wise Ranching of adult Hilsa at upstream of Farakka Barrage in river Ganga

8.6. Length-Weight Relationship (LWR) among the ranched fish

A total of 31,867 specimens of length range 2.3 – 50.1 cm TL weighing 8 – 1134 g have been collected. This includes 2,537 females of length range 12.2 – 50.1 cm TL; 29,447 males of length range 2.3 – 48.2 cm TL. In *Tenualosa ilisha*, the LWR was estimated for male, female and pooled data on exponential equation as $W = 0.02239324L^{2.7067}$, $W = 0.02419625L^{2.723}$ and $W = 0.02857085L^{2.6312}$ (Figs. 307a,c,e). There is no significant difference in 'b' value between the male and female. The constants 'a' and 'b' in the linear form were calculated for male, female and pooled data using methods of least squares in the logarithmic form as log W = -1.6499 + 2.7067 log L (r^2 = 0.8119), log W = - 1.6163 + 2.723 log L (r^2 = 0.84) and log W = -1.5441 + 2.6312 log L (r^2 = 0.7632). The least square regression for male, female and pooled specimens were found to be y = 2.7067x – 1.6499 (r^2 = 0.8195), y = 2.723x – 1.6163 (r^2 = 0.8522) and y = 2.6312x – 1.5441 (r^2 = 0.7732) (Figs. 307 b,d,f). The obtained 'b' value for male, female and pooled specimens indicates negative allometric growth (Table 26).

The knowledge on aspects such as length-weight relationship (LWR), condition factor and growth parameters of fishes are very important in fisheries management. In order to predict weight effectively from length measurements of fish in the yield assessment, LWR parameters can be utilized (Pauly, 1993). Fishes can attain either isometric growth, negative allometric growth or positive allometric growth which can be inferred from the obtained 'b' value. As the fish species under study were showing negative allometric growth, it can be inferred that the fish becomes slenderer as it increases in weight.

Table 26. Length-weight relationship of male and female Hilsa

	No. of Sample	**Length range (cm TL) (n)**	**Weight (gms)**	**Log a**	**b**	***W-L* equation**	**Determination Coefficient (r^2) original data**	**Determination Coefficient (r^2) log transformed data**	**Growth type**
Male	29,447	2.3 - 48.2	8 - 959	-1.649	2.706	$W = 0.02239324L^{2.7067}$	0.8119	0.8195	(-) Allometric
Female	2,537	12.2 - 50.1	19 - 1134	-1.616	2.723	$W = 0.02419625L^{2.723}$	0.84	0.8522	(-) Allometric
Pooled	31,867	2.3 – 50.1	8 - 1134	-1.544	2.631	$W = 0.02857085L^{2.6312}$	0.7632	0.7732	(-) Allometric

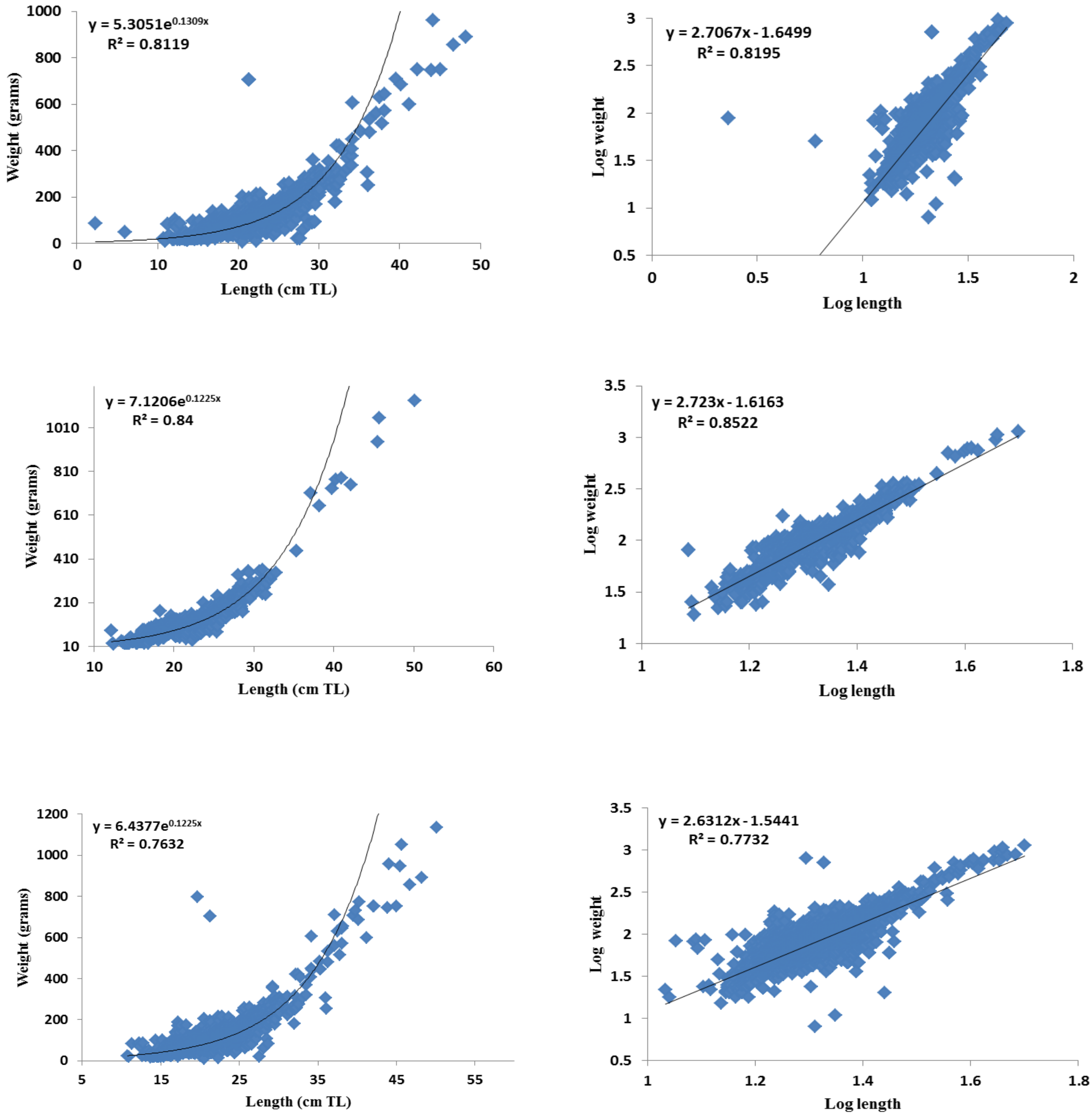


Fig. 307. a) LWR of male *Tenualosa ilisha*, b) LWR derived from log transformed data of male *Tenualosa ilisha*, c) LWR of female *Tenualosa ilisha*, d) LWR derived from log transformed data of female *Tenualosa ilisha*, e) LWR of *Tenualosa ilisha*, f) LWR derived from log transformed data of *Tenualosa ilisha*

OBJECTIVES- II: TO INCREASE THE NATURAL STOCK OF HILSA IN RIVER GANGA (UPSTREAM OF FARRAKA BARRAGE) THROUGH ARTIFICIAL BREEDING OF HILSA AND GROWING AND RANCHING THE SEEDS/ JUVENILES AS WELL AS DEVELOPING CAPTIVE BROOD STOCK

One of the primary goals in enhancing the Hilsa population in the middle stretches of the river Ganga is the acquisition of robust, high-quality brooders (males and females) and the implementation of artificial breeding techniques. To achieve this objective, mature brooders were collected from downstream of the Farakka Barrage, specifically from Murshidabad and Godakhali in South 24 Parganas, West Bengal. These fish were skillfully captured from the river using methods such as hand nets and nylon monofilament gill nets (with a mesh size of 70-90 mm). Importantly, these fish were harvested without experiencing any undue stress.

Fig. 308. Images representing striping eggs from oozing out female and the milt from male Hilsa followed by wet stripping method

Artificial breeding of Hilsa was conducted through both dry and wet stripping methods. Initially, selected Hilsa females with ideal oozing conditions had their belly regions lightly stripped, allowing the smooth release of eggs onto a stainless-steel tray. Simultaneously, gentle pressure was applied to the abdomens of Hilsa males to extract milt, which was then added over the eggs. In the dry method, a bunch of feathers was used to thoroughly mix the milt with the eggs, whereas in the wet method, a stainless-steel tray filled with filtered river water was gently pressed against the oozing female's belly to facilitate the mixing of milt, followed by feather assistance. In the dry method, precautions were implemented to ensure that the eggs and milt did not come into contact with water before undergoing thorough mixing. Following fertilization, the eggs promptly swelled, and the yolk's color shifted from a light yellow to a pale greenish-yellow tint. Given the sensitivity of the stripped eggs and milt to light, they were carefully protected from direct sunlight.

The collected oozing-out females had an average length ranging from 21.5 to 35.4 cm, with weights ranging from 108 to 705 grams. Matured males, on the other hand, exhibited lengths of 18.5 to 29.5 cm and weights of 125 to 450 grams. The fertilization rate achieved ranged from 72% to 80%, and the hatching rate was recorded at 57% to 60%. Between November 2021 and April 2023, a total of 188 Hilsa were utilized for breeding purposes, with 121 males and 67 females in Farakka and 60 males and 18 females in Godakhali (Table 27).

Fig. 309. A&B) Hilsa rearing indoor unit at office quarter Farakka. C) Egg ready for hatching, D) Approximate counted numbers of fertilized eggs poured in to the tray, E& F) hatchlings of Hilsa

Table 27. Artificial Breeding details of Hilsa in different places

Details of Artificial Breeding	**Farakka, Murshidabad**	**Godakhali, S24Pgs**
Total Breeding No	32	10
Breeding Time	4.05 - 6.30 pm	4:15 - 7:30 pm
Total Female & Male Ratio	1:1.8	1:3.3
Total Male No	121	60
Total Female	67	18
Average Male Hilsa Weight (in gm)	147.43	333
Average Male Hilsa Total Length (in cm)	24.65	28.5
Average Female Hilsa Total Weight (in gm)	108.58	705.8
Average Female Hilsa Total Length (in cm)	21.49	35.4
Method of Breeding	Dry/Wet	Dry/Wet
Water Used	Filtered River water/ Packaging Water	Filtered River water/ Packaging Water
Water Temperature	22-27.3°C	22.4-28.6°C
Total Approximate Eggs	40,52,000	715300
Avg. Fertilized Eggs (%)	56.2	87.9
Approximate Hatching (%)	53.65	73.3

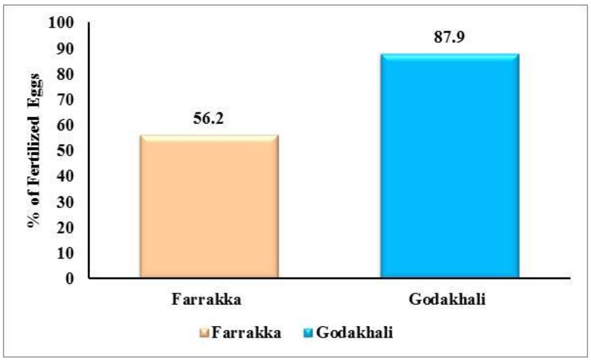


Fig. 310. Avgerage fertilized eggs (%) of Hilsa in different breeding zone

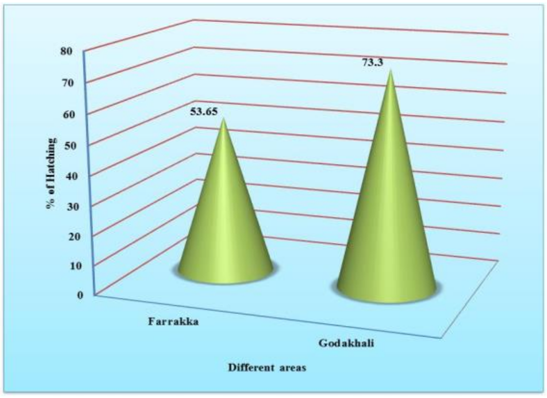


Fig. 311. Approx. hatching (%) of Hilsa fertilized eggs from different breeding zone

9. Reproductive biology of adult Hilsa

Fish serve as crucial indicators for detecting substantial changes in aquatic habitats and water quality. Wild fish populations play a pivotal role in maintaining biodiversity, ensuring habitat quality, and preserving ecological balance. To effectively safeguard these fish species, it becomes imperative to acquire comprehensive knowledge of their reproductive biology, dietary habits, fecundity, and breeding behaviors. The term 'fecundity' refers to a fish's capacity to lay eggs, specifically the number of mature eggs produced by a fish during a single spawning season. In this research, the objective is to ascertain fecundity and its correlation with various factors like total body length, total body weight, ovary length, and ovary weight. This information is vital for monitoring fish species presence, effective stock management, and assessing aquatic ecosystems.

To gather data, the study involved recording morphological parameters such as body length and weight for fresh fish specimens. Subsequently, mature gravid fish were dissected. Their ovaries were carefully extracted, dried using blotting paper to eliminate moisture, and then preserved in 5% formalin, Bouin's solution, or Gilson fluid, depending on the study's future requirements.

Fig.312 A fresh specimen of a mature female Hilsa fish (L=36.7cm, W=546g)

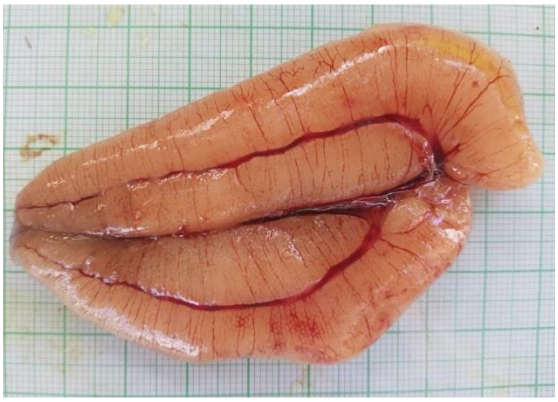


Fig. 313A. Hilsa specimen with mature ovary

Fig. 313B. Hilsa ovary after dissection

Fig. 313 (A-B): Images of mature female Hilsa ovary

Hilsa, a prized anadromous migratory fish, primarily ventures into freshwater habitats for breeding. In Ganga River system, Hilsa engages in two breeding cycles throughout the year. The first breeding phase typically occurs in the late monsoon season, from September to October, coinciding with monsoon migrations. The second breeding season takes place in late winter, specifically in February and March. Fish maturity varies depending on their size and age. A comprehensive examination of their gonads reveals that adult Hilsa specimens are either mature or in a spent condition, confirming the occurrence of the breeding season. For successful breeding, Hilsa requires specific temperature conditions. The study notes that a temperature range of 25-30 ℃ in water and 27-37 ℃ in the atmosphere is conducive for breeding during both the late monsoon and late winter seasons.

9.1. GSI (Gonado-Somatic Index)

The Gonado-Somatic Index (GSI) is a measure that evaluates the gonad (reproductive organ) mass relative to the total body mass of an organism. It has been applied to both male and female specimens to determine and assess the timing of the spawning season. The GSI was calculated using the formula below:

$$\mathbf{GSI = (GW/\ BW) \times 100}$$

Where, GSI is Gonado-Somatic Index, GW is gonad weight and BW is total body weight with intact gonad.

9.2. Ovary Structure

The ovaries of Hilsa were observed as a fleshy bilobed structure, occupying a variable portion of the abdominal cavity, spanning from one-third to two-thirds depending on the maturity stage. Both lobes of the ovary appeared relatively uniform in size. Notably, the middle and anterior segment of the ovary was broader compared to the posterior regions. In terms of egg characteristics, fully ripe ovaries in Hilsa exhibited a yellowish hue. It's worth noting that the shape, size, and color of the ovaries underwent discernible changes across different maturity stages.

9.3. Ova Diameter

The ova diameter of Hilsa throughout the study period was found to be in the range of 0.26 mm to 0.93 mm for ovary size ranging from 5.2 cm to 21.59 cm. The GSI (Gonado-Somatic Index) of both male and female Hilsa was in the range of 0.58-2.80 and 4.15-19.80, respectively (Fig 314). Different mature to spent stages of male and female Hilsa were found throughout the year. In the spent stage ova diameter ranges from 0.15-0.39 mm and during breeding time almost 92% ova diameter ranges from 0.72-0.84 mm.

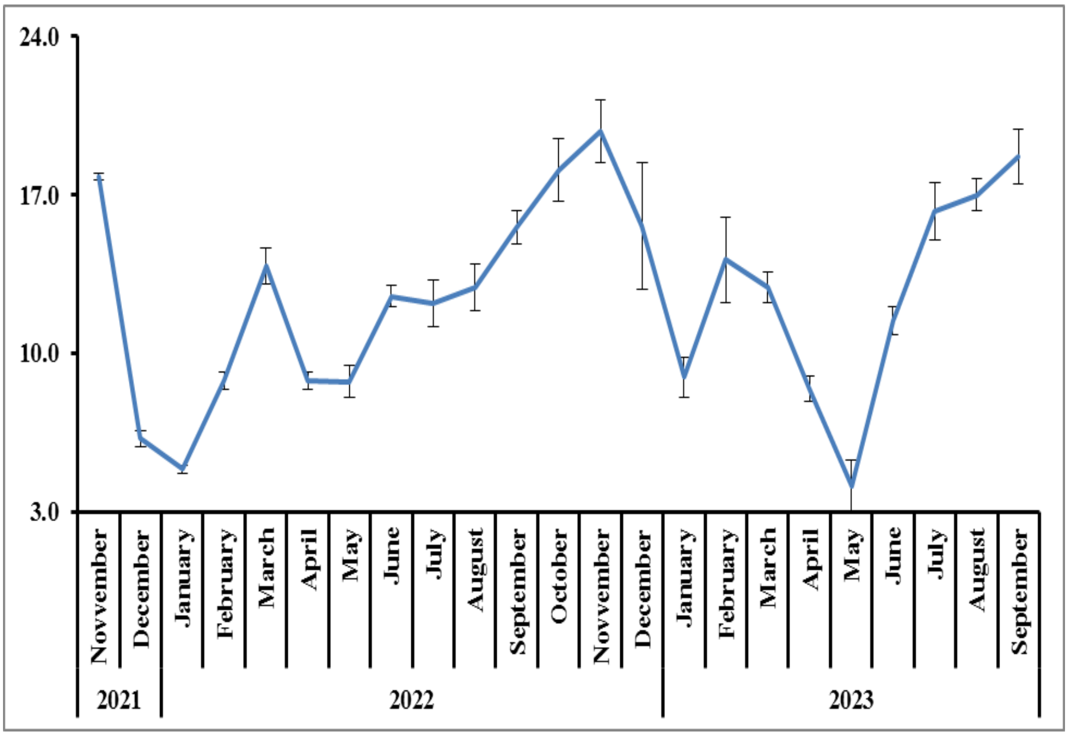


Fig. 314. Monthly GSI data of female Hilsa for the period 2021-23

9.4. Fecundity

During both the late monsoon and late winter seasons, all observed ova were found to be in the mature stage. Specifically, in the months from September to November, the absolute fecundity of female Hilsa ranged from 81,454 to 7,37,100. In the late winter months, particularly during the Hilsa's winter migration in February and March, the absolute fecundity of female Hilsa ranged from 27,084 to 2,79,665. Across the entire year, the fecundity of female Hilsa ranged from 18,311 to 7,37,100 in absolute numbers. Interestingly, the months of September and March exhibited the highest fecundity among Hilsa specimens. (Fig. 315)

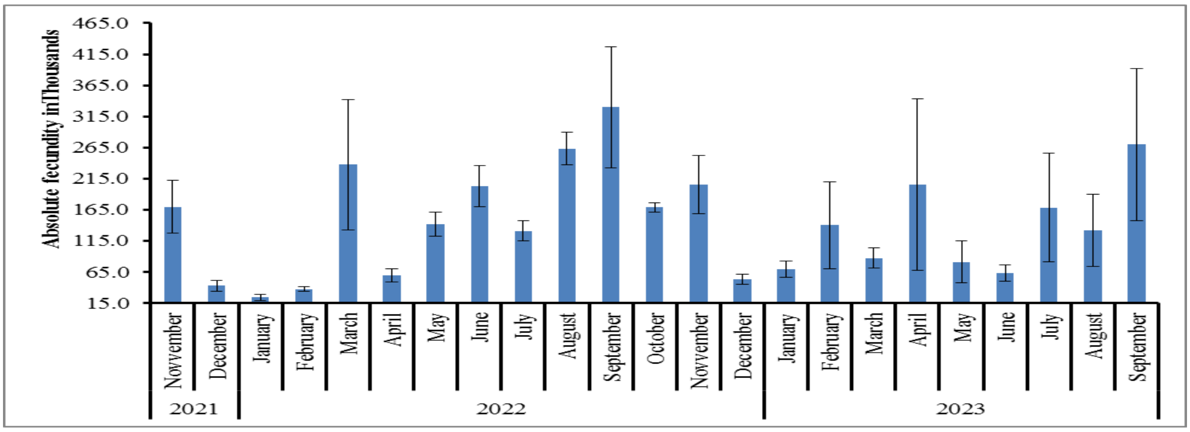


Fig. 315. Graphical representation of absolute fecundity data of Hilsa (2021-23)

9.5. Histological observation of matured Gonads

Histology of Hilsa mature eggs reveals important insights into their reproductive biology. When examining mature Hilsa eggs under a microscope, several key characteristics become apparent. In our study mature Hilsa eggs are relatively large and spherical, with a well-defined shape. Cytoplasm of mature eggs was abundant and often appears granulated. Microscopic pictures showing that it contains various organelles essential for supporting early embryonic development. A distinct vitelline membrane surrounds the egg. Mature Hilsa eggs contain a substantial amount of yolk, which serves as a nutrient reserve for the developing embryo (Fig. 316).

Histological studies of mature Hilsa eggs are crucial for understanding the reproductive physiology of this species, including aspects of egg development, maturation, and the timing of spawning.

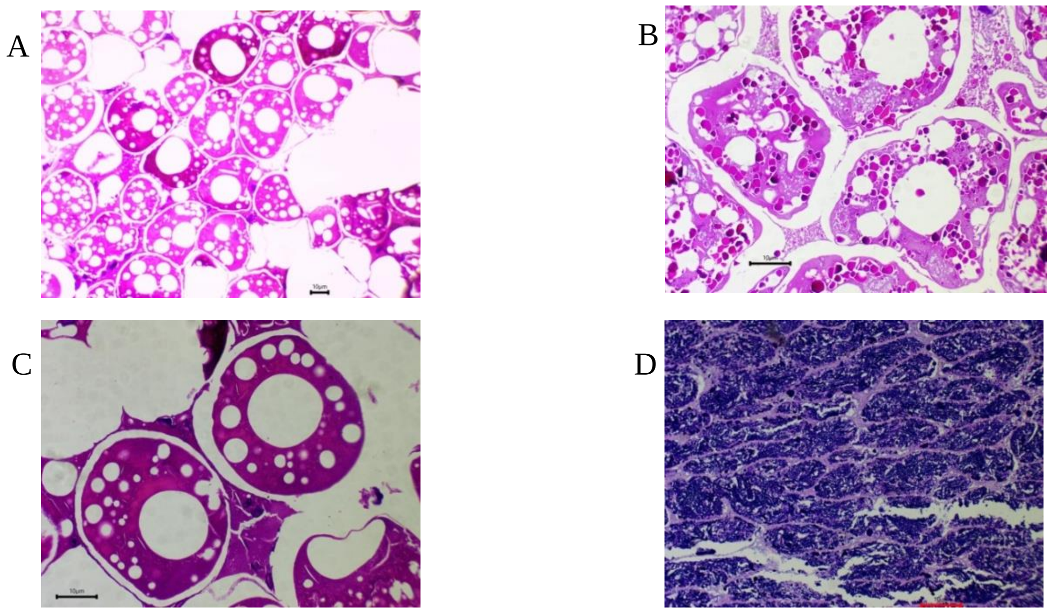


Fig. 316. Histology of mature Hilsa ovary (a-c) in different magnification (a-4X & b-d-10X) & sperm (d)

9.6. Study on Hilsa Reproductive Biology on Molecular aspects (i.e., Identification and Characterization of GnRH Gene)

The Hilsa fish (*Tenualosa ilisha*) is an economically important species and understanding its reproductive biology at the molecular level is crucial for conservation and fisheries management. Gonadotropin-releasing hormone (GnRH) is the key regulator of the reproductive axis. Development and maintenance of normal reproductive function requires a coordinated interplay between neuroendocrine, metabolic, and environmental factors. The GnRH-gonadotropin system plays a central role in the regulation of reproduction by integrating different signals and factors. GnRH pulsatile secretion determines the pattern of secretion of the gonadotropin follicle-stimulating hormone and luteinizing hormone, which regulates both the endocrine function and gamete maturation in the gonads. In this study, we aimed to identify and characterize the gonadotropin-releasing hormone (GnRH) gene in Hilsa and and the process of regulation of GnRH secretion.

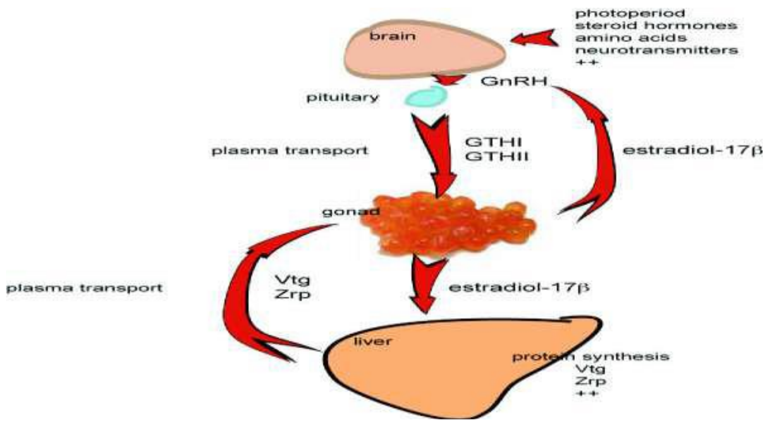


Fig. 317. Schematic diagram of GnRH Gene

9.7. Methodology

9.7.1 Identification and characterization

Brain and Pituitary tissue (*Fig*) samples were collected from mature Hilsa fish (weighing between 800g to 1000g each) that were taken from Farraka Barrage. Following RNA extraction, cDNA was synthesized and amplified the gene of interest. cDNA fragment was cloned after the GnRH gene was successfully amplified using the PCR method. Then plasmid extraction was done using a Plasmid purification kit (HI-MEDIA, India). Plasmid PCR confirmed the presence of positive clones. The purified plasmid was sequenced by outsourcing. After that, we use the Gene Racer kit for the complete sequence. After obtaining the complete GnRH sequence it was submitted to the NCBI database for public access for the first ever time. Simultaneously, In silico characterization was done using computational tools and techniques to provide insights into the gene's structure, function, and regulation mechanisms processes associated with the GnRH gene in Hilsa fish. (i.e., Sequence alignment, Homology modeling, functional analysis, promoter analysis, molecular docking, dynamic simulation, and Gene expression study)

9.8. Result

9.8.1 Characterization of GnRH transcript in Hilsa

The complete (CDS) sequence 605 bp was obtained after sequencing. The complete CDS was submitted to the GenBank. The GnRH cDNA contains an open reading frame of 605 bp corresponding to 232 amino acid residues with ATG at the start codon of 118 bp and TGA at the stop codon at 427 bp

Phylogenetic analysis

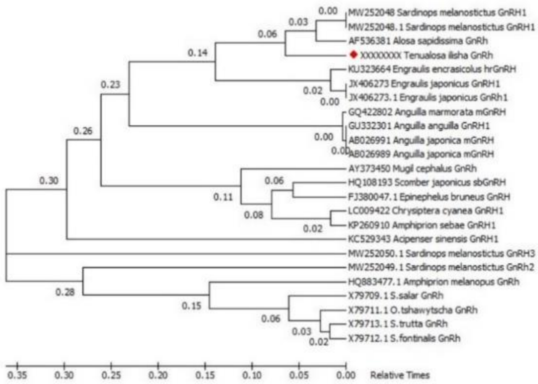


Fig. 318. Phylogenetic tree of Hilsa GnRH sequences generated by MEGA11 program

Conclusion

This study represents a significant step in unraveling the molecular aspects of Hilsa fish reproduction. The GnRH gene has been identified and characterized. This genetic study provides a foundation for further research into the reproductive mechanisms of this important species and contributes valuable information to our understanding of the reproductive biology of the species, which can have implications for conservation and fisheries management. Additionally, we have submitted the GnRH gene sequence, to the NCBI database for further study by the researcher.This report summarized the key milestones findings of our study on Hilsa reproductive biology, with a focus on the GnRH gene. Further research in this area is essential to support the conservation and management of the Hilsa population regenerate

10. Ranching of Hilsa seed (fertilized eggs & spawn) in the upstream of Farakka Barrage

A total no. of 22,47,000-23,57,000 eggs and 16,900 spawn of Hilsa were ranched at upstream of Farakka barrage for improvement of natural Hilsa population in respect of declined stretches of river Ganga (Table 25). Adult Hilsa males and females were artificially bred on board through the stripping method. The fertilization rate was achieved avg. 72.05% and the average hatching rate was 63.47%. The spawns were packed with oxygen support and transported to the ideal ranching site. Transportation was done during the early morning or evening to avoid the rise in water temperature. Before the ranching, a proper site in the river Ganga above Farakka was selected to avoid the high-water current, greater depth, and fewer human interventions (Figs.319, 320, 321 & 322)

Fig. 319 A & B) Ranching of Hilsa fertilized eggs and spawn at Raajmahal, Jharkhand upstream in river Ganga

Fig. 320 A&B) Transportation of fertilized eggs from Godakhali, S24PGs, C-E) Ranching eggs and spawn in Rajmahal, Jharkhand and F) Ranching in Gazipara, Jharkhand –West Bengal Border

Fig. 321. Ranching of fertilized eggs in river Ganga at Sahebganj, Jharkhand

Fig. 322. Ranching of spawn in river Ganga at Taltala ghat, West Bengal

Table 28. Ranching list of total numbers of fertilized eggs and spawn of Hilsa

Sl. No.	Date	latitude	Longitude	Nos. of spawn ranched	Nos. of fertilized eggs ranched	Ranching site	State
1.	27.02.2021	24.858045	87.910385	-	**58,000**	Upstream, river Ganga	Jharkhand
2.	11.03.2021	24.809054	87.918875	-	**49,000**	Taltola Ghat	West Bengal
3.	10.11.2022	24.940537	87.92294	400	**2,000**	Paranpur	Jharkhand
4.	16.11.2022	24.852835	87.91358	-	**98,000**	Upstream, river Ganga	Jharkhand
5.	17.11.2022	24.851633	87.90837	2000	**89,000**	Upstream, river Ganga	Jharkhand
6.	18.11.2022	24.858045	87.910385	-	**90,000**	Upstream, river Ganga	Jharkhand
7.	19.11.2022	24.85772	87.912661	-	**1,07000**	Upstream, river Ganga	Jharkhand
8.	23.11.2023	24.844228	87.901372	-	**2,05000**	Upstream, river Ganga	Jharkhand
9.	01.12.2022	24.867588	87.911126	4,500	-	Lalchand	Jharkhand
10.	22.12.2022	24.84694	87.898402	-	**73,000**	Kumar Para Ghat	Jharkhand
11.	23.12.2022	24.844202	90.13442	-	**50000**	Neem Shahar	Jharkhand
12.	14.02.2023	24.854708	87.910408	-	**90,000**	Sikarpur	Jharkhand
13.	15.02.2023	24.861309	87.916899	-	**1,08,000**	Near Gaziapara	Jharkhand
14.	17.02.2023	25.252471	87.649122	3,000	**1,75,000**	Ojha Toli Ghat, Sahib Ganj	Jharkahnd
15.	17.02.2023	24.858809	87.915615	-	**93,000**	Upstream river Ganga	Jharkhand
16	18.02.2023	24.866202	87.919149	3000	**56,000**	Gajipara	Jharkhand
17.	20.02.2023	24.856488	87.914577	-	**1,71,000**	Upstream river Ganga	Jharkhand
18.	21.02.2023	24.830324	87.913409	-	**1,56,000**	Nimshahar	Jharkhand
19.	22.02.2023	25.054662	87.837739	2000	**1,77,000**	Raaj Mahal Ghat	Jharkhand
20.	23.02.2023	24.830324	87.913409	-	**64,000**	Nim Shahar	Jharkhand
21.	24.02.2023	24.870939	87.920769	-	**1,05,000**	Gajiya Para	Jharkhand
22.	27.02.2023	24.853049	87.913777	-	**1,75,000**	Sikarpur	Jharkhand
	24.03.2023	25.057641	87.84617	2000	**2,00000**	Raajmahal Ghat	Jharkhand
			Total	**16,900**	**23,91,000**		

11. Hilsa seed collection and acclimatization in captive condition at Godakhali, lower zone of Hooghly-Bhagirathi River stretch (earthen ponds)

Hilsa seed or fingerling locally known as a ‘*khoira*’, was captured near Kalinagar ghat, Uluberia, Howrah opposite sight of Godakhali, South 24 Parganas district of West Bengal. The fishing operations were carried out with a boat lift net for better survivability of Hilsa juveniles. The Hilsa have a shoaling behavior, which means they swim in groups. A silent environment was maintained to ensure that the fish survived in groups for a period of 1 hr. Approx. 1000-1100 Hilsa fingerlings were collected through a lift net without stress. All the fingerlings were stocked in the earthen pond at Godakhali, South 24 Parganas.

Fig. 323. Hilsa seed stocking in the pond, Godakhali

Due to the natural calamity of "*Yass*" super cyclone in May 2021, the pond dyke was collapsed and earthen pond was inundated, as a result the entire Hilsa stock was departed.

12. Rearing of Hilsa seeds and grow-out system for standardization

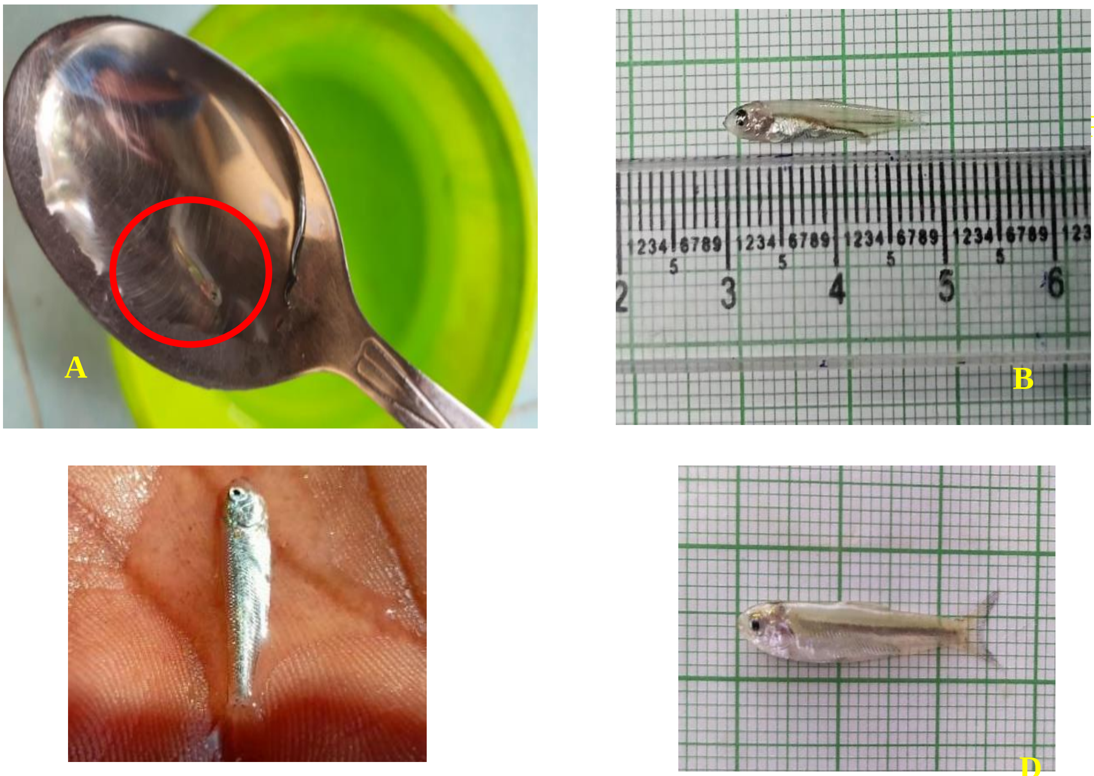
After successful artificial breeding at Godakhali and Farakka, the fertilized eggs were carried out in oxygen packets. Fertilized eggs were released and stocked in different captive grow-out system at the Hilsa Ranching Station, Farakka. The dissolve oxygen level and water temperature in the grow-out system were maintained in optimal condition with the help of external aeration and illuminating the area by using 100-watt bulbs. After 18-30 hours, eggs were hatched. Un-hatched eggs were carefully removed by dropper from the system. After 3-5 days the spawn is carefully transferred to the FRP (300L) and aquarium tanks (25-30L). From the 5th day of hatchlings feed with live feed chlorella (2-10 µm) and from the 11th day feed with zooplankton (rotifers) were given to the hatchlings. The supplementary artificial feed (> 35% Crude protein) was grind and make powder form then feed to the 20 days older spawn. The cultivable water is replenished two times a day by careful siphoning through a bolting silk cloth and the dead larvae if any are removed regularly. A 15-day older spawn carefully stocked in an earthen raceways pond, FRP tanks (5,000 L) at Hilsa Ranching Station, and in a cemented rectangular tank at Farakka, reared up to grow in fries and juveniles Hilsa (Fig. 324). During the rearing period feeding them with live feed chlorella, rotifers and supplementary feed and also monitoring the water quality of each rearing unit (Fig. 324).

Fig. 324 A & B Stocking and rearing of Hilsa spawn in cemented rectangular tank at Farakka C) Outdoor mass culture and D) *Chlorella* sp. culture indoor condition E & F) Preparation of Rotifer culture

12.1. Experimental pond and Raceway preparation for Hilsa nursery rearing

Fig..325 A) Earthen Experimental Nursery Pond preparation B) Calculation of lime doses C& D) Liming & manuring in pond

Fig. 326 A) Experimentalpond ready for Nursery rearing B) Stocking the hilsa spawn in earthen pond Rearing of spawn and juveniles in raceway. C&D) Hilsa spawn also stocked in FRP tanks in indoor system E) Raceway preparation F) Hilsa spawn stocked in raceway



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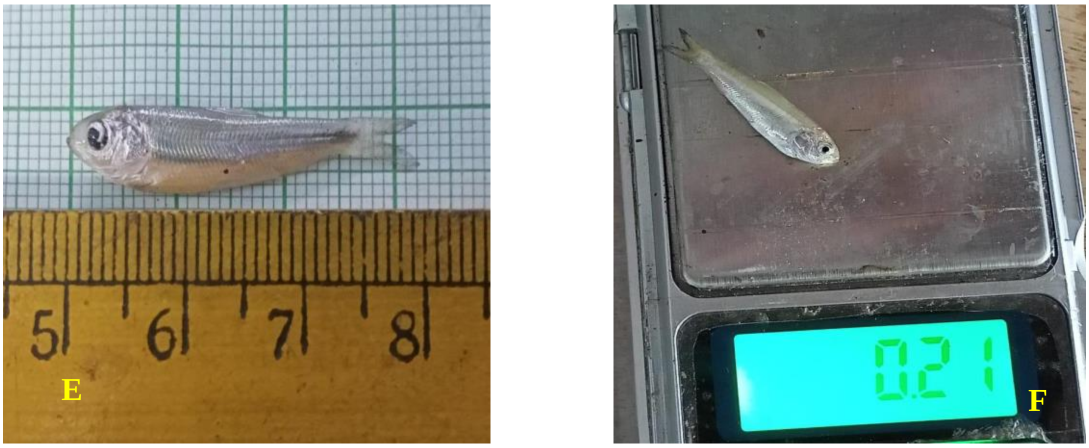

Fig. 327 A-F) Reflecting the growth (length and weight) of Hilsa spawn reared in rectangular cemented tank at office quarter, Farakka

Fig. 328 A-D) Reflecting the growth (length & weight) of hilsa spawn reared in earthen circular pond at Hilsa Ranching Station, Farakka. E) Earthen Circular Pond

13. Collection of Hilsa brooders and acclimatization under captive condition

To develop Hilsa brooders in captive condition in different water bodies in a confined area like earthen pond, pen in river, raceway, and circular FRP cages has been selected. Circular cages (diameter 16m and depth 8m) designed by ICAR-CIFRI were installed in the free-flowing water stretch, particularly upstream of the Farakka barrage, and aimed to provide a natural river environment in a confined area (Table 29). In 2021-22 one circular cage and in 2022-23 two more circular cages were installed to develop Hilsa brood stock. A total 243 numbers of brooders of Hilsa developed in cages I, II, and III.

13.1. Stocking and feeding of wild adult Hilsa in circular cages

Healthy wild Hilsa, 87 nos. of size ranges from 50 g to 150 g were stocked in the circular cage 1 in 2021-22. During 2022-2023 total of 649, 238 and 145 nos. Hilsa were stocked in cage no. I, II and III, with an average size was 65-160 g. Stocking management including regular feeding, with artificial feed (developed by CIFRI) at 10% of total biomass was provided. Feeding was done twice a day during morning and evening time. Regular cleaning of cages was done daily to remove foul materials from cages. (Fig. 329)

Fig.329 Installed cages at upstream of Farakka Barrage, river Ganga

Fig. 330 Stocking of Hilsa brooders in cages

13.2. Growth performance of reared Hilsa in circular cages

Regular growth check was done on monthly basis. Before sampling, fishes were starved overnight and fishes were collected by lifting net from corners. The collected fish (n=20/cage) were weighed in a weighing balance with an accuracy of 1g. The length of the fish was measured using a standard scale with an accuracy of 1 mm. At the time of stocking average size of Hilsa was 115±4.12 g, during last 7 months culture the average size recorded 175±2.39 g. The cage reared Hilsa showing that 58% increase in body weight but simultaneously mortality of the fish was also high touching 87.5% of the stocked Hilsa were died during the rearing period (Fig. 331).

Fig. 331. Length-weight measurement of cage reared Hilsa at Farakka

Two pens were also installed in Ganga at the upstream of Farakka Barrage with the lengths and widths (69 x 36 and 36 x33 feet) of a total number of 72 Hilsa brooders, in raceways (32 x12.5x 1.5 feet) 600 Hilsa spawn and 30 juvenile Hilsa were stocked and in the experimental pond (6 x 6 x 1.5 feet) 400 spawn were stocked for Hilsa brood stock development in captive conditions.

13.3. Constrains of hilsa rearing in captive condition

- Earthen pond, raceway and pen were selected for rearing of Hilsa in captive condition.
- Floods posed the most significant obstacle to pond rearing of Hilsa, resulting in the loss of approximately 85% of the reared Hilsa during natural disasters. Additionally, Hilsa, being a fast-moving bentho-pelagic species, could not thrive in stagnant water bodies.
- The raceway system proved to be highly effective for nursery rearing of Hilsa. However, due to insufficient water depth and water seepage through the sandy soil bottom, it was not suitable for the rearing of adult Hilsa.

The primary challenge with pen culture was the inconsistency in water depth, which fluctuated throughout the year and was not conducive to Hilsa rearing. A maximum mortality of approximately 69% was occurred.

Table 29. Specificatons of different confined water bodies for Hilsa brood stock development

Sl. No.	Water bodies name	Water bodies area	Numbers of Hilsa stocked		Total nos.	Mortality (%)
			2021-22	2022-23		
1.	Stocking pond-I (ha)	0.5	634	0	**634**	**87**
2.	Stocking pond-II (ha)	0.3	585	0	**585**	**93**
3.	Experimental pond (ha)	0.2	132	400	**532**	**97**
	Raceways (feet)	35 x12.5 x 1.5	520	110	**630**	**89**
4.	Circular FRP Cage-I (m dia.)	16 x 8	87	649	**736**	**76**
5.	Circular FRP Cage-II (m dia.)	16 x 8	0	238	**238**	**Ranched in river Ganga**
6.	Circular FRP Cage-III (m dia.)	16 x 8	0	145	**145**	**Ranched in river Ganga**
7.	Pen 1 (m)	11 x 21 x1.5	53	78	**131**	**67**
8.	Pen 2 (m)	10 x 19 x1.5	234	75	**309**	**69**

Abbreviation: ha-hectare; dia-diameter; FRP-Fibre Reinforced Plastic ;m- meter;

13.4. Challenges of cage culture of Hilsa

- Precautionary measures were taken to protect the cages from heavy rainfall and drastic water flow of the Ganga River in the monsoon.
- Due to heavy monsoon in August (1st week) a tributary of river Ganga, Gumani river were exploded with heavy rainfall. Huge water flows (0.48 - 1.82 m/sec) were measured in the Ganga river's main channel.
- The water pressure damages the cage badly and other unwanted floating substance and heavy siltation chocked the cage's outer net. Cage-II & III overlapped with each other, iron poll was also damaged in the cage as a result the net attached with poll was also distorted (Figs. 332 & 333). In this situation, a large number of Hilsa stocked in the cage were ranched in the river.

Fig. 332 Macrophytes and other debris clogging the nets

Fig. 333 Cage structure deformed due to water pressure and siltation

Fig. 334. Different types of captive Hilsa rearing systems

14. Recovery of juvenile and adult Hilsa from different places of river Ganga

A total number of 97 Hilsa (Weight ranges 170 - 485 g) were collected from different places like upstream of Farakka barrage. These all Hilsa were recovered from the untagged condition from different places at upstream of Farakka Barrage. It was noticed that fishers were catching Hilsa from Khursela, Bihar up to 225 km from the ranching point at upstream of the Barrage.

14.1. Recovery of Hilsa juveniles at middle stretch of River Ganga

A sizeable catch of Hilsa fry and early juveniles was recorded during 2022 to 2023 in varying quantities in the upstream of Farakka barrage between Panchanandanpur at Malda site and Gobindarampur at Farakka Site to Sahibganj 19.65 km to 174.12 km upstream of barrage respectively. Estimated catch of juvenile Hilsa commonly known as *"Khoira"* in West Bengal ánd in Jharkhand, Bihar it called as *"Marwa"* from local fishermen and fish landing center 0.87 kg to 142.37 kg May to June of 2022 and 2023 (Table 30.). The resurgence of young Hilsa suggests that the sustained ranching of adult Hilsa in the middle stretch of Ganga River contributes to fostering natural breeding processes, ultimately aiding in the restoration of the Hilsa population upstream in the Ganga River. The combined impact of Hilsa fertilized egg ranching significantly expedites the rejuvenation of young Hilsa juveniles in the upstream region of the Farakka Barrage. Local fishermen employ 'Char-petta' nets during the pre-monsoon season when water levels in the Ganges are relatively low. Consequently, the resurgence of juveniles primarily takes place in May and June each year.

Table 30 . Estimated catches in kg (no) of Hilsa juveniles at middle stretch of river Ganga

Place Name	2022		2023	
	May	June	May	June
Kamaltipur fishing Ghat	17.3 (494)	13.8 (353)	29.31 (953)	29.22 (813)
Rajnagar Ghat, Malda	12.8 (393)	19.5 (467)	17.5 (333)	49.6 (837)
Panchanandapur Ghat, Malda	19.7 (567)	19.8 (660)	21.2 (689)	37.22 (502)
Rajmahal, Jharkhand	42.7 (823)	101.7 (1701)	63.5 (1183)	142.37 (2384)
Sahibganj, Jharkhand	51.07 (630)	68.9 (1325)	49.22 (946)	10.3 (312)
Bhagalpur, Bihar	3.1 (65)	4.71 (255)	0.87 (57)	15.2 (403)

Fig. 335A. Hilsa fingerlings recovered from Rajmahal, Jharkhand

Fig. 335B. Recovery Hilsa at Kamaltipur fishing Ghat, Malda

OBJECTIVE VIII: TO MONITOR THE MIGRATION OF HILSA THROUGH FLOY TAGGING AND ADVANCED TECHNIQUES THROUGH TAGS

Tagging is an essential technique for fisheries biologist to gather the wide variety of information. Tagged the adult *Tenualosa ilisha* for the marking those migratory fish movement, gather the information about the migration pattern, gonadal development, population estimate and their growth. These components are very much needful for these studies because it provided the present status of Hilsa fish population in the middle stretches of river Ganga (Farakka to Prayagraj) and those tagged fish could migrate to upstream & downstream for complete their life cycle.

A total of 3,065 numbers of Hilsa were tagged (Fig.336) to assess their upstream migration starting from October, 2020 up to September 2023 (Table 31.). Out of total ranched Hilsa (91,588), 3.34% of adult Hilsa tagged and released during the project tenure. The tagging programme was widely circulated through various means of communications such as creating mass awareness, placing posters / pamphlets of ranching fish & through writing articles in newspapers on Hilsa conservation among the fishermen from Farakka to Allahabad in upstream and also downstream of Farakka Barrage for recovery report to analyze the migration pattern of Hilsa in the selected study stretch.

Table 31. Year wise tagging of Hilsa in the upstream of Farakka Barrage of river Ganga

Sl. No.	Year	Tagging
1.	2020-2021	576
2.	2021-2022	1,697
3.	2022-2023 (up to September)	792
	Total	**3,065**


Fig. 336. Tagging operation on Adult Hilsa

In 2020-2021, 576 adult Hilsa was tagged which avg. weight 252±6.8 gm and avg. length 28±2.6 cm. In 2021-2022, 1,697 nos. adult Hilsa was tagged however maximum no. of Hilsa tagged during in November 2021 around 550 pcs. Lowest tagging was done in the month of May and June, 2021, only 07 & 02. In this time Hilsa availability at the downstream of Farakka Barrage is very less.

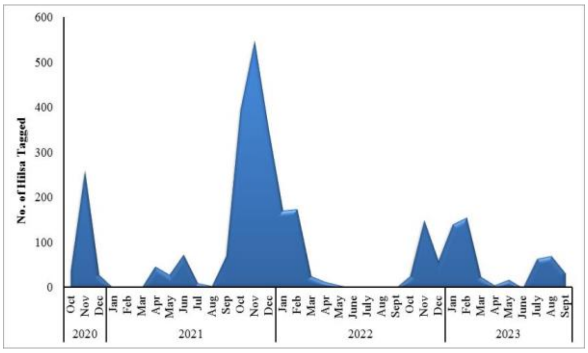

Fig. 337. Monthly tagging operation of Adult Hilsa

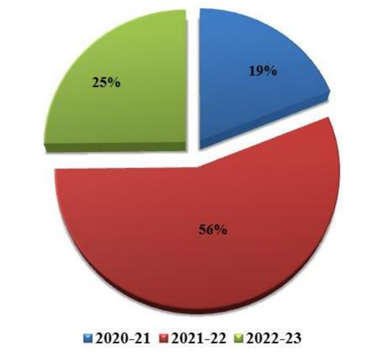

Fig. 338. Year wise tagging operation of Adult Hilsa

15. Impact of tagging and ranching

15.1. Recovery of tagged Hilsa

These co-ordinates positively indicate that those adult Hilsa tagged and ranched at the upstream of Farakka Barrage, river Ganga they migrate at middle stretch of river Ganga up to Uttarpradesh, Gazipur approx. 593.5 km from Farakka Barrage. Hilsa also recorded at lower stretches of Hooghly-Bhagirathi River Nimaitirtha Ghat, Baidyabati, West Bengal and it's almost cover 225 km from Farakka Barrage. Some of Hilsa migrate towards Padma River, downstream of Farakka Barrage nearer to Bangladesh border which almost cover 54.6 km from Farakka Barrage.

Fig. 339A. Fisher captured tagged Hilsa during fishing, from Manikchowk on 30th October,2021

Fig. 339B. Fisher captured tagged Hilsa during fishing, from Shahibganj

Fig. 339C. Fisher captured tagged Hilsa during their fishing, from Dhuliyan, Farakka

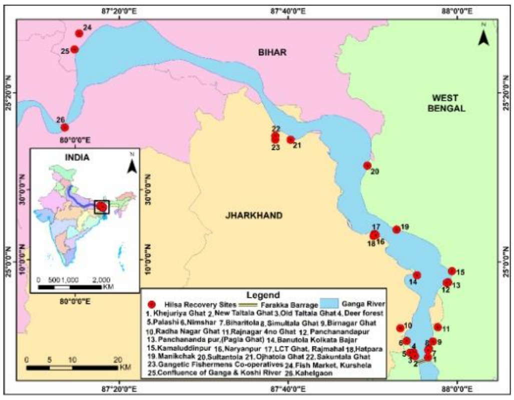

Fig 340. GIS map representing tagged Hilsa recovery sites from the middle stretch

Among the total tagged adult Hilsa more than 7.8% adult Hilsa recovered from different location from their released point. Above 50% adult Hilsa recovered from middle stretch of river Ganga while 17% Hilsa was recover from Feeder canal, Aduha to Baidyabati, West Bengal. 27% of the Hilsa was retrieved in the Beniyagram, Jafarganj, Hossenpur, and Dhuliyan, Murshidabad districts, where the Ganga flows toward Bangladesh downstream of the Farakka Barrage (Fig. 341).

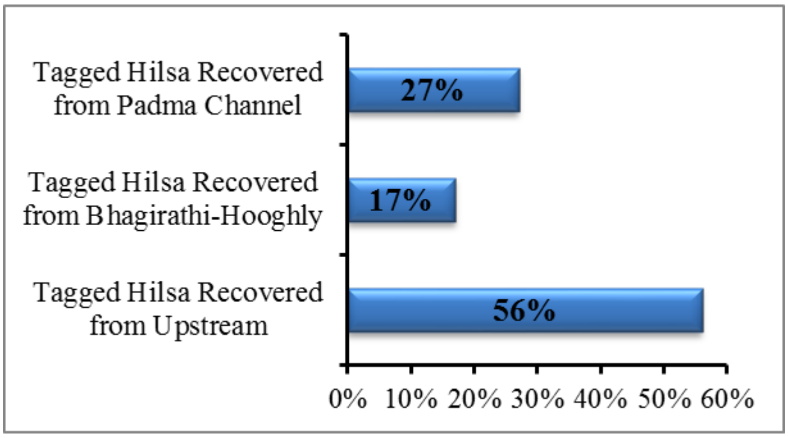

Fig. 341. Location wise recovery percentage (%) of tagged Hilsa

Component-III

Community participation and awareness programme on the fish conservation in the entire stretch of river Ganga for improving livelihood of the poor fishers

OBJECTIVE IX: TO CREATE THE AWARENESS PROGRAMME AMONG THE FISHERMEN FOR CONSERVATION OF DEPLETED FISH AND GANGETIC DOLPHIN ALL ALONG THE RIVERBANK OF GANGA FROM PRAYAGRAJ TO FARAKKA *VIA* BALIA, BUXAR, PATNA, BHAGALPUR AND RAJMAHAL

Hilsa called anadromous fish, travel from the ocean to rivers for the goal of spawning. Important fish hilsa's socio-economic situation is getting worse every day. This fish is in decline for a number of reasons, including indiscriminate fishing, small mesh size net fishing, fishing for juveniles, fishing during the reproductive season, water pollution, climate change, anthropogenic activities, etc. Prior to 1975, Hilsa migrates all the way up to Prayagraj, but once the Farakka Barrage was built, it was only allowed upstream. With all these different factors in mind, our initiative's goal was to grow the hilsa population while also conserving it and re-establishing its migration route with the aid of fishermen. One component of this project was raising public awareness of the issue.

In particular, Bihar, Jharkhand, West Bengal, and the surrounding areas, as well as both the bank of the river Ganga, North 24 Parganas, and Hooghly district, the ICAR-Central Inland Fisheries Research Institute conducted awareness programmes on Hilsa and Dolphin in the middle to lower stretch and the estuarine zones of the Ganga. The major goal of the awareness initiative is to educate the river Ganga's fishing community about the need to protect, restore, and recover the Hilsa. The total awareness program in last 3 years carried out in component II was 401 and the number of participants were 14,906. Of these, 86 numbers were carried out mainly in Farakka and the adjacent places like Ghandhi Ghat, Deer Forest, Gumani, Nimsahar, Nimtola, Bottola, Taltola Ghat, Samsherganj, Jafarganj, Sankarpur, Dhuliyan ghat, Feeder Canal, Rail Colony, Farakka Panchayat, Palashi, Shikarpur, Arjunpur , Beniagram etc. In Malda there are so many places like Khejuriya ghat, Baisbnagar, Rajnagar, Simultala, Bihari Tola, Lalutola, Laskari Tola, Bolalpur, Sultan Tola, Pachkuri Tola etc. Jharkhand places like Nakitola, Nurai, Rupaspur, Jitpur kalitola, Paharpur, Sahibganj, Rajmahal, LCT Ghat etc. Awareness program was also carried in the estuarine stretch, mainly in Bakkhali, Fraserganj Godakhali, Sagar Island and in Barrackpore and their adjacent places. During the awareness programme all the fishermen were sensitized regarding how to increase Hilsa in their native water bodies. In these awareness programmes active participation of male and female fishermen was 94.13% and 5.87%. The total number of fishermen, the number of boats, nets possessed/operated by them, their fishing time, monthly income, family size, other incomes, catch composition and their problems other such things. We advised them through Hilsa awareness not to use small mesh size net, keep Ganga clean and pollution free, not to catch juvenile and matured Hilsa with full of egg and may release again into the Ganga and make them complete their life cycle. Fish tagging is an important aspect to study the migration pattern. Fishermen were awarded of reporting of tagged Hilsa during their fishing activity in river Ganga.

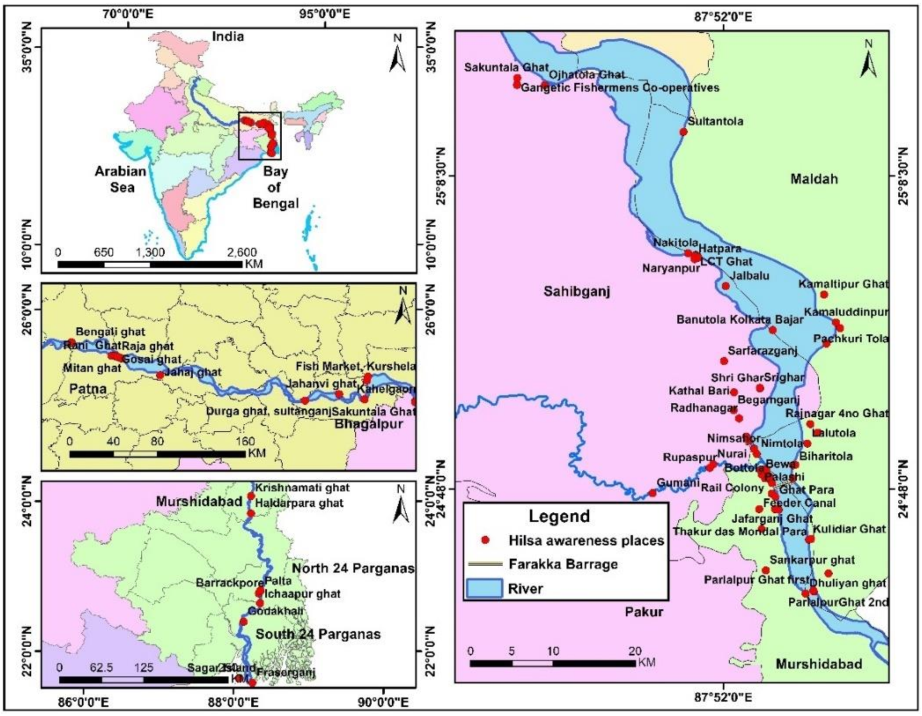

Fig. 342. GIS map of awareness programmes on Hilsa and Dolphin

16. Awareness Program in West Bengal mainly at Farakka and their adjacent places

As our project is focused on Farakka, maximum awareness programmes were conducted at Farakka and their adjacent places like Ghandhi Ghat, Deer Forest, Gumani, Nimsahar, Nimtola, Bottola, Taltola Ghat, Jafarganj, Sankarpur, Dhuliyan ghat, Feeder Canal, Rail Colony, Farakka Panchayat, Palashi, Shikarpur, Beniagram, Forest ghat, Old Taltola Ghat, Nimsahor. In Malda there are so many places like Khejuriya ghat, Rajnagar, Simultala, Bihari Tola, Lalutola, Laskari Tola, Sultan Tola, Pachkuri Tola, Kamaluddinpur, Panchanandapur, Jalbalu, Kamaltipur Ghat, etc. Jharkhand places like Nakitola, Nurai, Rupaspur, Jitpur kalitola, Paharpur, Sahibganj, Rajmahal, LCT Ghat, Hatpara, Naryanpur, Mirnagar, Srighar, Gobargari, Moniharitola, Banutola Kolkata Bajar, Rupaspur, Jolbalu, Barali, Goborgara etc. The Fishermen belongs (94.8%) SC/ST community and they mostly use gill net to catch

Hilsa. Through this awareness programme local fishers were sensitized about conservation of Hilsa, Dolphin and river Ganga.

17. Awareness programme at Barendrapara ghat, Nawabganj ghat and Chandannagar Jetty ghat, West Bengal

Awareness programme were conducted at different ghat *viz.*, Barendrapara ghat, Nawabganj ghat and Chandannagar Jetty ghat of Ganga bank from November 2021 and 400 people were sensitized for conservation of Gangetic fish, Hilsa and Dolphin in the Ganga River.

Fig. 343. Awareness program at Barendrapara Ghat, Howrah,West Bengal

18. Awareness programme at Krishnagar and Jibontala, Sagar Island, West Bengal

A mass awareness programme was organized at Krishnagar and Jibontala, Sagar Island, South 24 Pgs on November 2021 towards conservation of indigenous fish species of Ganga, Hilsa and Dolphin as well as Ganga resources. A total of 350 people participated in this awareness programme.

Fig. 344. Awareness program in Krishnagar and Jibontala, Sagar Island

19. Awareness programme at Balagrah, Hooghly, West Bengal

An awareness programme was organized at Balagrah on November 2021 to create awareness among local people including fishers along the Ganga River stretch regarding the conservation of indigenous fish species of Ganga, Hilsa and Dolphin as well as Ganga resources. There were 50 people have participated in this awareness programme.

20. Awareness programme at Nabadwip, Balagarh and Tribeni, West Bengal

The awareness programme was organized by ICAR-CIFRI under the National Mission for Clean Ganga Programme aimed to educate the fishermen about IMC, Hilsa, and Dolphin Conservation in the River Ganga, at Tribeni, Nabadwip, and Balagarh on March 2022. The gathering was addressed the importance of Indian major carp on the livelihood of the fishermen and was suggested not to catch the juvenile fish so that they can attain marketable size. The recent activities on Hilsa production improvement in the river Ganga were described in detail along with the initiatives for Dolphin conservation taken by the Institute. Total of 82 local people participated in this awareness programme.

Fig. 345. Awareness programme at Milandeep Ghat, Balagarh on 10 March 2022

Fig. 346. Awareness programme at Kuntighat, Tribeni on 7 March 2022

21. Awareness programme at Gandhi Ghat, Barrackpore, West Bengal

An awareness programme was organized on the occasion of 'Ganga Mashaal Yatra' programme by ICAR-CIFRI team at Gandhi Ghat, Barrackpore on 23rd November 2021. More than 42 local people were sensitized towards sustainable fisheries, Hilsa and dolphin conservation.

Fig. 347. Awareness program at Gandhi Ghat, Barrackpore

22. Awareness programme at Nistarini Ganga Ghat, Seoraphully, West Bengal

An awareness programme was organized by ICAR-CIFRI under NMCG project at Nistarini Ganga Ghat, Seoraphuli on December 2021. Awareness was created towards enhancing the indigenous germplasm conservation, conservation of aquatic biodiversity, sustainable fisheries and Ganga River health. The awareness also created among fishers regarding Dolphin conservation and importance of Dolphin as a nation aquatic animal of River Ganga. Dr. B. K. Das, Director, ICAR-CIFRI in his addressed emphasized on rejuvenation of the Ganga River through ranching of indigenous fish species towards enhancing the indigenous germplasm conservation. Active participation more than 150 of local people including fishers was noticed in this awareness programme.

23. Awareness programme at Godakhali, South 24Pgs, West Bengal

An awareness campaign was organized at Godakhali towards conservation of indigenous fishes including Hilsa and Dolphin in the river Ganga. In this programme a fairly good number of local fishermen was participated enthusiastically. There was a mixed response from fishermen in the awareness campaign conducted by the visiting team. The local people and fishers were sensitized to protect and conserve endangered fish species including Hilsa and dolphin. Most of fishermen were realized the importance of fish conservation and negative impact of overexploitation. They were also sensitized towards adopting eco-friendly fishing method for developing sustainable fisheries. They were also informed about ongoing activities of ICAR-CIFRI under NMCG project and initiatives towards replenish and recoup the fish germplasm in river Ganga by river ranching and mass awareness programme.

Fig. 348. Awareness programme at Godakhali, South 24 Pgs, West Bengal

24. Awareness programme at Jangipore, Lalgola & Berhampore, West Bengal

Another awareness programme was conducted at three different sites namely Jangipore, Lalgola & Berhampore, West Bengal on September, 2022 and 2023 to create awareness among local people towards conservation of indigenous fish species including Hilsa and Dolphin. Active participation of 140 local fishermen and people was observed during the awareness programme. Discussion was also made with fishers regarding their sustainability issues related to fishing and conservation of Dolphin.

25. Awareness programme at Beniagram and Jafarganj, West Bengal

In the Beniagram and Jafaraganj (Downstream of Farakka Barrage), it was found that some fishermen are using fish poison for capturing prawn and fish during winter. Fishermen are not following Government rules and using small net for capturing hilsa and others fish is a major problem. It was informed by the fishermen that they are not getting any government subsidies from states and centre, more than 90% of them doesn't have fishermen card for to support their livelihood. Government should immediately stop the illegal capture of dolphins. It was also seen that most of the fishermen doesn't have "Paka House" for living and they also don't have alternative livelihood during off fishing season.

Fig. 349 Awareness program at Beniagram, downstream of Farakka Barrage

26. Awareness programme at Feeder canal, West Bengal

In the Feeder canal fishermen were sensitized regarding hilsa fisheries. As they were involved in other capture fisheries like Indian Major Carp, *Rita rita* as well as collecting fish seed the awareness also made on sustainable fisheries of river Ganga.

Fig. 350 Awareness program at Feeder canal, Farakka

27. Awareness programme at upstream of Farakka Barrage, West Bengal

Fishermen of Upstream like Taltola Ghat, Rail Colony, Farakka, Deer Forest, Nimsahar wanted government should forcefully stop zero mesh net which are used in Upstream for whole year fishing.

Fig. 351 Awareness programme at Taltola Ghat, Farakka

28. Awareness programme on 75th Foundation day at CIFRI , Barrackpore, West Bengal

In the occasion of 75th (Platinum Jubilee) Foundation day of CIFRI, an awareness program was held at ICAR-CIFRI, Barrackpore, Eminent dignitaries as Swami Viswamayananda Ji, Secretary, Ram Krishna Mission Ashram, Sargachi, Murshidabad, Dr. Dr. B. S. Mahapatra, Vice Chancellor, Bidhan Chandra Krishi Viswavidyalaya, Dr. D. S. Shakyawar, Director, ICAR-NINFET, Kolkata and Dr. Gauranga Kar, Director, ICAR-CRIJAF visited the exhibition and expressed their satisfaction remark after going through 'highly informative' posters and publications related to Hilsa fisheries on river Ganga. In this program 100 numbers of Fishermen were participated. Fishers and students were also sensitized about Hilsa conservation and restoration in this program.

Fig. 352 (A-B) NMCG Hilsa Exhibition on the occasion of 75th (Platinum Jubilee) Foundation day of ICAR-CIFRI

A two-days' workshop was organized by ICAR-CIFRI at Barrackpore under NMCG project on February 2021 to create awareness regarding sustainable management of Hilsa fisheries among Ganga fishers. More than 200 fishers from upper Hooghly estuary actively participated in the programme and were sensitized regarding Hilsa conservation as well as conservation. The awareness also created among fishers regarding Dolphin conservation and importance of Dolphin as a nation aquatic animal of River Ganga. Some of the issues faced by the fishers as mentioned by them are (i) presence of large amount of plastic garbage in water column disturbing net operation, (ii) pollution especially presence of a layer of oil-like substances in water surface, discharged by local industries, (iii) destruction of fishing net by movement of ships/transport vessel, etc. (iv) presence of large amount of solid wastes on water surface especially dead body of animals, (v) harassment by police / local goons, (vi) lack of appropriate fishers specific identity cards, (vii) requirement of a dedicated contact number for communication with ICAR-CIFRI, (viii) application of pesticides/poison for fish catching from the river, (ix) use of unscientific fishing gears with low / zero mesh size destroying juvenile fishes, (x) lack of other better job during the seasons of low / nil fish catch, etc.

Fig. 353 (A-D) Awareness programme of Ganga fishermen on 23rd to 24th February 2021

29. Awareness programme at South 24 paraganas, West Bengal

Three consecutive awareness programmes were conducted towards ‘Conservation of Hilsa Fisheries’ at Bakkhali and Jeti Ghat and Koshtala at Fraserganj, West Bengal on February, 2021. A total of 70 people were sensitized through this awareness programme.

Fig. 354 Awareness programme on ‘Conservation of Hilsa Fisheries at Fraserganj

In the Birlapur, Budge Budge ghat we observed the presence of 120 Hilsa fishermen. Total of 30 numbers of boats and 3 to 4 persons operate gill net from a boat. The fishing time is dependent on tidal flow of the wate and the average catch of hilsa is 3kg/boat/day during premonsoon (March).

Fig. 355 Awareness program at Birlapur, Budge Budge,West Bengal

30. Awareness programme at Kolkata, West Bengal

Awareness program was held in different places of Kolkata, like Barahnagar, Bagbazar, In the Barahnagar ghat we observed 21 numbers of fishermen were present that time of survey among them 10 were Hilsa fishermen. They have their own boat. In the time of operation 3 to 4 fishers were going on a boat to operate fishing. They used Gill net for Hilsa fishing and also use small seine (*Ber jal*), Bag net and set barrier net (*Chorpata jaal*) for other fishes when off season of Hilsa. The main season of Hilsa fishing is Rainy season as per their statement. Apart from Hilsa, *Setipina phasa*, shrimp, *Otolithoides* spp., *C. garua*, *Cynoglossus* sp. are the common fishes they caught along with hilsa. It was also stated that the hilsa catch is comparatively lower than the previous year's catch.

Fig. 356 Awareness program at Barahnagar ghat, West Bengal

In the Bagbazar ghat, we observed the presence of 23 migratory Hilsa fishermen. They have total 18 numbers of boats and 3 to 4 persons operate the gill net from a boat. They frequently use bag net during the same operation. Their fishing time depends on the lunar cycle. In this season, they caught Hilsa 2-2.5kg/day/boat. Apart from hilsa, they also caught some other fishes like *Setipinna phasa* (Phasa), Prawn, *Odontamblyopus rubicundus* (gobies), *Gudusia chapra (*Khoira*), Polynemus paradiseus* (Topshe), etc.

Fig. 357 (A-B) Awareness program at Bag Bazar Ghat, West Bengal

31. Awareness programme at Barrackpore and the adjacent places, West Bengal

An awareness program on Hilsa has been conducted along with Sachwata pakhwada program at Barrackpore to Icchapur stretch and at the two ghats of Baidyabati. "*Save Hilsa for a better future"* was the theme of this program. The team of ICAR-CIFRI went to the Nabajganj ghat at Barrackpore, Devitala ghat of Iccahapore, Ranighat and Rajbanshi ghat at Baidyabati to clean the ghat area with an objective to sensitize the public about the importance of a cleaned Ganga or the Ganga free from water and plastic pollution; and the team also pasted some banners and posters of '*Save Hilsa*', '*Clean Ganga*', '*No to plastic pollution*' on the wall of the ghat and near the market area. Cleaning of the plastic material was done by the team and also make them understand the adverse effect on plastic in Ganga. Further, sensitized 75 to 80 local fishermen through this awareness programme. Through the interaction during the programme, we could know that their livelihood is solely dependent on hilsa fisheries.

Fig. 358 Awareness program at Baidybati, Hooghly, West Bengal

32. Awareness programme in the adjacent places of Jharkhand

In this three years, total awareness programmes at Jharkhand were 84 (3, 35, 46 nos. during 2020-2023 respectively) and places were like Nakitola, Nurai, Rupaspur, Jitpur kalitola, Paharpur, Sahibganj, Rajmahal, LCT Ghat, Hatpara, Naryanpur, Mirnagar, Srighar, Gobargari, Moniharitola, Banutola Kolkata Bajar, Rupaspur, Jolbalu, Barali, Goborgara etc. The total participants were **2274**.

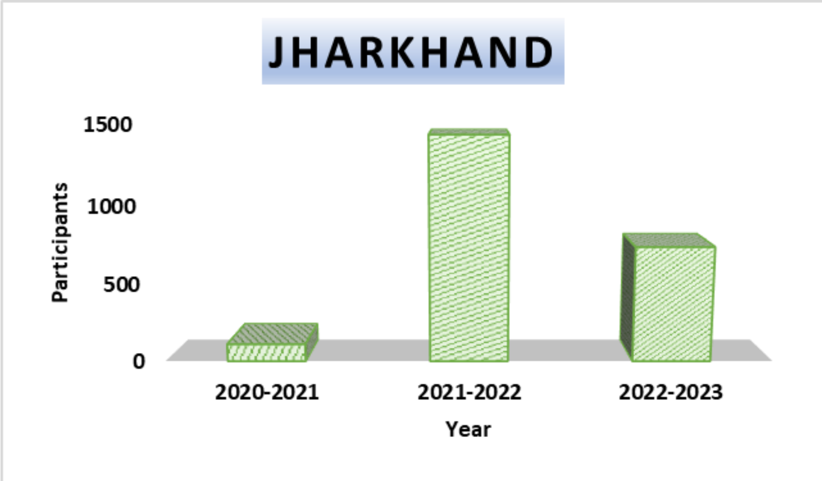

Fig. 359 Yearly breakup of the participants sensitized in Jharkhand

33. Awareness programme in the adjacent places of Jharkhand

An awareness campaign was organized at Sakuntala ghat and Mukteshwar Ghat, Sahibganj, Jharkhand on June and August, 2022 towards the conservation of Hilsa including dolphins in the river Ganga. In this programme more than 100 local fishermen from a local cooperative society participated. Further conservation stride towards Hilsa restoration by ICAR-CIFRI was also discussed. Shri Ramniwas Yadav (IAS) took active participation in the programme and sensitized local fishermen to protect and conserve endangered fish species including dolphins in the region. A meeting was also held between Dr. B. K. Das, Director, ICAR-CIFRI with the Mr. Ashok Choudhary, Chairman of Jharkhand Eastern Gangetic Fishermen Cooperative Society Limited regarding fish diversity conservation of river Ganga in the stretch.

Fig. 360 Awareness with local fishermen at Sakuntala Ghat, Sahibganj

34. Awareness programme in the adjacent places of Bihar

A total of 38 awareness campaigns were organized at different places of Patna, Bhagalpur and Chapra and the total participants were 784. Apart from the above people awareness programme the visiting team interacted with state fisheries officials and informed them how ICAR-CIFRI takes initiatives towards recruitment of Hilsa fishes at upstream of Farakka. The team also visited to fish market for exchange of views in connection with availability of Hilsa and IMC in river Ganga.

Fig. 361 (A) Sensitization programme at Ganga-Koshi confluence, Kurshela, Bihar

Fig. 361 (B) Sensitization programme at Kurshela Fish Market, Bihar

Fig. 361 (C) Sensitization programme on Dolphin at LCD Ghat, Rajmahal

Fig. 361 (D) Sensitization programme on Hilsa at Bhagalpur, Bihar

Fig 361 (A-D):Hilsa awareness in different sites of Bihar and Jharkhand

In the three years of Hilsa awareness programme, ICAR-CIFRI achieved to target a good numbers of participants and sensitized fishermen along the Ganga River stretch both side of the river bank especially different places of West Bengal, Jharkhand and Bihar. Maximum programmes were done in West Bengal in the Year 2021-22 followed by 2020-2021 and 2022-23. In the 2nd year hilsa fishers of Jharkhand were more reachable and sensitized than 1st year due to pandemic situation. More over CIFRI has achieved more success than target given and as a result good network with fishers are made and they start to give information about recovery and tagged Hilsa.

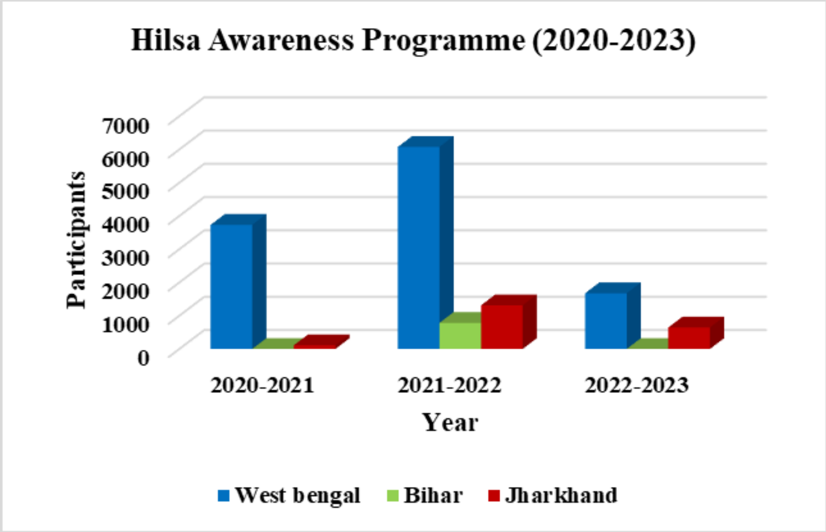

Fig. 362 State and year wise awareness programme of Hilsa

Table 32. List of Hilsa and Dolphin Awareness Programme conducted during 2020- 2021

Sl. No	Year	Month	Place	No. of Participants
WEST BENGAL				
1	2020	November	Farakka Barrage	190
2	2021	March	Farakka Barrage	190
3	2021	February	CIFRI, Barrackpore	200
4	2021	February	Bakkhali and Jeti Ghat and Koshtala at Fraserganj	70
5	2021	March	CIFRI, Barrackpore	100
6	2021	March	Barahnagara	21
7	2021	March	Bagbazar	23
8	2021	March	Birlapur, Budge Budge	120
9	2021	March and August	Godakhali	86
10	2021	March and August	Nawabganj ghat	
11	2021	March and August	Devitala, Icchapur	75
12	2021	March and August	Ranighat, Baidybati	
13	2021	March and August	Rajbanshipara, Baidybati	
14		July	Bichuli ghat, Nawabganj Ghat and Daspara Ghat, Barrackpore	80
15		July	Taltola ghat, Farakka fish market, hilsa fish ranching station, Deerforest, feeder canal and Nawabganj Ghat, Barrackpore	625
16		August	New Taltala Ghat Farakka Barrage Upstream)	71
17		August	Old Taltala Ghat (Farakka Barrage Upstream, Murshidabad)	108
18		August	Khejuriya ghat (Farakka Barrage Downstream) Malda Town)	54
19		August	Hossenpur (Farakka Barrage Downstream) Malda Town)	57
20		August	Baisbnagar (Farakka Barrage Downstream) Malda Town)	20
21		August	Nimsahar (Farakka Barrage Upstream, Murshidabad)	34
22		August	Nimtola (Farakka Barrage Upstream, Murshidabad)	18
23		August	Dhuliyan Ghat (Farakka Barrage Downstream, Murshidabad)	42
24		August	Samsherganj (Farakka Barrage Downstream, Murshidabad)	21
25		August	Arjunpur (Farakka Barrage Downstream, Murshidabad)	27
26		August	Bolalpur (Feeder Canal Murshidabad)	28
27		August	Pachula (Feeder Canal Murshidabad)	19
28		August	Sankarpur (Feeder Canal Murshidabad)	23
29		August	Housenagar (Farakka Barrage Downstream, Murshidabad)	65

30		August	Bhangatola (Farakka Barrage Downstream) Malda Town)	15
31		August	Baisbnagar (Farakka Barrage Upstream) Malda Town)	18
32		August	LCT Ghat (Farakka Barrage Downstream, Murshidabad)	29
33		August	Bindugram (Farakka Barrage Downstream, Murshidabad)	56
34		August	Palashi (Farakka Barrage, Murshidabad)	88
35		August	Lockgate (Farakka Barrage Murshidabad)	21
36		August	Dearforest (Farakka Barrage Upstream, Murshidabad)	18
37		August	Gumani (Farakka Barrage Upstream, Murshidabad)	12
38		August	Nimtola (Farakka Barrage Upstream, Murshidabad)	16
39		August	Sikarpur (Farakka Barrage Upstream, Murshidabad)	20
40		August	Rajnagar (Farakka Barrage Upstream) Malda Town)	87
41		August	Ramrampur (Farakka Barrage Downstream, Murshidabad)	15
42		August	Jalghora (Farakka Barrage Downstream, Murshidabad)	16
43		August	NTPC (Feeder Canal) Murshidabad)	21
44		August	2No. Colony (Feeder Canal) Murshidabad)	11
45		August	Behari Tola (Farakka Barrage Upstream) Malda Town)	18
46		August	Andhua (Feeder Canal) Murshidabad)	33
47		August	Samsherganj (Farakka Barrage Downstream) Malda Town)	13
48		August	Parlalpur (Farakka Barrage Downstream) Malda Town)	22
49		August	Dayonapur (Farakka Barrage Downstream) Malda Town)	13
50		September	Hatat Colony (Farakka Barrage Upstream) Murshidabad	32
51		September	Ambikanagar Rail Colony (Farakka Barrage Upstream) Murshidabad	73
52		September	Beniagram (Farakka Barrage Downstream) Murshidabad	168
53		September	Samsan ghat Beniagram (Farakka Barrage Downstream) Murshidabad	37
54		September	Farakka High School Khunthipara (Farakka Barrage Downstream) Murshidabad	31
55		September	Forest ghat, Beniagram (Farakka Barrage Downstream) Murshidabad	26
56		September	New Farakka Market Corner (Feeder Canal) Murshidabad	16
57		September	Ghoraipara Ghat (Lockgate) Farakka, Murshidabad	12
58		September	Ghoraipara Gram Panchayat (Lockgate) Farakka, Murshidabad	20
59		September	Nishindra Ghat (Lockgate) Farakka, Murshidabad	12
60		September	Simultala (Upstream of Farakka Barrage) Malda Town	48
61		September	Azimtala (Farakka Barrage Upstream) Malda Town	43
62		September	Chak Bahadurpur (Farakka Barrage Downstream) Malda Town	16
63		September	Gandhi Ghat Hilsa Ranching Station	318
64		September	Bihari Tola (Upstream of Farakka Barrage, Malda)	43
65			New Farakkamode(feeder canal ghat I)	19
66			New Farakkamode(feeder canal ghat II)	18
67			Jhafarganj Farakka Barrage Downstream, Murshidabad	44
68			Nainsukh, Farakka Barrage Downstream, Murshidabad	36
			JHARKHAND	
69	2020	November	Rajmahal	50
70	2020	November	Sahib Ganj	35
71	2020	November	Bijali Ghat	26
			Total	**3482**

Table 33. List of Hilsa and Dolphin Awareness Programme conducted during 2021- 2022

Sl. No	Year	Month	Place	No. of Participants
WEST BENGAL				
1	2021	November	Barendra para ghat, Belur, Howrah, West Bengal	53
2	2021	November	Ghandhi Ghat (Upstream of Farakka Barrage, Murshidabad)	544
3	2021 & 2022	Nov, Dec (2021) and May (2022)	Deer Forest (Upstream of Farakka Barrage, Murshidabad)	184
4	2021 & 2022	Nov, Dec (2021) and March, May, Sep (2022)	Gumani (Upstream of Farakka Barrage)	259
5	2021	November	Nimsahar, (Upstream of Farakka Barrage)	52
6	2021	November	Barrackpore, Palta, Ichaapur ghat of West Bengal	305
7	2021	November	Hilsa Ranching Station (Upstream of Farakka Barrage)	1897
8	2021	November	Nimtola (Upstream of Farakka Barrage	43
9	2021	Dec	Nistarini Ganga Ghat, Seoraphully	156
10	2021	Nov, Dec	Bottola (Upstream of Farakka Barrage)	59
11	2021 & 2022	Nov, Dec (2021) and March, May (2022)	Taltola Ghat (Upstream of Farakka Barrage)	200
12	2021 & 2022	Nov, Dec (2021) and Jan (2022)	Jafarganj Ghat (Downstream of Farakka Barrage)	213
13	2021 & 2022	Dec (2021) and March (2022)	Sankarpur ghat, Feeder canal (Farakka Barrage Project,	44
14	2021 & 2022	Dec (2021)	Dhuliyan ghat, Feeder canal (Farakka Barrage Project)	38
15	2021 & 2022	Dec (2021) and March (2022)	Feeder Canal (Farakka Barrage Project, Murshidabad, West Bengal)	55
16	2021 & 2022	Dec (2021), January (2022)	Simultala ghat (Upstream of Farakka Barrage, Malda, West Bengal)	25
17	2021	Dec	Ranagar ghat (Upstream of Farakka Barrage, Malda, West Bengal)	43
18	2021	Dec	Rail Colony (Upstream of Farakka Barrage, Murshidabad, West Bengal)	118
19	2021	Dec	Farakka Panchayat (Upstream of Farakka Barrage, Murshidabad, West Bengal)	28
20	2021	Dec	Palashi (Upstream of Farakka Barrage, Murshidabad, West Bengal)	52
21	2021 & 2022	Dec (2021) and March, June (2022)	Shikarpur, Farakka (Upstream of Farakka Barrage, Murshidabad, West Bengal)	56
22	2021	Dec	Biharitola (Upstream of Farakka Barrage, Malda, West Bengal)	63
23	2021	Dec	Lalutola (Upstream of Farakka Barrage, Malda, West Bengal)	55
24	2021 & 2022	Dec (2021) and Jan, June (2022)	Khejuriya Ghat (Upstream of Farakka Barrage, Malda, West Bengal)	95
25	2022	May	Rajnagar Ghat -1 (Upstream of Farakka Barrage, Malda, West Bengal)	44
26	2022	May	Rajnagar Ghat-2 (Upstream of Farakka Barrage, Malda, West Bengal)	35
27	2022	May	Rajnagar Ghat-3 (Upstream of Farakka Barrage, Malda,West Bengal)	13
28	2022	May	Rajnagar Ghat-6 (Upstream of Farakka Barrage, Malda, West Bengal)	15
29	2022	May	Rajnagar Ghat-8(Upstream of Farakka Barrage, Malda, West Bengal)	14
30	2022	Jan, May	Rajnagar 4 no Ghat-1 (Upstream of Farakka Barrage, Malda, West Bengal)	44
31	2022	May	Rajnagar 4 no Fish landing Ghat (Upstream of Farakka Barrage, Malda, West Bengal)	266

32	2022	Jan	Rajnagar market (Upstream of Farakka Barrage, Malda, West Bengal)	29
33	2022	Jan, March, April, June	Natun Basti, Beniagram, Farakka (Downstream of Farakka Barrage, Murshidabad)	75
34	2022	Jan, March, June	Malar Math, Beniagram (Downstream of Farakka Barrage, Murshidabad)	108
35	2022	May	Forest ghat (Upstream of Farakka Barrage, Murshidabad, West Bengal)	19
36	2022	May	Parlalpur Ghat first (Downstream of Farakka Barrage, West Bengal)	24
37	2022	May	ParlalpurGhat 2nd (Downstream of Farakka Barrage, West Bengal)	11
38	2022	May	Parlalpur Panchayat (Downstream of Farakka Barrage, West Bengal)	16
39	2022	May	Parlalpur Market (Downstream of Farakka Barrage, West Bengal)	26
40	2022	May	Old Taltola Ghat (Upstream of Barrage, Murshidabad, West Bengal	23
41	2022	March, April	Ghat Para, Beniagram first (Downstream of Farakka Barrage, Murshidabad, West Bengal)	50
42	2022	May	LaskariTola (Upstream of Farakka Barrage, Malda, West Bengal)	17
43	2022	May	Sultan Tola (Upstream of Farakka Barrage, Malda, West Bengal)	10
44	2022	May	Pachkuri Tola (Upstream of Farakka Barrage, Malda, West Bengal)	14
45	2022	May	Kamaluddinpur Ghat, (Upstream of Farakka Barrage, Malda, West Bengal	46
46	2022	May	Panchanandapur, Pagla ghat (Upstream of Farakka Barrage, Malda, West Bengal)	77
47	2022	May	Jalbalu (Upstream of Farakka Barrage, Malda, West Bengal)	22
48	2022	May	Beuya Ghat (Upstream of Farakka Barrage, Murshidabad, West Bengal)	18
49	2022	May	Nimsahor, (Upstream of Farakka Barrage, Murshidabad, West Bengal)	11
50	2022	June	Kumar Para Ghat (Upstream of Farakka Barrage, West Bengal)	17
51	2022	June	Kamaltipur Ghat (Upstream of Farakka Barrage, Malda West Bengal)	27
52	2022	June	Kulidiar Ghat Mondal Para Upstream of Farakka Barrage	10
53	2022	June	Kulidiar Thakur das Mondal Para Upstream of Farakka Barrage	12
54	2022	June	Kulidiar Chand Mondal Para Upstream of Farakka Barrage	14
55	2022	July	Godakhali, South 24 Pgs, West Bengal	28
56	2022	July	Fraserganj, South 24 Pgs, West Bengal	32
57	2022	Sep	Godakhali and Fraserganj, South 24 Pgs, West Bengal	35
58	2022	Sep	Haldarpara ghat, Krishnamati ghat, Berhampore	28
59	2022	Sep	Haldarpara ghat, Rejinagar, Berhampore	38
60	2022	Sep	Sagar Island, South 24 Pgns, West Bengal	30
61	2022	Sep	Jangipore, Lalgola & Berhampore, West Bengal	140
			JHARKHAND	
62	2021	Nov	Nakitola, Raj Mahal (Upstream of Farakka Barrage, Jharkhand)	117
63	2021 & 2022	Dec (2021) and June (2022)	Birnagar (Upstream of Farakka Barrage, Jharkhand)	47
64	2021 & 2022	Dec (2021) and Jan, March, May, June, Sep (2022)	Radhanagar, Upstream of Farakka Barrage, Jharkhand	229
65	2021	Dec	Kathal Bari (Upstream of Farakka Barrage, Jharkhand)	45
66	2021	Sep and Dec	Shri Ghar (Upstream of Farakka Barrage, Jharkhand)	136
67	2021	Dec	Bewa (Upstream of Farakka Barrage, Jharkhand)	22
68	2021 & 2022	Dec (2021) and April, May (2022)	Begamganj, Jharkhand (Upstream of Farakka Barrage, Jharkhand)	165
69	2022	Feb	Nurai (Upstream of Farakka Barrage, Jharkhand)	47
70	2022	Feb	Rupaspur (Upstream of Farakka Barrage, Jharkhand)	53
71	2022	Feb	Jitpur kalitola (Upstream of Farakka Barrage, Jharkhand)	61
72	2022	Feb	Paharpur (Upstream of Farakka Barrage, Jharkhand)	38
73	2022	Jan	Sarfarazganj, Sahibganj (Upstream of Farakka Barrage, Jharkhand)	63
74	2022	Jan	Rajmahal Ferry Ghat 1st (Upstream of Farakka Barrage, Jharkhand)	18
75	2022	Jan	Rajmahal Ferry Ghat 2nd (Upstream of Farakka Barrage, Jharkhand)	14
76	2022	Jan and Sep	Rajmahal Ghat (Upstream of Farakka Barrage, Jharkhand)	30
77	2022	Jan	Rajmahal Market 1st (Upstream of Farakka Barrage, Jharkhand)	24
78	2022	Jan	Rajmahal Market 2nd (Upstream of Farakka Barrage, Jharkhand)	17
79	2022	Jan	Sindhi ghat, Rajmahal (Upstream of Farakka Barrage, Jharkhand)	15

80	2022	Jan	Railway station Rajmahal (Upstream of Farakka Barrage, Jharkhand)	32
81	2022	June	LCT Ghat, Rajmahal, Jharkhand	12
82	2022	June	Hatpara, Rajmahal, Jharkhand	08
83	2022	March	Mirnagar (Upstream of Farakka Barrage, Jharkhand)	13
84	2022	May	Srighar (Upstream of Farakka Barrage Jharkhand)	15
85	2022	May	Gobargari (Upstream of Farakka Barrage Jharkhand)	19
86	2022	May	Moniharitola (Upstream of Farakka Barrage Jharkhand)	40
87	2022	May	Banutola Kolkata Bajar (Upstream of Farakka Barrage Jarkhand, West Bengal)	34
88	2022	May	Rupaspur Ghat (Upstream of Farakka Barrage, Jharkhand)	29
89	2022	June	Sakuntala Ghat, Sahibganj	15
90	2022	June	Ojhatola Ghat, Sahibganj	05
91	2022	June	Gangetic Fishermens Co-operatives, Sahibganj	09
92	2022	June	Hatpara, Rajmahal, Jharkhand	08
93	2022	June	Naryanpur, Rajmahal, Jharkhand	09
94	2022	Sep	Goborgara, Sukpara, Jharkhand (Farakka Barrage, Upstream)	13
95	2022	Sep	Barali, Jharkhand (Farakka Barrage, Upstream)	16
96	2022	Sep	Sikarpur Chor, Jharkhand (Farakka Barrage, Upstream)	11
			BIHAR	
97	2022	Sep	Kahelgaon, Bihar	57
98	2022	Sep	At confluence of Ganga & Koshi River Bank Kursela, Bihar	11
99	2022	Sep	Fish Market, Kurshela, Bihar	137
100	2022	Sep	Durga ghat, Sultanganj, Bhagalpur	22
101	2022	Sep	Nit ghat Patna	14
102	2022	Sep	Gulabi ghat 1st and ghat 2nd Patna	12
103	2022	Sep	Raushan ghat1st and ghat 2nd Patna	09
104	2022	Sep	Chaudhary ghat Patna	09
105	2022	Sep	Sabji bag ghat Patna	07
106	2022	Sep	Machhua ghat Patna	05
107	2022	Sep	Adalat ghat Patna	05
108	2022	Sep	Bhadra ghat Patna	12
109	2022	Sep	Mahabir ghat Patna	07
110	2022	Sep	Mitan ghat Patna	08
111	2022	Sep	Bengali ghat Chhapra	08
112	2022	Sep	Bengali ghat 2 Chhapra	05
113	2022	Sep	Jahaj ghat Chhapra	06
114	2022	Sep	Tiwari ghat Chhapra	07
115	2022	Sep	Balu ghat Chhapra	08
116	2022	Sep	Samsan ghat Chhapra	09
117	2022	Sep	B N rai ghat Patna	07
118	2022	June	Gosai ghat Patna	07
119	2022	Sep	Raja ghat Patna	08
120	2022	Sep	Rani Ghat, Patna	09
121	2022	Sep	Alamganj 2 ghat Patna	11
122	2022	Sep	Ghagha 2 ghat Patna	08
123	2022	Sep	Bazar samiti ghat Patna	05
124	2022	Sep	Bazar samiti ghat Patna	05
125	2022	Sep	Raja ghat 2 Patna	07
126	2022	Sep	Mirchai ghat Patna	05
127	2022	Sep	Kangan ghat Patna	08
128	2022	Sep	Ghagha ghat Patna	06
129	2022	Sep	Alamganj ghat Patna	05
130	2022	Sep	Lahrwa ghat Patna	07
131	2022	Sep	Hanuman ghat Patna	06
132	20222	Sep	Jahanvi ghat, Bhagalpur, Bihar	32
133	2022	Sep	Patna, Bihar	139
134	2022	Sep	Buxar, Bihar	151
			Total	**8326**

Table 34. List of Hilsa and Dolphin Awareness Programme conducted during 2022- 2023

Sl. No	Year	Month	Place	No. of Participants
WEST BENGAL				
1	2022	October	Taltola Ghat, Farakka, Murshidabad, West Bengal (Farakka Barrage Upstream	51
2	2022	November	Khejuria ghat, West Bengal (Farakka Barrage Upstream)	07
3	2022	November	Taltola ghat, West Bengal (Farakka Barrage Upstream)	08
4	2022	November	Farakka Railcolony, Farakka, WB (Farakka Barrage Upstream)	16
5	2022	November	Deer Forest Ghat, Farakka, WB (Farakka Barrage Upstream)	17
6	2022	November	Palasi, Farakka, West Bengal (Farakka Barrage Upstream)	9
7	2022	November	Ghoraipara Ghat, Feeder Canal, WB (Farakka Barrage)	25
8	2022	November	Nishindra Ghat, Feeder Canal, WB (Farakka Barrage)	21
9	2022	November	Neemshahar, Farakka,WB (Farakka Barrage Upstream)	20
10	2022	November	Dear Forest, Farakka, WB (Farakka Barrage Upstream)	17
11	2022	November	Rajnagar ghat, West Bengal (FarakkaBarrageUpstream)	11
12	2022	November	Modelghat,West Bengal (Farakka Barrage Upstream)	15
13	2022	November	Rajnagar Market, West Bengal (Farakka Barrage Upstream)	17
14	2022	November	Satuagola ghat, West Bengal (Farakka Barrage Upstream)	21
15	2022	November	Paglaghat, West Bengal (Farakka Barrage Upstream)	14
16	2022	November	Sikarpur ghat, West Bengal (Farakka Barrage Upstream)	9
17	2022	November	Panchanandpur ghat, West Bengal (Farakka Barrage Upstream	11
18	2022	November	Nayagram, West Bengal (Farakka Barrage Upstream)	12
19	2022	November	Cloney bus deepo, West Bengal (Farakka Barrage Upstream)	18
20	2022	November	Forest Ghat, West Bengal (Farakka Barrage Upstream)	15
21	2022	November	Ghoraipara ghat, West Bengal (Farakka Barrage Upstream)	11
22	2022	November	Barrage fish market, West Bengal (Farakka Barrage Upstream)	10
23	2022	November	Farakka sabji market, West Bengal (Farakka Barrage Upstream)	8
24	2022	December	Deer forest ghat West Bengal (Farakka Barrage Upstream)	16
25	2022	December	Bewa, West Bengal (Farakka Barrage Upstream)	19
26	2022	December	Neemshahar ghat, West Bengal (Farakka Barrage Upstream)	15
27	2022	December	Raghunathpur ghat, West Bengal (Farakka Barrage Downstream)	14
28	2022	December	Jafferganj ghat, West Bengal (Farakka Barrage Downstream)	11
29	2022	December	Jafferganj fish Market ghat, West Bengal (Farakka Barrage Downstream)	09
30	2022	December	Beniagram Matasjeevi ghat, West Bengal (Farakka Barrage Downstream)	19
31	2022	December	Naya Basti, West Bengal (Farakka Barrage downstream)	16
32	2022	December	Ballarpur, West Bengal (Farakka Barrage downstream)	15
33	2022	December	Near NTPC Field hostel, West Bengal, (Farakka Barrage downstream)	17
34	2022	December	Beniagram, West Bengal (Farakka Barrage downstream)	12
35	2022	December	Shankar Pur Ghat, West Bengal, (Farakka Barrage downstream)	08
36	2022	December	Rajnagar Ghat, West Bengal (Farakka Barrage Upstream)	71
37	2022	December	Parlalpur, West Bengal (Farakka Barrage Downstream)	22
38	2022	December	Dhulian Ghat 1, West Bengal (Farakka Barrage Downstream)	13
39	2022	December	Dhulian Ghat 2, West Bengal (Farakka Barrage Downstream)	19
40	2022	December	Dhulian Shree Ghat, West Bengal (Farakka Barrage Downstream)	23
41	2022	December	Deer forest Ghat, West Bengal (Farakka Barrage Upstream)	16
42	2022	December	Neem Sahar, West Bengal (Farakka Barrage upstream)	12
43	2022	December	Radha Nagar, West Bengal (Farakka Barrage upstream)	21
44	2022	December	Saheb Danga, West Bengal (Farakka Barrage upstream)	09
45	2022	December	Beniagram Ghat, West Bengal (Farakka Barrage Downstream)	13
46	2022	December	New Farakka market, West Bengal (Farakka Barrage Downstream)	11
47	2022	December	Subhashpally, West Bengal (Farakka Barrage Downstream)	15
48	2022	December	02 no. colony, West Bengal (Farakka Barrage Downstream)	12
49	2023	January	Ghoraipara Ghat, West Bengal (Farakka Barrage Upstream)	08
50	2023	January	Barrage Fish market, West Bengal (Farakka Barrage Upstream)	06
51	2023	January	Deer forest Ghat, West Bengal (Farakka Barrage Upstream)	09
52	2023	January	Taltola Ghat, West Bengal (Farakka Barrage Upstream)	11
53	2023	January	Beniagram Ghat, West Bengal (Farakka Barrage Downstream)	18
54	2023	January	LCD Ghat, West Bengal (Farakka Barrage Downstream)	16
55	2023	January	Nutun basti, West Bengal (Farakka Barrage Downstream)	14
56	2023	January	Neemsahar Ghat, West Bengal (Farakka Barrage Upstream)	14
57	2023	January	Kodalkati, Ghat West Bengal (Farakka Barrage Upstream)	13
58	2023	January	Lalchan Ghat, West Bengal (Farakka Barrage Upstream)	16
59	2023	January	Jalbalu, west Bengal, (Farakka Barrage Upstream)	14

60	2023	February	Rajnagar Ghat I, West Bengal (Farakka Barrage Downstream	15
61	2023	February	Rajnagar Ghat II, West Bengal (Farakka Barrage Downstream)	12
62	2023	February	Binnagar, West Bengal (Farakka Barrage Downstream)	14
63	2023	February	Dogachhi ghat, West Bengal (Farakka Barrage Upstream)	11
64	2023	February	Panchanandpur, West Bengal (Farakka Barrage Upstream)	08
65	2023	February	Pagla ghat, West Bengal (Farakka Barrage Upstream)	21
66	2023	February	Sukalpur ghat, West Bengal (Farakka Barrage Upstream)	12
67	2023	February	No.09 Rajnagar ghat, West Bengal (Farakka Barrage Downstream)	13
68	2023	February	Binnagar ghat, West Bengal (Farakka Barrage Downstream)	12
69	2023	February	Gobargadi ghat, West Bengal (Farakka Barrage Upstream)	09
70	2023	February	English bazar ghat, West Bengal (Farakka Barrage Downstream)	10
71	2023	February	Priyarpur ghat, West Bengal (Farakka Barrage Downstream)	14
72	2023	March	Mela ghat, west Bengal, (Farakka Barrage downstream	18
73	2023	March	Beniagram ghat, west Bengal, (Farakka Barrage downstream)	22
74	2023	March	Nutunbasti, west Bengal, (Farakka Barrage downstream)	17
75	2023	March	Feeder canal, west Bengal, (Farakka Barrage downstream)	23
76	2023	April	Taltola ghat, west Bengal, (Farakka Barrage upstream)	15
77	2023	April	Bertala ghat, west Bengal, (Farakka Barrage Upstream)	18
78	2023	April	Bhagwanadpur, west Bengal, (Farakka Barrage Upstream)	21
79	2023	April	Radhanagar, west Bengal, (Farakka Barrage Upstream)	19
80	2023	April	Rajnager Ghat-1, Malda, West Bengal, (Farakka Barrage Upstream)	26
81	2023	April	Rajnager Ghat-2, Malda, West Bengal, (Farakka Barrage Upstream)	17
82	2023	April	Arsainik Ghat (Rajnager), Malda, West Bengal, (Farakka Barrage Upstream)	13
83	2023	May	Pagla Ghat-1, Malda, WB, (Farakka Barrage Upstream)	12
84	2023	May	Pagla Ghat-2, Malda,West Bengal, (Farakka Barrage Upstream)	21
85	2023	May	Rajnagar Ghat 1, Malda, West Bengal, (Farakka Barrage Upstream)	14
86	2023	May	Rajnagar Ghat-2, Malda, West Bengal, (Farakka Barrage Upstream)	12
87	2023	May	Kamaltipur Fish Ghat, Malda, WB, (Farakka Barrage Upstream)	26
88	2023	May	Rajnagar Ghat 1, Malda, West Bengal, (Farakka Barrage Upstream)	15
89	2023	May	Rajnagar Ghat-2, Malda, West Bengal, (Farakka Barrage Upstream)	13
90	2023	May	Taltola Ghat, Farakka, West Bengal, (Farakka Barrage Upstream)	11
91	2023	May	Taltola Ghat,Farakka, West Bengal, (Farakka Barrage Upstream)	42
92	2023	May	Hilsa ranching station Farakka,West Bengal, (Farakka Barrage Upstream)	50
93	2023	June	Kamaluddin Ghat, Malda, West Bengal (Farakka Barrage Upstream)	15
94	2023	June	Majhiyashara, Malda, West Bengal, (Farakka Barrage Upstream)	20
95	2023	June	Panchanandpur Ghat, Malda, West Bengal, (Farakka Barrage Upstream)	24
96	2023	June	Deerforest, Farakka, WB, (Farakka Barrage Upstream)	10
97	2023	June	Taltola ghat, Farakka, WB, (Farakka Barrage Upstream	14
98	2023	July	Nimsahar ghat, Farakka,West Bengal, (Farakka Barrage Upstream)	09
99	2023	July	Nimsahar ghat -2, Farakka, West Bengal, (Farakka Barrage Upstream)	15
100	2023	July	Nimtala, Farakka, West Bengal, (Farakka Barrage Upstream)	07
101	2023	July	Tufi Ghat, Malda, West Bengal, (Farakka Barrage Upstream)	11
102	2023	July	Rajnagar Ghat-1, Malda, West Bengal, (Farakka Barrage Upstream)	09
103	2023	July	Rajnagar Ghat-2, Malda, West Bengal, (Farakka Barrage Upstream)	07
104	2023	July	Rajnagar Pump House, Malda, West Bengal, (Farakka Barrage Upstream)	09
105	2023	July	Khejuriya Ghat, Malda, West Bengal, (Farakka Barrage Upstream)	12
106	2023	July	Simultola, Malda, West Bengal, (Farakka Barrage Upstream)	07
107	2023	July	Taltola Ghat, Farakka, WB, (Farakka Barrage Upstream)	14
108	2023	July	Benia gram, Farakka, WB, (Farakka Barrage Upstream)	13
109	2023	July	Feeder canal, Farakka, WB, (Farakka Barrage Upstream)	14
110	2023	July	Dhulian, Murshidabad, Farakka, WB, (Farakka Barrage downstream	19
111	2023	August	Taltola ghat, Farakka, West Bengal, (Farakka Barrage Upstream)	14
112	2023	August	Beniagram, Farakka, WB, (Farakka Barrage Downstream)	13
113	2023	August	Feeder Canal, Farakka, WB, (Farakka Barrage Downstream)	14
114	2023	August	Dhuliyan Ghat, Murshidabad, WB, (Farakka Barrage Downstream)	19
115	2023	August	Nimtala, Murshidabad, WB, (Farakka Barrage Upstream)	12
116	2023	August	Khejuriya Ghat-1, Malda, WB, (Farakka Barrage Upstream)	11
117	2023	August	Khejuriya Ghat-2, Malda,WB, (Farakka Barrage Upstream)	15
118	2023	September	RajnagerGhat ,Malda,WB, (Farakka Barrage Upstream)	21
119	2023	September	Beniagram Ghat ,WB, (Farakka Barrage downstream)	11
120	2023	September	Feeder canal,Farakka, WB, (Farakka Barrage downstream)	09
121	2023	September	GhoraiparaGhat ,WB, (Farakka Barrage downstream)	09
122	2023	September	Ghoraipara Ghat-2 ,WB, (Farakka Barrage downstream)	10
123	2023	September	Railcolony ,Farakka,WB, (Farakka Barrage Upstream)	11

124	2023	September	KhejuriyaGhat ,Malda,WB, (Farakka Barrage Upstream)	09
125	2023	September	Khejuriya Ghat-2 ,Malda,WB, (Farakka Barrage Upstream)	10
126	2023	October	Malarmath ,Farakka,WB, (Farakka Barrage Downstream)	30
127	2023	October	Beniagram ,Farakka,WB, (Farakka Barrage Downstream)	24
128	2023	October	Taltola Ghat ,Farakka,WB, (Farakka Barrage Upstream)	10
129	2023	October	Ghoraipara Ghat ,Farakka,WB, (Farakka Barrage Upstream)	12
130	2023	October	Palasi ,Farakka,WB, (Farakka Barrage Upstream)	09
131	2023	October	Beniagram ,Farakka,WB, (Farakka Barrage Downstream)	08
132	2023	October	NTPC Field Hostal ,Frakka,WB, (Farakka Barrage Downstream)	10
133	2023	October	Feeder Canel ,Farakka,WB, (Farakka Barrage Downstream)	11
134	2023	October	New Farakka ,Farakka,WB, (Farakka Barrage Upstream)	10
135	2023	October	Khejuriya Ghat ,Malda,WB, (Farakka Barrage Upstream)	08
136	2023	October	Khejuriya Ghat -2,Malda,WB, (Farakka Barrage Upstream)	15
137	2023	October	Gandhi Ghat ,Farakka,WB, (Farakka Barrage Upstream)	22
138	2023	October	Taltala Ghat ,Farakka,WB, (Farakka Barrage Upstream)	11
139	2023	November	Beniagram Ghat,Farakka,WB, (Farakka Barrage Downstream)	56
140	2023	November	Farakka Barrage Township,Farakka,WB, (Farakka Barrage Upstream).	64
141	2023	November	Sikarpore,Farakka,WB, (Farakka Barrage Upstream).	10
142	2023	November	Bhabanandapur,Farakka,WB, (Farakka Barrage Upstream).	08
143	2023	November	Rajnagar Ghat,Malda,WB, (Farakka Barrage Upstream).	11
144	2023	November	Rajnagar Ghat-2,Malda,WB, (Farakka Barrage Upstream).	14
145	2023	November	Khejuriya Ghat,Malda,WB, (Farakka Barrage Upstream).	11
146	2023	November	Gandhi Ghat,Farakka,WB, (Farakka Barrage Upstream).	45
147	2023	November	Khejuriya Ghat,Malda,WB, (Farakka Barrage Upstream).	14
148	2023	November	Khejuriya Ghat -2,Malda,WB, (Farakka Barrage Upstream).	18
			JHARKHAND	
149	2022	October	Kolkata Bazar, Jharkhand, (Farakka Barrage Upstream	21
150	2022	October	Kadabanda, Jharkhand, (Farakka Barrage Upstream)	12
151	2022	October	Shri Ghar, Jharkhand, (Farakka Barrage Upstream)	23
152	2022	November	English Bazar, Jharkhand (Farakka Barrage Upstream)	10
153	2022	November	Goldhap, Jharkhand, (Farakka Barrage Upstream)	07
154	2022	November	Rajnagar ghat I, Jharkhand (Farakka Barrage Upstream)	13
155	2022	November	Rajnagar ghat II, Jharkhand (Farakka Barrage Upstream)	24
156	2022	November	Rajnagar ghat Market, Jharkhand (Farakka Barrage Upstream	11
157	2022	November	English Bazar, Jharkhand (Farakka Barrage Upstream)	10
158	2022	November	Shrighar, Jharkhand (Farakka Barrage Upstream)	21
159	2022	November	Begamganj, Jharkhand (Farakka Barrage Upstream)	20
160	2022	December	Baka ghat, Jharkhand (Farakka Barrage Upstream)	18
161	2023	January	Subhan Tola, Jharkhand (Farakka Barrage Upstream)	31
162	2023	January	Paranpur, Jharkhand (Farakka Barrage Upstream)	21
163	2023	January	Piyarpur. Jharkhand, (Farakka Barrage Upstream)	18
164	2023	January	Kolkata Bazar, Jharkhand, (Farakka Barrage Upstream)	9
165	2023	February	Radhanagar, Jharkhand (Farakka Barrage Upstream)	13
166	2023	February	Bhagwanandpur ghat, Jharkhand (Farakka Barrage Upstream)	18
167	2023	February	Meernagar ghat, Jharkhand (Farakka Barrage Upstream)	11
168	2023	Mar-April,	Shreeghar, Jharkhand, (Farakka Barrage Upstream)	08
169	2023	May	Surya dev ghat Rajmahal, Jharkhand, (Farakka Barrage Upstream)	16
170	2023	May	Rajmahal Ganga Ghat, Jharkhand, (Farakka Barrage Upstream)	27
171	2023	May	Rajmahal Fish market, Jharkhand, (Farakka Barrage Upstream)	12
172	2023	May	Rajmahal fish market, Jharkhand, (Farakka Barrage Upstream)	11
173	2023	May	Sahebganj fishing ghat, Jharkhand, (Farakka Barrage Upstream)	13
174	2023	May	Ojhatoli Ghat Sahebganj, Jharkhand, (Farakka Barrage Upstream)	32
175	2023	May	Rajmahal Fish market, Jharkhand, (Farakka Barrage Upstream)	22
176	2023	June	Kolkata Bazar 1, Jharkhand, (Farakka Barrage Upstream)	21
177	2023	June	Kolkata Bazar 2, Jharkhand, (Farakka Barrage Upstream)	17
178	2023	June	GaziparaGhat, Malda, (Farakka Barrage Upstream)	08
179	2023	June	Radhanager, Jharkhand, (Farakka Barrage Upstream)	26
180	2023	June	Shreeghar-1, Jharkhand, (Farakka Barrage Upstream)	14
181	2023	June	Shreeghar-2, Jharkhand, (Farakka Barrage Upstream)	09
182	2023	June	Shikarpur, Jharkhand, (Farakka Barrage Upstream)	12
183	2023	July	Radhanager ghat, Jharkhand, (Farakka Barrage Upstream)	08
184	2023	July	Kumarpara Ghat, Jharkhand, (Farakka Barrage Upstream)	11
185	2023	July	Bat Tala Ghat, Jharkhand, (Farakka Barrage Upstream)	23
186	2023	July	Gajipur, Jharkhand, (Farakka Barrage Upstream)	15
187	2023	July	Palgachi, Jharkhand, (Farakka Barrage Upstream)	21
188	2023	July	Baluka, Jharkhand, (Farakka Barrage Upstream)	09
189	2023	August	Lalchand, Jharkhand, (Farakka Barrage Upstream)	9

190	2023	August	Shreeghar, Jharkhand, (Farakka Barrage Upstream)	8
191	2023	August	Gajipur, Jharkhand, (Farakka Barrage Upstream)	7
192	2023	August	Kadapanna, Jharkhand, (Farakka Barrage Upstream)	15
193	2023	August	Rajmohal Ghat-1, Jharkhand, (Farakka Barrage Upstream)	14
194	2023	August	Rajmohal Ghat-2, Jharkhand, (Farakka Barrage Upstream)	35
195	2023	August	Bauya,Jharkhand, (Farakka Barrage Upstream)	10
			Total	**3098**

35. Other research conducted on physiology and biochemical part of Hilsa

35.1. Molecular study of Hilsa Reproductive Biology study (Identification and Characterization of GnRH Gene)

The Hilsa fish (*Tenualosa ilisha*) is an economically and ecologically important species and understanding its reproductive biology at the molecular level is crucial for conservation and fisheries management. In this study, we aimed to identify and characterize the gonadotropin-releasing hormone (GnRH) gene in Hilsa and explore its molecular aspects.

The GnRH gene in Hilsa was identified using PCR method and successfully amplified and isolated the complete GnRH gene for Hilsa sample. The obtained GnRH gene sequence was first time submitted to the NCBI database for public access. In silico (Bioinformatics) characterization was going on using computational tools and techniques to provide insights into the gene's structure, function, and regulation mechanisms. (i.e., Sequence alignment, Homology modeling, functional analysis, promoter analysis, molecular docking, dynamic simulation, and Gene expression study)

This study represents a significant step in unraveling the molecular aspects of Hilsa fish reproduction. The identification and characterization of the GnRH gene provide a foundation for further research into the reproductive mechanisms of this important species. The data generated through this study contribute valuable information for conservation efforts and sustainable fisheries management.

35.2. Amino acids analysis of Hilsa

Amino acids analysis of a total of 10 nos. of Hilsa were carried out. The analysis revealed the availability of 16 different amino acids in Hilsa muscle (weight ranges from 300 to 650g). The below graph (Fig.363) depicts that Glutamic acid (0.77±0.57 g/100g body weight of Hilsa) was observed to be higher following Aspartic acid, Threonine, Lysine, Leucine, Alanine, Isoleucine, and Phenylalanine respectively.

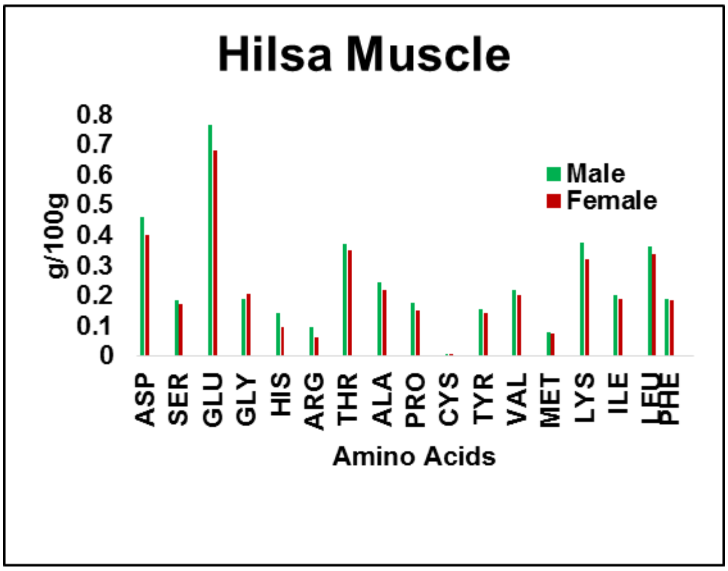

Fig 363. Amino acids analysis of Hilsa muscle

35.3. Antioxidant Analysis of Hilsa

Antioxidant analysis of a total of 10 nos. of Hilsa was carried out. The analysis revealed that Hilsa muscle (weighing 300 to 650g) contained more than 70% of antioxidants. Females contained more antioxidants than male Hilsa in blood serum; this is the first report about the antioxidant property of Hilsa.

35.4. Biochemical evaluation of Hilsa milt

The antioxidant, amino acid, and fatty acid profile of Hilsa milt as well as Gonado Somatic Index (GSI) of male Hilsa was studied. The antioxidant assay indicated that DPPH radical scavenging efficacy of the Hilsa milt was 66.5±2.5% which was closer to synthetic antioxidant Butylated hydroxyltolune and exhibited significant reducing power ability. Themilt showed 15 amino acids and out of which Arginine was highest (0.7g/100g) followed by Glutamic acid (0.14g/100g). The fatty acid composition showed that among this saturated fatty acid Palmitic acid was high followed by Stearic acid. The GSI (Gonado Somatic Index) of male testis was ranges from 0.71 -1.82 within the weight ranges from 113.8g to 432g.

35.5. Breeding hormonal analysis of Hilsa

A total of 10 Hilsa (weight range 100 g to 500 g and length) was collected from Farakka for hormonal analysis of serum. It was noticed that Gonadotropin-releasing hormone (GnRH) hormone varied from1.37mIU/ml to 4.75mIU/ml.

36. Activities related to river dolphins' conservation under the Namami Gange program

36.1. Present status and distribution of river Dolphin in Ganga basin

ICAR-Central Inland Fisheries Research Institute, Barrackpore, along with the Regional Center at Prayagraj, have been continuously monitoring and assessing the ecology and fisheries, including fishermen's livelihood and river habitat, of the Ganga River and have created a repository of biological and ecological data on the Ganga River system. Simultaneously, the institute has been assigned issues related to the conservation of the river dolphin along the Ganga River stretch. The occurrence of river dolphins has been observed in the main channel of the Ganga, covering states like Uttar Pradesh, Bihar, Jharkhand, and West Bengal across upper, middle, and lower stretches. The abundance of dolphins was noticed very frequently at different places along the Farakka stretch of the river Ganga, such as Deer Forest, Gumani, the lower Farakka barrage, and the confluence zone of the Ganga and Jalangi Rivers at Nabadwip. In the lower stretch, dolphins have been reported on a regular basis during the operation of bag nets in the winter season, specifically February and March.

In the selected and nearer sites, mainly small groups (3-5 in number) of dolphins were recorded; however, at confluence sites such as Katwa (confluences of the Ajoy-Bhagirathi River), Nabadwip (Bhagirathi-Jalangi River confluence), Sabuj Dweep (Hooghly-Behula River confluence), Balagarh (confluence of the Bhagirathi-Churni River), Kulpi (Hooghly-Haldi River confluence), etc., as many as 5–17 individuals of dolphins were recorded. As per the study of ICAR-CIFRI under the NMCG program in the lower stretch of the Ganga (Farakka to Kakdwip), the survey could estimate as many as 289 dolphin populations, and the dry seasons were found to have the highest abundance (0.44 dolphins per linear km) compared to the wet seasons (0.29 dolphins per linear km). Construction of the Farakka barrage significantly isolated the upstream and downstream migration of dolphins in the main river channel. The study also confirmed that freshwater dolphins mainly inhabited river confluences, or tributary junctions, and river meanderings with prey-fish abundance.

Fig. 364. Dolphin sighting at Dumri ghat, Sonbarsah, Dist-Khagaria, Bihar

A dolphin availability survey was also conducted by the CIFRI-NMCG team at Khandua, Lalgola, West Bengal, during the period. It is reported that dolphin sightings in the area are common throughout the year. Both adults and juveniles are available in the region, with numbers greater than 25. Regular sightings of 8–10 per hour is very common in this area. A mass awareness campaign on the conservation of Gangetic dolphins was conducted in the area, and the local fishermen were highlighted about the importance of the biodiversity aspects of the river Ganga. In Perlalpur, Gangetic dolphin sightings are very common and frequent. 33 adult and juvenile Gangetic dolphins are frequently observed up to Nimtita (Bangladesh border), Murshidabad, West Bengal.

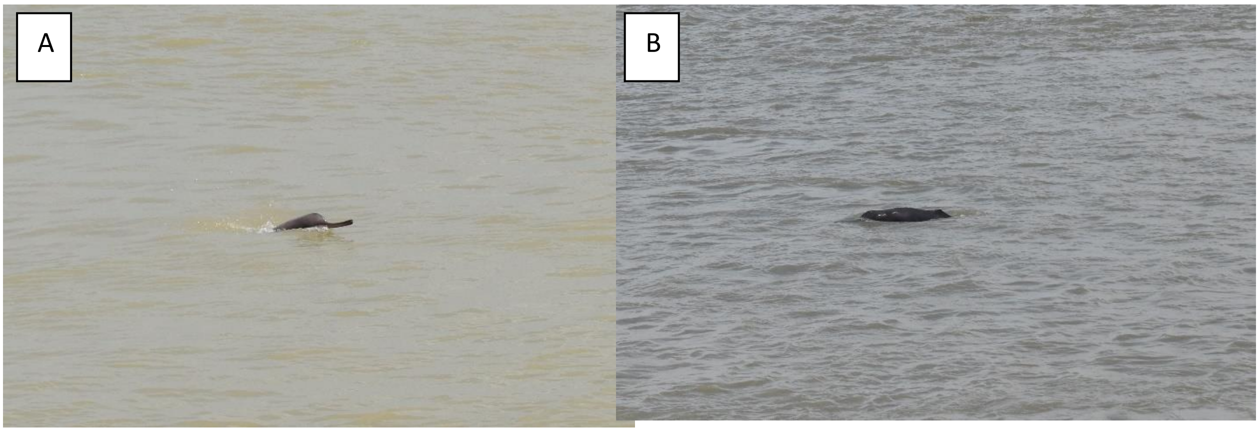

Fig. 365 (A-B) Gangetic Dolphin Sighting at Godakhali and Farakka, West Bengal

36.2. Dolphin conservation activities under the project

As a part of its impact on dolphin conservation, the CIFRI team handed over the dead dolphin to the forest department and state fisheries department as per the directive from the NMCG, New Delhi, during March 2022. In a separate activity, CIFRI team members of the NMCG project also rescued an entangled juvenile dolphin and released it back into the river at Farakka. A dead dolphin was also reported at Dui Paisa Ghat, Barrackpore, on May 20, 2021, by a local fisherman and handed over to the District Forest Officer, Barasat, North 24th Parganas, for postmortem. Another dolphin was rescued at Balagarh, Hooghly, by a local fisherman caught unintentionally in a monofilament disco net used for hilsa fishing. Later, the dolphin was released in live condition into the Baghirathi River. Earlier, three dead dolphins were reported during the year 2021 at Farakka (n = 2) and Godakhali (n = 1) by local fishermen. Another dolphin was rescued at Balagarh, Hooghly district, in West Bengal, by local fishermen after being caught accidently in a monofilament gill net used for hilsa fishing. Later, the dolphin was released in live condition into the Bhagirathi River. The local fishermen were also requested to report dead dolphins and take necessary action for rescue operations.

Fig. 366. Dolphin conservation related activities in different sites of river Ganga

Fig. 367. Rescue operation and release of Dolphin at Farakka, West Bengal by team CIFRI-NMCG during March, 2022

36.3. Celebration of 'National Dolphin Day'

The ICAR-Central Inland Fisheries Research Institute commemorated 'National Dolphin Day' on October 5, 2022, at four different places, namely Farakka, Nabadwip, Tribeni, and Balagarh, on the bank of the Ganga under the Namami Gange flagship project. On this occasion, more than 200 personnel, including active fishers, social activities, and students residing on the banks of the river, participated and were aware of the day. Exhibitions related to conservation have also been initiated by CIFRI on various platforms, where many school students, fishermen, and commoners were educated and informed about the need for dolphins in the Ganga.

Fig. 368 Celebration of 'World Dolphin Day' by ICAR-CIFRI on 5th October 2020

Fig. 369 Celebration of National Dolphin Day 2022 at Balagarh, West Bengal

Fig. 370 Celebration of National Dolphin Day 2022 at Farakka, West Bengal

36.4. Awareness programmes

The Ganges Dolphin is considered the reflector of the Ganga River's health; therefore, the National Ganga River Basin Authority (NGRBA) declared the Ganges River Dolphin as the National Aquatic Animal of India in 2009. The main reason for the declaration was to save the animal from extinction in the ecosystem. The population of river dolphins is declining at a high rate, and the possible reasons are pollution, damming of rivers for irrigation, destructive fishing activities, and electricity generation, which degrades habitat and isolates the populations of dolphins as well as preventing seasonal migration in the river system. The river dolphins are vulnerable to accidental entanglement in monofilament gillnets, which causes mortality.

A total of 389 awareness programs were conducted by ICAR-CIFRI under the Namami Gange program during the years 2020–2023, respectively, covering states like Uttar Pradesh, Jharkhand, Bihar, and West Bengal towards the conservation of Gangetic River dolphins at different ghats of the Ganga River. More than 13,000 local people, including fishers, were sensitized about the importance of dolphins as a national aquatic animal and not to harm their habitat on the Ganga River stretch, as well as the way fishers can contribute to conservation through their active participation and involvement. The list of awareness campaigns conducted for the period 2020–2023 is depicted in Table 35.

Table 35. List of awareness programs conducted for conservation of dolphins in different states at various places on the bank of the Ganga

Sl. No.	**Year (Duration)**	**Total nos. of awareness programme conducted**	**Nos. of Participated fishermen**
1.	Nov 2020 to Oct, 2021	98	3,149
2.	Nov 2021 to Oct, 2022	134	8,326
3.	Nov 2022 to Oct, 2023	157	2,469
	Total	**389**	**13,944**

Fig. 371. Awareness programme on the conservation of Dolphin conducted by ICAR-CIFRI under NMCG project during the period 2020-2023

36.5. Programmes on dolphin conservation

Several steps were taken by ICAR-CIFRI towards holistic conservation of Gangetic dolphins through different awareness programs, workshops, exhibitions, outreach activities, and conducting webinars online. Different participatory approaches, like the celebration of ‘World Dolphin Day’ and a webinar on International Freshwater Dolphin Day, were also organized to create awareness among stakeholders. A webinar focusing on "Community Participation in the Conservation of River Dolphin" was organized by ICAR-Central Inland Fisheries Research Institute with collaboration with NMCG (National Mission for Clean Ganga), IFSI (Inland Fisheries Society of India), and PFGF (Professional Fisheries Graduates Forum) to celebrate ‘International Freshwater Dolphin Day’ on November 24, 2020. The webinar was attended by participants from India, Bangladesh, Indonesia, Myanmar, and Nepal. The successful case studies on the conservation of Ganga River dolphins, Indus River dolphins, and Irrawady River dolphins were presented by invitees on the webinar to outline the future roadmap for dolphin conservation in the Ganga.

Fig. 372 Webinar on International Freshwater Dolphin Day on 24th November, 2020

A two-day workshop was organized by ICAR-CIFRI at Barrackpore under the NMCG project from February 23rd to February 24th , 2021. Awareness was also created among fishermen regarding dolphin conservation and the importance of the dolphin as a national aquatic animal of the Ganga.

Fig. 373 (A-D) Awareness programme of Ganga fishermen on 23rd to 24th February 2021

37. SURVEY ON SOCIO-ECONOMIC STATUS OF FISHERS IN BALLIA, UTTAR PRADESH

A survey was conducted in four different villages (Sarai Kota, Kali Ghat, Paschim tola, Nasirpurmath and Narwatpur) of Balliadistrict, Uttar Pradesh during the period. A total of 110 fishermen were surveyed to assess the socio-economic status of the fishermen. Daily fishing at river Ganga was found to be the primary livelihood assessed for all the fishermen in the area. The population involved in fishing in the region ws found to be dominated by Other Backward Class (OBC) community. As estimated from the present survey, 97% of the fishermen populations involved in riverine fisheries activities were found to be literate in nature while only 3% of the populations were illiterate. The average age of the population directly involved in fishing activities were found to be 47 while it ranged from 18-75. The dominant group of fishers in the area was recorded between 35-55. A wide variety of fishing gears were recorded from the region with dominant being Gill net with mesh size varying from 8-60 mm. Besides gill net, fishing with hook and line was also found to be prevalent in the area mainly targeting fishes like *Rita rita*, *Wallago attu*, *Cyprinus carpio*, etc. The cost range of fishing nets vary from Rs. 1000-3000 depending upon the quality. The average annual repair cost of the nets lies between Rs.500-1000. The average fishing hours devoted by the fishermen is 6 hrs per day. The fish catch during lean, medium and peak months remain 2-11 kg/day, 2-15 kg/day and 2-10 kg/day respectively. Rampant operation of destructive fishing gears like zero meshed net and shooting net is also recorded. Hand boats without motors were found to be the most prevalent fishing crafts used in the area. The annual incomes of fishers in the stretch were found to be in between Rs. 15,000-25,000. Alternative livelihhod was also recorded for the fishermen during lean fishing period with labour and masonry works.

Fig. 374 Socio-economic survey at Ballia, Uttar Pradesh

38.Meeting held with Fishery officers and dignitaries of co-operative society

38.1. Bihar

A Meeting was held with officials of Dept. of Fisheries, members of *Gangetic Fishermen's Co-operative Society*, Sahibganj and local fishermen of Sahibganj and Bhagalpur, Bihar on 15th June 2022. They provided the possible sources for collecting the information regarding the Hilsa fishery and published a noticed from district office of Sahibganj regarding "Sensitization program on Hilsa & Gangetic Dolphin Conservation during 15th -18th June 2022". DFO also informed about two fishermen who caught juvenile Hilsa (25-50 gm) in a few numbers (5-7 pcs) within 3 to 4 days from Sahibganj. Another meeting was held with Co-operative society and Panchayat Pradhan at Kurshela, Bihar on 16th June 2022.

Fig. 375 Sensitization programme in the presence of DFO & FEO of Sahibganj, Jharkhand

38. Dolphin rescue operation

As a part of the impact on dolphin conservation, the CIFRI team handed over the dead dolphin to the forest department and state fisheries department as per the directive from the NMCG, New Delhi, during March 2022. In a separate activity, CIFRI team members of the NMCG project also rescued an entangled juvenile dolphin and released it back into the river at Farakka. A dead dolphin was also reported at Dui Paisa Ghat, Barrackpore, on May 20, 2021, by a local fisherman and handed over to the District Forest Officer, Barasat, North 24th Parganas, for a postmortem. Another dolphin was rescued at Balagarh, Hooghly, by a local fisherman caught unintentionally in a monofilament disco net used for hilsa fishing. Later, the dolphin was released in live condition in the Baghirathi River. Earlier, three dead dolphins were reported during the year 2021 at Farakka (n = 2) and Godakhali (n = 1) by local fishermen. Another dolphin was rescued at Balagarh, Hooghly district, in West Bengal, by a local fisherman after being caught accidentally in a monofilament gill net used for hilsa fishing. Later, the dolphin was released in live condition in the Bhagirathi River. The local fishermen were also requested to report on dead dolphins and take the necessary action for rescue operations.

Fig. 376 Rescue operation and release of dolphins at Farakka, West Bengal, by team CIFRI-NMCG during March 2022

Fig. 377. Measurement of dead Dolphin at Farakka, West Bengal

Fig. 378 Dead Dolphin reported at *Dui Paisa Ghat*, Barrackpore, West Bengal, on May 20, 2021

Fig. 379 Incidental killing of dolphin by monofilament gill at Godakhali, West Bengal

39. Impact of awareness programmes on Hilsa and Dolphin

After the celebration of last year's Dolphin Day, 2021, the people from West Bengal, Bihar, and Jharkhand became aware of Hilsa and Dolphin. ICAR- CIFRI performed the whole awareness programme on Hilsa and Dolphin at West Bengal, Jharkhand, and Bihar in component II (227 fishermen participated). Some fishermen over telephoned informed from the lower stretches of Ganga that they released natural or accidental Dolphin in the River with a document to the NMCG-CIFRI, Barrackpore, Headquarter and few numbers of incidences are as shown in the Table 36.

Table 36. Impact of awareness program on Hilsa and Dolphin

Sl No.	Duration	Places	Description	Cause of Death	Action taken
			Hilsa		
1	May-June, 2022	Farakka to Bihar	1921 nos. of juvenile Hilsa	Netting	Fishermen informed to CIFRI about the juvenile Hilsa they are getting after 35 years in Sahebgunj 92 km. above Farakka Barrage, Rajmahal (43.2 km)
2	June, 2022	Farakka to Bihar	Adult Hilsa (300-400g)	Netting	In Kurshela, Bihar some fishermen were informed that they got adult Hilsa after long years
3	November and December, 2022	Farakka and adjacent places	Weight- 24g to 200g	No death, released into natural sources	25 nos. of tagged Hilsa information got from Fishermen
4	April, 2022	Rajmahal, Jharkhand	Weight-171g Length- 26.7cm	No death, releasedin to natural sources	Fishermen informed to CIFRI about the tagged Hilsa
			Dolphin		
5	March, 2022	Gandhi ghat, Farakka, WB	Length- 9.2 ft Weight- 133.15 kg	Netting	The CIFRI team handed over the dead dolphin to the forest department and State fisheries department as per the directive from the NMCG, New Delhi.
6	September, 2022	Gumani ghat, Farakka, WB	Length: 2.11 ft and weight: 25 kg	Alive but entangled with net	Fishermen informed to CIFRI, and the team members of NMCG project rescued, entangled the juvenile Dolphin and released back into the river

40. Special Day Celebration/Important events/Exhibition/Workshop

Period 2020-21

40.1. Ganga Utsav Celebration-2020

On the eve of Ganga Utsav 2021 initiated by National Mission of Clean Ganga (NMCG), ICAR-Central Inland Fisheries Research Institute, Barrackpore fervently celebrated the event from 2nd to 4th November, 2021. The three day long occasion was launched by decorating through colorful rangoli depicting Ganga and its rich biodiversity. The inaugural programme session of the Ganga Utsav was commenced by Dr. Basanta Kumar Das, the PI and Director ICAR-CIFRI, along with the Chief Guest Mr. Dhrubajyoti Dey, IPS, Joint Commissioner of Police (Barrackpore Police Commisionerate). Ranching of more than 300 number prized Hilsa (*T.ilisha*) was also conducted in upstream of Farakka stretch of river Ganga in this occasion. On the other hand, tagging of 98 numbers of Hilsa species was also carried out to examine its migratory pattern. In the 2nd day programme, a cultural event was organized in the CIFRI campus involving participants from the institute. On the 3rd day of the event, after a blissful *Ganga Arati* (ritual of offering prayer to the Ganges river), carp ranching was organized at Gandhi Ghat, Barrackpore. A total of 50,000 number of fishes combining fingerling and advanced fingerling of Rohu, Catla and Mrigal were released in the river. A painting competition was also organized on the occasion after the ranching programme. School students, research scholar and staff of the institute participated in it. The theme of the painting competition was to visualize Nirmal Ganga to spread awareness among the people.

Fig. 380a *Ganga Arati* at Gandhi Ghat, Barrackpore

Fig. 380b Ranching of IMC fingerlings at Gandhi Ghat, Barrackpore

Fig. 380c Cultural Programme at ICAR-CIFRI

Fig. 380d Cultural Programme at ICAR-CIFRI

Fig. 380 a-d Different activities during Ganga Utsav, 2020

Period 2021-22

40.2. ICAR-CIFRI Bagged 1st prize at Kultoli, Sundarban, West Bengal

ICAR-CIFRI, Barrackpore has participated in the "25th Sundarban Krishti Mela O Loko Sanskriti Utsab" and bagged 1st prize under the NMCG project entitled 'Fish Stock Enhancement including Hilsa and Livelihood Improvement for Sustainable Fisheries and Conservation in River Ganga', from 28th January to 6th February 2022 at Kultoli, Sundarban, West Bengal. Dr. Basanta Kumar Das, Director, ICAR-CIFRI visited the programme and received 'Lifetime Achievement Award' on 4th February 2022. He deliberated a speech on "Impact of COVID on Ganga River fisheries and created awareness among the local people including fishers and other stakeholders towards the conservation of indigenous fishes, hilsa and dolphin in river Ganga". He also shared the activities regarding various inputs from CIFRI to 500 beneficiaries in post COVID situation. 'National Mission for Clean Ganga' pavilion showcasing different ongoing activities of the project, Ganga fish and fisheries related books, pamphlets, leaflets, fishing gears, posters etc., under the programme 'NAMAMI GANGE'. The Pavilion included various publications of NMCG describing overall activities by NMCG to make the river Ganga clean. The exhibition witnessed the participation of several local dignitaries, school students and local people including fishermen communities. A special radio talk regarding ongoing activities under the NMCG project was covered by Akash Vani on 28th January and on 2nd February, the radio talk was covered by All India Radio and Doordarshan. Around 1200 to 1500 visitors were observed per day in the NMCG pavilion. Visitors like school students, academicians, researchers, and fishers were enlightened about the present threats to fish diversity and ways of sustainable management as well as Hilsa and dolphin conservation.

Fig. 381a Dr. B. K. Das, Director, ICAR-CIFRI

Fig. 381b Dr. B. K. Das, Director, ICAR-

received ‘Life Time Achievement Award’ on 4th February 2022

CIFRI delivered speech on Impact of COVID on Ganga River fisheries

Fig. 381c Visitors at NMCG pavilion at Kultoli, South 24 Pgs, West Bengal.

Fig. 381d ICAR CIFRI-NMCG team bagged 1st prize in 25th Sundarban Krishti Mela O Loko Sanskriti Utsab Kultoli, Sundarban, West Bengal

Fig. 381 (a-d). ICAR-NMCG Team pavilion at 25th Sunderban Mela, 2022

40.3. CIFRI-NMCG exhibition pavillion in Magh Mela, Prayagraj, Uttar Pradesh

An NMCG exhibition pavillion was organized by ICAR-CIFRI in Magh Mela 2022 at Praygraj, Uttar Pradesh. The exhibition started on 01st February 2022 and continued till 01 March 2022. Several posters viz. Fishes of River Ganga, Exotic fishes of River Ganga, River ranching, Mahseer conservation, leaflets, pamphlets, and Fish specimens are displayed at the stall to aware people about the CIFRI activities conducted under the NMCG project. Near about 300000, pilgrims, priests, students, local people, etc. visited the stall and they were sensitized about the Ranching of IMC, biodiversity and its conservation aspects. The fish specimen and aquarium are the main attraction for the visitors. Several special guests viz. Dr.

P. K. Sahoo (Principal Scientist, Division of Agriculture Engineering, ICAR-IARI, Pusa, New Delhi) visited the stall on date 08-02-2022, Mr. R. N. Mishra (IPS, SSP Pryagrajmagh mela 2022) visited the stall on date 17-02-2022 and appreciated the work of CIFRI.

On the occasion of '***Mahashivratri*** (01/03/2022)', the last bathing festival of Magh mela, Mr. Ramesh Chandra (DFO, Prayagraj), Mr. Lal Bahadur (MLA, Manjhanpur, Kaushambi), Acharya Shantanu Ji maharaj and Mr. Laxmikant Mishra (Magh mela Authority) visited the stall and appraised the work of CIFRI towards IMC and Mahseer conservation.

A

B

C

D

E F

G H

Fig. 382 (A-H) Glimpses of ICAR CIFRI-NMCG pavilion at Magh Mela 2022, Prayagraj, U.P

40.4. NMCG Exhibition on the conference of 1st Indian Fisheries Outlook 2022

NMCG Exhibition was showcased by the NMCG team, ICAR-CIFRI, Barrackpore to display the different posters related to different ongoing activities of river Ganga under the NMCG project with an emphasis on fish and fisheries and hilsa conservation in the pavilion on the conference of 1st Indian Fisheries Outlook 2022 at Headquarter of CIFRI, Barrackpore from 22nd March to 24th March 2022. Eminent dignitaries visited the exhibition and expressed their satisfaction remark after going through 'highly informative' posters and publications related to River Ganga. In this programme, per day approximately 300 numbers of fishers, students, researchers and other stakeholders visited, and awareness is given to NMCG activities.

Fig. 383 (A-D) NMCG Exhibition on the conference of 1st Indian Fisheries Outlook 2022

40.5. NMCG Exhibition on the 25th National Exhibition, Kolkata (24th to 27th, August 2022)

NMCG Exhibition was showcased by the NMCG team, ICAR-CIFRI, Barrackpore to display the different posters related to different ongoing activities of river Ganga under the NMCG project with an emphasis of fish and fisheries and hilsa conservation in the pavilion on 25th

National Exhibition, Kolkata 2022 at Central Park, Salt lake, Kolkata from 24th to 27th August 2022. The exhibition pavilion was visited by several school students, local people and eminent dignitaries and expressed their satisfaction remark after going through 'highly informative' posters and publications related to River Ganga. In this programme, more than 100 numbers of students, researchers, local people, and other stakeholders visited and were sensitized about the ongoing CIFRI-NMCG activities.

Fig. 384 ICAR- CIFRI NMCG pavillion at 25th National Exhibition, 2022 at Kolkata

40.6. Satellite symposium on Hilsa Dialogue: A Bay of Bengal (BoB) Perspective

A Satellite symposium on Hilsa Dialogue: A Bay of Bengal (BoB) prospective was conducted by 1stIndian Fisheries Outlook, ICAR-CIFRI on 23rd March 2022 to connect the fisheries experts from India, Bangladesh, Myanmar, Norway and other countries. Several organizationslike NMCG, ICAR-CIFRI, WorldFish (Bangladesh), WorldFish (Myanmar): KANAKVA, (Norway); BoB, (India); BFRI, (Bangladesh) was present in both offline and online modes. The symposium was graced by Dr, B. K. Das, Director, ICAR- CIFRI, Kolkata, Prof. Abdul Wahab, Advisor, (WorldFish), Bangladesh, Dr. Michael Akester, Country Director (WorldFish), Myanmar, Dr. Atle Mortensen, KANAKVA, Norway, Dr. P. Krishnan, Director Bay of Bengal Project, India, Dr. Anisur Rahman, Director BFRI, Bangladesh, Dr. B.P. Mohanty, Assistant Director General (Fishery Science), ICAR, New Delhi, India, Dr. Md. Jalilur Rahman, Scientist (Ecofish II) WorldFish, Bangladesh, Prof. Ashim Kumar Nath, Professor of Zoology, SidhoKanho University, Dr. Arnab Biswas, MD, Director, Alo Eye Hospital, Kolkata, Dr. Dilip Kumar, Ex. Director , ICAR-CIFRI, Dr. K.K. Vass, Ex. Director , ICAR-CIFRI, Dr. S. Samanta, ICAR-CIFRI, Dr. A. K. Sahoo, ICAR-CIFRI, Dr. R. K. Manna, ICAR-CIFRI, Dr. D.K. Meena, ICAR-CIFRI, delegates and research scholars of ICAR-CIFRI. A poster session on Hilsa fishers was deliberated by scientists and research scholars along with 19 different abstracts were added in the abstract book.

Fig. 385 Satellite symposium on Hilsa Dialogue: A BoB perspective at ICAR-CIFRI, Barrackpore

40.7. Celebration of National Dolphin Day- 2022

Healthy aquatic environments contribute to the planet's overall well-being. Dolphin conservation would therefore help ensure the survival of the species and the humans who depend on the aquatic ecosystem for their way of life. Dolphins are the ideal ecological markers of a healthy aquatic ecosystem. On August 15, 2020, "Project Dolphin" was launched by the honourable Prime Minister Narendra Modi to include both river dolphins and marine dolphins in its conservation program. Because of the significance of dolphins, Environment Minister Bhupendra Yadav declared October 5th as "National Dolphin Day", to be observed annually to raise awareness for dolphin conservation. He announced while presiding over the 67th meeting of the Standing Committee of the National Board for Wildlife in New Delhi.To mark the day a significantly remarkable one, ICAR-Central Inland Fisheries Research Institute commemorated 'National Dolphin Day' on 5th October 2022 at four different places namely Farakka, Nabadwip, Tribeni, and Balagarh on the bank of river Ganga under NMCG-II flagship project. On this occasion, more than 200 personnel including active fishers, social activities, and students residing on the banks of the river participated and were aware of the day. Dr. Basanta Kumar Das, Director of ICAR-CIFRI and Principal Investigator of the NMCG project, informed us in the conveying message that India's waters are home to about 30 species of marine mammals, including river dolphins. The Gangetic River dolphin (*Platanista gangetica*) lives only in the Ganga-Brahmaputra systems, while the

Indus River dolphin (*Platanista minor*) is only found in the Indus system, which includes the Sutlej, Ravi, and Beas rivers. He also emphasised the Gangetic dolphin's importance as an indicator species for the Ganga ecosystem, whose vulnerability to changes in water quality and flow offers information on the general condition of the ecosystem and other species in that ecosystem. The International Union for Conservation of Nature's Red List lists it as endangered. Recent data (2017-18) shows that the estimated Ganges River dolphin in the Ganga River basin, along with tributaries, stands around 2644, and in the Brahmaputra, along with its tributaries, stands at 987. “Due to multiple threats, including pollution, water diversion, habitat fragmentation, and bycatch, the Ganges River dolphin is seriously threatened.

Dolphins in India face numerous challenges, so spreading knowledge about them is crucial, Locals have been made aware of various river conservation measures through the awareness and sensitization programme, such as refraining from using pesticides on agricultural and horticultural lands along the river, reforestation of the riverbank to prevent bank erosion, refraining from discarding plastic and other trash in the river, releasing enough water from dams and barrages, maintaining riverine biodiversity using scientific fishing gears, and more. This is the stated goal of the recently established **"National Dolphin Day."**

Fig. 386 Celebration of National Dolphin Day 2022 at Balagarh, West Bengal

Fig. 387 Celebration of National Dolphin Day 2022 at Farakka, West Bengal

ICAR-Central Inland Fisheries Research Institute commemorated 'National Dolphin Day' on October 5, 2023, at Sheorapally Ghat on the bank of the river Hooghly and at Farakka Taltala Ghat in river Ganga under the Namami Gange Program. On this occasion, more than 100 personnel, including active fishermen, social activities, and students residing on the banks of the river, participated and were aware of the day.

Fig. 388 Celebration of National Dolphin Day 2023 at Barrackpore and Farakka, West Bengal

Period 2022-23

40.8. Two-day National Seminar Organized by ICAR-CIFRI, Prayagraj

A two-day National Seminar on “Ecology Vs Economic Development with special reference to Ganga Basin (NEED-2023)” was organized jointly by ICAR-CIFRI and Nehru Gram Bharti Deemed to be University (NGBU), Prayagraj, Uttar Pradesh from 25th to 26th February 2023. The Inaugural session of the program was held at NGBU, Prayagraj. Dr. Dilip Kumar, Adviser (FAO) and former Vice Chancellor ICAR-CIFE, Mumbai was the chief guest of the Program. Prof. S. K. Srivastava, Vice-chancellor, of the university highlighted the importance of ecosystem management in his presidential address.The concluding session of the program was held at ICAR-CIFRI, Prayagraj on 26th February 2023. The event was graced by eminent scientists and professors like Dr. S. C. Tiwari (Pro-VC, NGBU), Prof. Prakash Nautiyal, HOD zoology department, Garhwal University Srinagar, Dr. Sandeep Behera (Sr. Consultant, NMCG),Prof. R. S. Verma, Director, MNNIT & IIIT, Prayagraj, and Dr. K.D. Joshi, Former Head, ICAR-CIFRI.

Fig. 389 National Seminar at Prayagraj, Uttar Pradesh (25.02.2023 to 26.02.2023)

40.9. One-day exhibition at ICAR-CIFRI

The NMCG team of ICAR-CIFRI, Barrackpore, conducted a mass sensitization of students from different local schools of Barrackpore on 17 March 2023 on the occasion of the 77 foundation day of the glorious institute. The NMCG pavilion demonstrated the present activities, Ganga cleanliness, and overall sustainable fisheries of the river. The pavilion was also attended by Hon'ble Secretary, Sri Avanindra Singh (IAS), Department of Fisheries, Govt. of West Bengal, several students, scholars, and local people.


Fig. 390 School students visiting the NMCG pavilion on the occasion of the 77th ICAR-CIFRI foundation day (17.03.2023)

Fig. 391 Visit of Hon'ble Secretary, Sri Avanindra Singh (IAS), Department of Fisheries, Govt. of West Bengal

41. Workshop and special programme

One day workshop was organized at ICAR-Central Inland Fisheries Research Institute (CIFRI), Barrackpore on '*'Stakeholder Consultation on Fish conservation and Ranching*'' under NamamiGangeprogramme on 26 September 2023. The workshop was conducted to address on the accomplishment of the three-year project completion. Dr. Basanta Kumar Das, Director of CIFRI addressed the meeting and presented a brief outcome of the project. Dr. B. K. Das highlighted the mission mode ranching and effforts taken up by the CIFRI under NamamiGange project under which more than 65 lakhs of fish fingerlings were released during the period 2020-23.ICAR-CIFRI under NamamiGangeprogramme could generate huge database on fisheries and ecology. Information pertaining to the pollution and tributaries were also registered by CIFRI under NMCG.The meeting was attended by Dr. Sandeep Kumar Behera, Senior Consultant (Biodiversity) from NamamiGange (Ministry of Jal Shakti), New Delhi. Representative from West Bengal State Fisheries DepartmentMrs. A. S.Alvi, DDF, Kolkata and Central Zone, Mr. Rajdeep Mukherjee, Policy analyst, Bay of Bengal Programme (BoBP-IGO), Mr. Surya Prasad Sharma and MrGoura Chandra Das from Wildlife Institute of India, Dehradun, and eminent professors of fisheries science like Dr. S. K. Das, Dr. R.K. Trivedi from West Bengal University of Animal and Fisheries Sciences also graced the programme and shared their valuable inputs.

Fishermen from local community was also present in the meeting and shared their issues with the CIFRI authority. The main issues raised were poisoning and use of small mesh sized fishing nets. Mrs A. S. Alvi also asked the fishermen to address their issues directly to the

State Fisheries Department for their wellbeing. Finally, the workshop was ended up with in synergy between CIFRI and NamamiGange, New Delhi.

Fig. 392. Workshop on *'Stakeholder Consultation on Fish conservation and Ranching*'' at ICAR-CIFRI on 26 September 2023

Fig. 393 Workshop on *'Stakeholder Consultation on Fish conservation and Ranching*'' at ICAR-CIFRI on 26 September 2023

A workshop under NMCG project on "*Stakeholders consultation cum consultative workshop on Hilsa fisheries improvement for sustainable fisheries and conservation in river Ganga*" was organized at ICAR-CIFRI, Barrackpore on 27September 2023. Dr. Basanta Kumar Das, Director, ICAR-CIFRI in his opening remarks highlighted the importance of the hilsa and dolphin conservation in the river Ganga and the scientific interventions taken up by ICAR-CIFRI since 2018. Dr. Sandeep Kumar Behera, Consultant, National Mission for Clean Ganga (NMCG), Mr. Rajdeep Mukherjee, Policy analyst, Bay of Bengal Programme (BoBP-IGO), Mr. G. C. Das, Wild Life Institute of India (WII), Dr. D.K. Dey, Retired Principal Scientist of ICAR-CIFRI, Dr. U. Bhowmik, Retired Principal Scientist & Former HoD of REF Division, ICAR-CIFRI, Dr. Subrata Dasgupta, Retd. Principal Scientist of ICAR-CIFE, Dr. Ashim Kumar Nath, Professor, Department of Zoology, SBKU University, Prof. Sudhir Kumar Das, WBUAFS, and Dr. Gayatri Tripathi, Principal Scientist, ICAR-CIFE were graced the occasion as expert members. Dr. Sandeep Behera in his opening remarks highlighted the importance of the Hilsa fisheries improvement programme carried out by ICAR-CIFRI since 2018. He updated the status of fish locks operation in Farakka barrage and believed that the fish locks will provide the additional support towards upstream hilsa migration in the river Ganga. Dr. B. K. Das, Director, ICAR-CIFRIoutlined the workshop with a brief presentation of the work carried out under NMCG Hilsa Project (Component II) for last 3 years. In the presentation, he highlighted the project's objectives, significant activities and achievements under the project.Dr. Das explained that more than 90,000 of adult Hilsa were ranched at the upstream of Farakka barrage with an aim to enhance the Hilsa stockin the middle stretch of the river Ganga. He also briefed about the Hilsa ranching procedure, tagging methods employed and their recovery in the upstream. Besides adult Hilsa, egg and spawns were also ranched into the river for increasing the juvenile availability and the impact of ranching on hilsa population was also presented. Dr. B.K. Das also presented the pilot-scale experiments conducted under the project for captive breeding and rearing of Hilsa. Issues and challenges related to the restoration and conservation of Hilsa in river Ganga and their captive rearing was also addressed.

Fig. 394 Workshop on *'Stakeholders consultation cum consultative workshop on Hilsa fisheries improvement for sustainable fisheries and conservation in river Ganga*' at ICAR-CIFRI on 27 September 2023

42. Media coverage

A prolific widespread of NMCG activities and findings was disseminated through several media platforms such as print media, social media and electronic media during the period 2020-23. The detail breakup of thepublished media in different platforms are presented in Table 37 . The print media has been published in different regional languages like Bengali, Hindi including English during the period 2020-23 (Fig 144).

Table 37. Classification of different media published during the period (2020-23)

Year	Printmedia	Socialmedia	Electronicmedia
2020-21	43	6	20
2021-22	54	22	12
2022-23	66	12	17

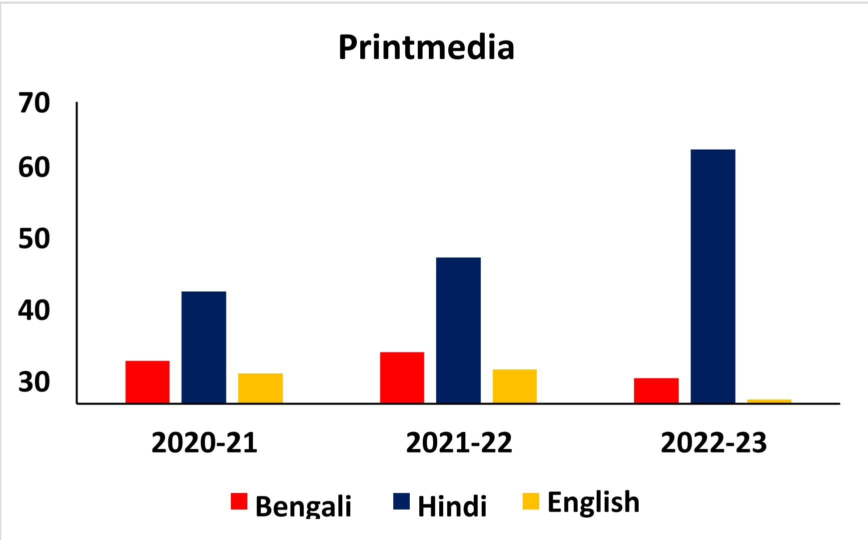

Fig. 395. Year wise break up of the media published

42.1 Print Media

1. Success story of ICAR-CIFRI bagged 1st prize at Kultoli coverage by Dainik Dabang Dunia in edition of Delhi, Mumbai, Jabalpur, Ranchi, Lucknow, Jaipur, Pune, Gwalior and Indore, 12th February 2022.
2. Thirty thousand fish seeds released in Ganga on the occasion of 76th Foundation Day of ICAR-CIFRI, United Bharat newspaper, dated 18.03.2022.
3. Thirty thousand fish seeds released in Ganga on the occasion of 76th Foundation Day of ICAR-CIFRI, Allahabad express dated 18.03.2022.
4. ICAR-CIFRI released ten thousand fish seeds in river Ganga at Prayagraj, Dainik Jagran, dated 29.03.2022.
5. Innovative approaches by ICAR-CIFRI for Dolphin conservation coverage by Dabang Dunia 27thApril 2022.
6. Artificial breeding and juvenile Hilsa ranching coverage by Bartaman patrika on 30thApril 2022.
7. National Ranching Programme' coverage by Times News Network on 15.05.2022
8. National Ranching Programme' coverage by Times of India on 15.05.2022
9. National Ranching Programme' coverage by Dainik Jagran on 15.05.2022
10. National Ranching Programme' coverage by Dainik Jagran on 18.05.2022
11. National Ranching Programme' coverage by Allahabad Express on 18.05.2022
12. National Ranching Programme' coverage by Chetna Samachar on 18.05.2022
13. National Ranching Programme' coverage by Amrit Vichar on 18.05.2022
14. 'National Ranching Programme' coverage by Awadhnama on 18.05.2022
15. National Ranching Programme' coverage by Shilpaneer news on 26.05.2022
16. National Ranching Programme' coverage by Times of India on 03.06.2022
17. National Ranching Programme' coverage by Sanbad Pratidin Patrika on 26.05.2022
18. National Ranching Programme' coverage byAnandabazarPatrika on 26.05.2022
19. Ganga fish diversity coverage by Times of India on 01.06.2022 (https://timesofindia.indiatimes.com/city/kolkata/west-bengal-endangered-Hilsa-kajri-vacha-back-fish-diversity-up-in-ganga/articleshow/91928722.cms
20. Endangered Hilsa, Kajri, Vachaback, fish diversity up in Gangacoverage by Times of India on 01.06.2022(https://timesofindia.indiatimes.com/india/fish-diversity-in-ganga-up-36-in-10 years/articleshow/91927210.cms)
21. National Ranching Programme' coverage by Dainik Jagran, Bhagalpur on 03.06.2022
22. 'National Ranching Programme' coverage by Prabhat Khabar, on 03.06.2022

23. 'National Ranching Programme' Dakshineswar coverage by Times of India on 03.06.2022
24. 'National Ranching Programme' coverage by Dainik Bhaskar, 03.06.2022
25. 'National Ranching Programme' coverage by DainikJagran, 03.06.2022
26. 'National Ranching Programme' coverage by Dainik Jagran, Patna on 04.06.2022
27. 'National Ranching Programme' coverage by Sanmarg on 04.06.2022
28. 'National Ranching Programme' coverage by Hindustan on 04.06.2022
29. 'National Ranching Programme' coverage by Dabang Dunia on 05.06.2022
30. *Namami Gange*: holistic conservation and rejuvenation of river Ganga, coverage by Employment News on 10.06.2022
31. Awareness of fishermen coverage by Sanmarg, 15.06.2022
32. Hilsa ranching coverage by Pravat Barta, 16.06.2022
33. Awareness of Hilsa and Dolphin coverage by Indian Punch, 16.06.2022
34. Hilsa awareness at Rajmahal coverage by The Hindustan,18.06.2022 (https://www.livehindustan.com/jharkhand/sahibganj/story-awareness-program-for-Hilsa-fish-conservation-6652727.html)
35. Restoration of indigenous fish stock in the Ganges coverage by Bartaman on 04.07.2022.
36. 56 lakh fish ranching coverage by The Print on 28·07.2022 (https://theprint.in/india/56-lakh-fish-seeds-released-in-ganga-govt/1059446/)
37. Declining of Hilsa catch due to overfishing coverage by Times of India on 27.07.2022(https://times of india.indiatimes.com/city/kolkata/decline-in-catch-due-to over-fishing-juvenile-netting-keep-Hilsa-pricehigh/articleshow/93149738.cms?UTM_Source=Google_Newsstand&UTM_Campaign=RSS_Feed&UTM_Medium=Referral)
38. Fish ranching coverage by Ek Sandesh live News, Sahibganj on 02.08.2022 (http://eksandeshlive.com/?p=5709)
39. Fish ranching coverage by Hindutanat, Sahibganj on 03.08.2022 (https://www.livehindustan.com/jharkhand/sahibganj/story-two-lakh-small-fishes-releases-in-the-ganges-river-6881180.html)
40. Fish ranching coverage by Jagran at Sahibganj on 03.08.2022 (https://www.jagran.com/jharkhand/sahibganj-district-residents-should-cooperate-in-maintaining-the-cleanliness-and-biodiversity-of-the-river 22949223.html?utm_source=referral&utm_medium=WA&utm_campaign=social_share)

41. World River Day programme celebration in ICAR-CIFRI, Prayagraj, Dainik Jagran, dated 26.09.2022.
42. Published in Hindi Daily ‘Dainik Bhaskar’ Title: Ganga cleanliness drive in school,dated:16.02.2023 (Bhagalpur, Bihar)
43. Published in Hindi Daily ‘Prabhat Khabar’ Title: Ganga cleanliness drive in school,dated:16.02.2023(Bhagalpur,Bihar)
44. Published in Hindi Daily ‘Dainik Bhaskar’Title:Ganga cleanliness drive in school, dated:18.02.2023(Munger,Bihar)
45. Published in Hindi Daily ‘Dainik Bhaskar’ Title: Ganga cleanliness drive in school, dated:18.02.2023(Munger,Bihar)
46. Published in Hindi Daily ‘Yuba Shakti’ Title:Release of hilsa seed by CIFRI in river Ganga, dated:18.02.2023(Sahibganj,Jharkhand)
47. Published in Hindi Daily ‘Awaz’ Title:Release of hilsa spawn by CIFRI in river Ganga,dated:18.02.2023(Sahibganj,Jharkhand).
48. Published in Hindi Daily ‘Desh Pradesh’ Title:Release of hilsa spawn by CIFRI in river Ganga,dated:18.02.2023(Sahibganj,Jharkhand)
49. Published in Bengali Daily ‘Durontobarta’ Title:Augmenting hilsa in Ganga,a CIFRI initiative,dated:22.02.2023(Kolkata,WestBengal)
50. Published in Bengali Daily ‘Bartaman’ Title: Release of 1.5 lahks of hilsa in Ganga,a CIFRI initiative,dated:22.02.2023(Kolkata,WestBengal)
51. Published in Hindi Daily ‘Dainik Jagran’ Title: Release fishes in river Ganga,dated:27.02.2023(Praygraj,WestBengal)
52. Published in Hindi Daily ‘Dainik Bhaskar’ Title: Release fishes in river Ganga,dated:27.02.2023 (Praygraj,WestBengal)
53. Published in Hindi Daily ‘Amar Ujala’ Title: Environment and conservation,dated:27.02.2023(Praygraj,WestBengal)
54. Published in Hindi Daily ‘Santhal Hool Express’ Title: Release of Hilsa spawn in river Ganga at Rajmahal,dated:25.03.2023
55. Published in Hindi Daily ‘Desh Pradesh’ Title:Release of 3.0lakh Hisa spawn in river Ganga at Rajmahal,dated:25.03.2023
56. Published in Hindi Daily ‘Awaz (Hindi),25.03.2023’ Title: Release of Hilsa will create an economic advantage to the fishers,dated:25.03.2023
57. Published in Hindi Daily ‘Jagran’ Title: Hilsa to be found in North Indian cuisine,dated:24.03.2023

58. Published in Hindi Daily ‘Dainik Bhaskar’ Title: Indication of water cleanliness through Hilsa availability,dated:07.03.2023
59. Published in Hindi Daily ‘Yuva jagran’ Title:Foreign species and their habitat in river Ganga,dated:06.03.2023
60. Published in Hindi Daily ‘Amar Ujala’ Title:River ranching of 30,000 fishes at Fatehpur,dated:03.04.2023
61. Published in Hindi Daily ‘Jagran’ Title:River ranching of 30,000 fishes at Fatehpur by CIFRI,dated:03.04.2023
62. Published in Hindi Daily Title: River ranching of 30,000 fishes at Fatehpur by CIFRI,dated:03.04.2023
63. Published in Hindi Daily ‘Dainik Jagran’ Title:Rise in fish stock through river ranching,dated:12.04.2023
64. Published in Hindi Daily ‘Amar Ujala’ Title: River ranching of 20,000 fishes at Mirzapur,dated:12.04.2023
65. Published in Hindi Daily ‘Dainik Jagran’ Title: River ranching at Atal Ghat, Kanpur,dated:18.04.2023
66. Published in Hindi Daily ‘Hindustan’ Title: River ranching of 2.12lakh fishes at Varanasi,dated:20.04.2023
67. Published in Hindi Daily ‘Dainik Bhaskar’ Title: Release of fingerlings at Varanasi,dated: 20.04.2023
68. Published in Hindi Daily ‘Ranbheri’ Title: River ranching of 2.12 lakh fishes at Varanasi,dated:20.04.2023
69. Published in Hindi Daily ‘SNB news’ Title: River ranching of 2.12 lakh fishes at,Varanasi,dated:20.04.2023
70. Published in Hindi Daily ‘Hindustan’ Title: River ranching of 2.12 lakh fishes at,Varanasi,dated:20.04.2023
71. Published in Hindi Daily ‘Janasandesh’ Title: River ranching of 2.12 lakh fishes at,Varanasi,dated:20.04.2023
72. Published in Hindi Daily ‘Shakuntimes’ Title: River ranching of 2.12 lakh fishes at,Varanasi,dated:20.04.2023
73. Published in Hindi Daily ‘Dainik Jagran’ Title: River ranching of 2.12 lakh fishes at,Varanasi,dated:20.04.2023
74. Published in Hindi Daily ‘Ananda Bazar Patrika’Title:River ranching of 2.12 lakh fishes at Nabadwip,dated:06.04.2023

75. Published in Bengali Daily ‘Ananda Bazar Patrika’ Title: River ranching of 2lakh fishes at,Farakka,dated:26.04.2023
76. Published in Hindi Daily ‘Awaz’ Title: River ranching at Sahibganj,dated:27.04.2023
77. Published in Hindi Daily ‘Santhal hool express’ Title:River ranching by Union Minister at Sahibganj,dated:27.04.2023
78. Published in ‘Kelanchal News’ Title:River ranching by Union Minister at Sahibganj dated 27.04.2023,Sahibganj
79. Published in ‘Pakur Punch’: River ranching by Union Minister at Sahibganj dated 27.04.2023,Sahibganj.
80. Published in ICAR-News’27.04.2023’Title: River ranching by Union Minister at Sahibganj
81. Published in Duronto Barta‘Title: ICAR-CIFRI ranches Indian Major Carps at Belur Math,Howrah dated:07.05.2023
82. Published in Kalinga Chronicle ‘Title: ICAR-CIFRI ranches Indian Major Carps at Bally,Howrah,West Bengaldated:08.05.2023
83. Published in Samaja ‘CIFRI releases 22 lakh juvenile under Namami Gange Plan’dated:09.05.2023
84. Published in Indian Punch ‘Women fishers of West Bengal takes part in river ranching’dated:11.05.2023
85. Published in Hidustan ‘Ranching of 2lakhs of Catla,Rohu,MrigalinriverGanga’dated:24.05.2023
86. PublishedinDainikBhaskar‘Ranchingof2lakhsinriverGanga’dated:24.05.2023
87. PublishedinDainikJagran‘Ranchingof2lakhsinriverGanga’dated:24.05.2023
88. PublishedinPrabhatKhabar‘Ranchingof2lakhsinriverGangaatKamarganj,Bhagalpur’dated: 24.05.2023
89. PublishedinPuberKolomNews‘Title:DolphinandHilsaconservationinitiativesbyCIFRI’,dated:06.06.2023
90. PublishedinSamvadNews‘Title:ICARCIFRIranches10thousandMahseeratDevprayag,dated:17.06.2023
91. PublishedinSaharaHindinews‘Title:Releaseof10,000MahseerfishinriverGanga’dated:18.06.2023
92. PublishedinDainikBhaskarnews‘Title:Releaseof2.0lakhfishinriverGangaatPatna’dated:01.07.2023
93. PublishedinHindustanNews‘Title:Releaseof2lakhseedinriverGanga’,dated:02.07.2023

94. PublishedinUnivartaHindiDainik‘Title:ReleaseofprizedMajorCarpsinriverGanga’,dated:02.07.2023
95. PublishedinDainikJagrannews‘Title:Releaseof2.0lakhsoffishseedinriverGanga’dated:02.07.2023
96. PublishedinRashtriyaSaharanews‘Title:ReleaseofprizedMajorCarpsinriverGanga’dated:02.07.2023
97. PublishedinAmarUjalanews‘Title:Releaseof2.0lakhsoffishseedinriverGanga’dated:02.07.2023
98. PublishedinJanSandeshTimesnews‘Title:Releaseof2.0lakhsoffishseedinriverGanga’dated:02.07.2023
99. PublishedinBharatEkaTimesnews‘Title:Releaseof2.0lakhsoffishseedinriverGanga’dated:02.07.2023
100. PublishedinKalingaChroniclenews‘Title:Releaseof2.0lakhsoffishseedinriverGanga’dated:02.07.2023
101. PublishedinJagrukExpressnews‘Title:Releaseof2.0lakhsoffishseedinriverGanga’dated:02.07.2023
102. PublishedinDainikBhaskar(BhagalpurEdition)‘Title:Releaseof4.0lakhsoffishseedinriver Gangaat Bhagalpur’dated:24.07.2023
103. PublishedinJharkhandDarshanNews‘Title:ReleaseoffishfingerlinginriverGangaby CIFRI’,dated:24.08.2023
104. PublishedinKalingaChronicle‘Title:FingerlingreleasedatKalna,WestBengalinriverGangabyCIFRIunderNationalRanchingProgramme,dated:24.08.2023
105. PublishedinDurontoBarta(Bengali)news‘Title:ReleaseoffishfingerlinginriverGangaby CIFRI’dated:24.08.2023
106. Published inShree 7news ‘Title: Release ofonelakhfishesin Dalmau, UP byICAR-CIFRI’dated:09.09.2023
107. PublishedinTheTelegraphnewspaper‘Title:ToxinalertonHilsabutnoproofofharmyet’byICAR-CIFRIdated:17.09.2023

12.1.2. Electronic Media

1. Thirty thousand fish seeds released in Ganga under ''River ranching programme, 2022'', DD Uttar Pradesh dated 29.03.2022 (https://youtu.be/ZlqNCIL0uRg)
2. Two lakh fishes released in Saryu River, Amrit Vichar dated 17.05.2022 (https://www.youtube.com/watch?v=Y58xEOBrUng)
3. Fish ranching coverage by PD News Express at Varanasi on 19.08.2022 (https://www.youtube.com/watch?v=9A4dMwT45g8)
4. Fish ranching coverage by Purvanchal News at Varanasi on 19.08.2022 (https://www.youtube.com/watch?v=zTMVNYATGso)
5. Fish ranching coverage by Amar Ujala at Varanasi on 19.08.2022 (https://www.amarujala.com/uttar-pradesh/varanasi/campaign-to-reduce-pollution-union-minister-purushottam-rupala-will-be-present)
6. Fish ranching coverage by etv bharat at Varanasi on 19.08.2022 (https://www.etvbharat.com/hindi/uttar-pradesh/city/varanasi/river-ranching-will-clean-gana-two-lakj-fishes-flown-in-varanasi/up20220819163105302302770)
7. 'National Dolphin Day' coverage published in Bengali News Paper EiSamay on 7.10.2022
8. Ranching programme at Farakka was published in Naya Zamana (Bengali newspaper) on 23.10.2022
9. Ranching programme at Berhampore was published in Din Darpan (Bengali newspaper) on 25.10.2022
10. Awareness programme for conservation of fish species in Prayagraj; telecasted on DD news UP on 16-11-2021 at 10:18:40 am (link- https://youtu.be/z2RND2pR9vw)
11. Awareness programme for conservation of fish species in Prayagraj, DD news UP dated 16-11-2021 at 08:20:40 am (link- https://youtu.be/etm_2B_4IDU)
12. Inauguration of "River Ranching Programme-2022" coverage by Krishibarta, dated 14.05.2022(https://pairokarvarta.com/%e0%a4%b0%e0%a4%be%e0%a4%b7%e0%a5%8d%e0%a4%9f%e0%a5%8d%e0%a4%b0%e0%a5%80%e0%a4%af-%e0%a4%b0%e0%a5%88%e0%a4%a8%e0%a5%8d%e0%a4%9a%e0%a4%bf%e0%a4%82%e0%a4%97-%e0%a4%95%e0%a4%be%e0%a4%b0%e0%a5%8d/)
13. Two lakh fish seeds released in Saryu river under "River Ranching Programme-2022" by NMCG Project, Hindustan Samachar dated 17.05.2022

14. (https://www.hindusthansamachar.in/Encyc/2022/5/17/Sifri-releases-two-lakh-fish-into-Saryu-river.php)
15. Two lakh fish seeds released in Saryu River under "River Ranching Programme-2022" by NMCG Project, Jaago Today dated 18.05.2022 (http://www.jaagotoday.page/2022/05/blog-post_271.html)
16. Awareness Programme on Fish and Dolphin conservation of river Ganga, STV Bhagalpur dated 02.06.2022 (https://youtu.be/YBeaVpxSgyg)
17. Subrat Kumar Sen, District Magistrate of Bhagalpur (Bihar) participated in "River Ranching Programme, 2022''at Kamarganj under NMCG Project, Silk TV dated 02.06.2022 (https://youtu.be/n-B0FMt1JWY)
18. Fish ranching coverage in Patna by Panchayat Tree, dated 03.06.2022 (https://youtu.be/BF_cWJzupPE)
19. Study on Gangetic River dolphin and Hilsa coverage by Aajtak on 11.06.2022 https://www.aajtak.in/science/story/govt-to-study-life-cycles-of-dolphin-and-Hilsa-in-ganga-tstr-1480151-2022-06-11)
20. ICAR-CIFRI releases two lakh fish fingerlings in river Ganga at Bhagalpur under "River Ranching Programme-2022'' of NMCG Project, Jagran dated 03.06.2022 (https://www.jagran.com/bihar/bhagalpur-bhagalpur-two-lakh-fishes-released-in-ganga-balance-in-biodiversity-better-livelihood-for-fishermen-22768782.html?utm_source=referral&utm_medium=WA&utm_campaign=social_share
21. Two lakh fishes released in river Ganga in Patna under "River Ranching Programme-2022'' of NMCG Project, Bihari Balak dated 03.06.2022 (https://youtu.be/cvkZMN_corQ)
22. District Commissioner, Sahibganj released carp yearlings in river Ganga, Fish ranching coverage by Sari Katha News, Sahibganj on 02.08.2022 (https://www.youtube.com/watch?v=wlBB0kJuysE)
23. Awareness programme on Dolphin and Hilsa conservation in Sahibganj organized by NMCG Project, Sari Katha News, Sahibganj, Jharkhand dated 22.09.2022 (https://www.youtube.com/watch?v=PzcS5F8Phb0)
24. Awareness programme on Dolphin conservation in Bhagalpur organized by NMCG Project, posted in Public vibe, Bhagalpur dated 17.09.2022 (https://bihar.publicvibe.com/video/bhagalpur/bhagalapur-machuaa-samaj-ke-bich-dolphin-sanrakshan-ko-lekar-chalaya-gaya-jagarukataabhiyan/1663404576979169140)

25. https://no1rmnews.blogspot.com/2023/02/blog-post_36.html (Awareness in conservation of river Ganga)
26. Publishedin'Mongabay'enewsplatform(17.01.2023):Topic:Challengesaboundtoconservepopular hilsa fish (https://india.mongabay.com/2023/01/challenges-abound-to-conserve-the-popular-hilsa-fish/)
27. Publishedin'Mongabay'(Hindi)enewsplatform(17.01.2023):Topic:Challengesaboundtoconservepopularhilsafishhttps://hindi.mongabay.com/2022/12/26/how-hilsa-fish-has-decreased-in-india-what-are-the-challenges-in-conserving-this-rare-species/
28. PublishedinAgriculturenewsdaily'KrishiJagaran'Title:ICAR-CIFRIreleases2000HilsaspawnintoGangaunderNMCGproject,dated:23.02.2023(https://krishijagran.com/news/icar-cifri-releases2-000-hilsa-spawn-into-ganga-under-the-national-mission-for-clean-ganga-project/)
29. AtalBharatNews(Sahibganj,Jharkhand,25.03.2023),Title:Releaseof3lakhHilsaeggsinRajmahalGhatofriverGanga(http://atalbharatnews.com/?p=2181).
30. Publishedin'LagatarNews'dated27.04.2023,Sahibganj(https://lagatar.in/sahibganj-under-the-namami-gange-project-the-minister-released-fishes-in-the-ganges/)
31. PublishedinDainikBhaskar'27.04.2023'Title:RiverranchingbyUnionMinisteratSahibganj(https://www.bhaskar.com/local/jharkhand/sahibganj/news/fisheries-research-center-took-ranching-program-to-namami-gange-campaign-131213273.html).
32. https://m.dailyhunt.in/news/india/hindi/live+hindustan-epaper-livehindu/photo+ganga+me+chodi+gai+rohukatala+prajati+ki+do+lakh+machaliya-newsid-n502677054?sm=Y(DailyhuntNews:24.05.2023)
33. https://bihar.publicvibe.com/video/sultanganj/ganga-nadi-me-chodi-gai-2-lakh-machaliya-vilupt-ho-rahi-machaliyo-ka-jira-choda/1684829423824183077?utm_source=share&utm_medium=android&userid=1636680773804384448(PublicvibeNews:24.05.2023)
34. https://dainik-b.in/LJCDLQwo2zb(DainikBhaskarNews:24.05.2023)
35. https://epaper.puberkalom.com/epaper/m/63587/6484a47febe8d(PuberKolom:06.06.2023)
36. https://www.garhninad.com/2023/06/ranching-cum-public%20awareness-programme-of-mahseer-fishes-organized-in-devprayag/(Garhninadnews:16.06.2023)
37. https://www.etvbharat.com/hindi/uttarakhand/state/pauri-garhwal/acharya-balakrishna-released-mahasheer-fishes-in-alaknanda-under-namami-gange-project/uttarakhand20230617113358599599192(etvBharathindi:17.06.2023)

38. http://www.kalingachronicletv.in/?p=3176(KalingaChronicle:01.07.2023)
39. http://www.kalingachronicletv.in/?p=3186(KalingaChronicle,02.07.2023)
40. http://hindustansamachar.in/?Encyc/2023/7/2/ballia-river-ganga-release-fish-rohu-.php(BhaskarNews,02.07.2023)
41. https://krishijagran.com/news/icar-cifri-releases-fish-fingerlings-in-river-ganga-at-kalna-west-bengal-under-national-ranching-programme/(KrishijagranNewsPortal:24.08.2023)

12.1.3. Social Media

1. Interview of ICAR-CIFRI Director-cum-Principal Investigator (NMCG Project) Dr. B.K. Das on conservation of endangered fish species of river Ganga, Biswa Bongo dated 14.05.2022 (https://fb.watch/c-0uQtLBc_/)
2. Interview of ICAR-CIFRI Director-cum-Principal Investigator (NMCG Project) Dr. B.K. Das on conservation of endangered fish species of river Ganga, Khaas Bangla news dated 14.05.2022 (https://fb.watch/c-6cZJ28AB/)
3. Ranching of Indian Major Carps in river Ganga by DG (NMCG) Mr. G. Ashok Kumar, Biswa Bongo dated 14.05.2022(https://fb.watch/c-5XMEO8YO/)
4. Prospects of ranching programme by Dr. B.K. Das (Director, ICAR-CIFE & Principal Investigator, NMCG Project), Biswa Bongo dated 14.05.2022 (https://fb.watch/c_-ZQE4lxR/)
5. Inauguration of National Ranching Programme, Biswa Bongo dated 14.05.2022 (https://fb.watch/c_Z5LeLmpD/)
6. First ranching under National Ranching Programme at Gandhi Ghat, Barrackpore, Timeon News dated 14.05.2022 (https://fb.watch/c-lyqjiiqE/)
7. Successful production of Hilsa now possible due to research, Channel 24X7 news dated 14.05.2022 (https://fb.watch/c-BrUKHeom/)
8. Dolphin seen in river Ganga, Channel 24X7 news dated 14.05.2022 (https://fb.watch/c-AgrZhI08/)
9. National Ranching Programme was observed at Gandhi Ghat, Barrackpore, Channel 24X7 news dated 14.05.2022 (https://fb.watch/c-znIHkvDI/)
10. Fishes released into Ganga at Barrackpore for economic development, Coverage by Web News Kolkata dated 14.05.2022 (https://fb.watch/c-CBvgQ81y/)
11. National ranching program was carried out in Farakka; Hilsa and other fish seedlings were released in Ganga, ZAYN TV dated 25.05.2022

(https://m.facebook.com/story.php?story_fbid=376072824582345&id=100065388913223&sfnsn=wiwspwa)

12. Shri Tarkishor Prasad, Deputy CM of Bihar participated in 'River Ranching Programme, 2022'at NIT Ghat, Patna under NMCG Project, Janpath News dated 03.06.2022 (https://fb.watch/dpKrcPz0zN/)
13. https://m.facebook.com/story.php?story_fbid=pfbid02iUhiZoKQCW2xMsCjX5Ezj5NZaFHc7HZpBRQUjvdqJAUjr8YjTbDzhVfLjUNqR59Yl&id=100064653373305 (Dolphin rescue report @ 'Namami Gange' official Facebook page)
14. https://m.facebook.com/story.php?story_fbid=pfbid0cGipCvEMMCsqpzEyRbaQNrdgJg8FPNJyFE2fUSSofEn5C4dErvgBS44FDgL9rtSnl&id=100064653373305&sfnsn=wiwspwa&mibextid=RUbZ1f(CIFRISeminar,Prayagraj)
15. https://m.facebook.com/story.php?story_fbid=pfbid0mwQaPtKVH6eUD8eWNfJFLKgfZDDe6FpPxWjMqYJG7aBmGzx5F8QBKdUAaMGAyes8l&id=100064653373305&mibextid=qC1gEa(CIFRISeminar,Prayagraj)
16. https://fb.watch/jLXMDLwduk/(News18Bangla,05.04.2023)
17. https://www.youtube.com/watch?v=DCWIWc3TLNc(KhabarUpdate,26.04.2023)
18. https://www.youtube.com/watch?v=2M8Mpi4ULWM(SariKatha,26.04.2023)
19. https://youtu.be/bHH5zf_FwVk(AllIndiaRadio,Ranchi,26.04.2023)
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21. https://twitter.com/News18Bihar/status/1660977344847441922?t=M2E804yTgCFmLijsAYpwKA&s=08(News18Bihar:24.05.2023)
22. https://www.youtube.com/shorts/oYOxgzX5bVs (Awareness in conservation of river Ganga)
23. https://youtube.com/watch?v=OFIfkbugIbY(AwarenessinconservationofriverGanga)
24. https://www.youtube.com/watch?v=uzLmPPaFuQQ(AwarenessinconservationofriverGanga)
25. https://youtube.be/zVrLSZQq0sghttps://youtube/R0a0T3YtD8k

ফরাক্কায় গঙ্গাবক্ষে মশাল যাত্রা। রবিবার। —শাহজাদ হোসেন

Uttar Banga Sambad, 24.11.2021

गंगा मशाल यात्रा का भव्य स्वागत

बैरकपुर. आठ नवंबर को दिल्ली से चली गंगा मशाल यात्रा उत्तराखंड, उत्तर प्रदेश, बिहार, झारखंड होते हुए मंगलवार को बंगाल के बैरकपुर भारतीय कृषि अनुसंधान परिषद पहुंची. यहां गंगा मशाल यात्रा का भव्य स्वागत किया गया. कल्याणी ग्रुप के ग्रुप कमांडर ब्रिगेडियर दीपक बनर्जी के निर्देश पर 48 बंगाल बटालियन यूनिट के कमांडिंग अफसर कर्नल राजेश सिंह के नेतृत्व में लगभग 100 एनसीसी कैडेट्स बैरकपुर की विभिन्न गलियों में प्रभातफेरी निकाल एवं नुक्कड़ नाटक का मंचन कर कोरोना एवं नशाखोरी के खिलाफ लोगों को जागरूक किया. कर्नल ने कहा कि स्वच्छता ही जीवन का मूल आधार है. इस अवसर पर सूबेदार मेजर एलएस राव, सूबेदार राकेश कुमार, सूबेदार कृष्णा भौमिक, हवलदार सोहन ध्यानी, एनसीसी अफसर गालिब इकबाल, दिवाकर सरदार, सुतनु दत्त चौधरी, रंजीत मंडी आदि उपस्थित थे. एनसीसी अधिकारी प्रमोद कुमार ने कोविड प्रोटोकॉल का पालन करने की अपील की. गंगा मशाल यात्रा के सदस्यों का एनसीसी कैडेटों ने स्वागत किया. इसके बाद दीप प्रज्वलित कर कार्यक्रम का उदघाटन किया गया. गंगा की साफ-सफाई पर नाटक का मंचन किया गया. मेजर एलएन जोशी मशाल यात्रा का नेतृत्व कर रहे थे. दिल्ली से आये एडीजी डॉक्टर विमल प्रोषण मोहंती, रिसर्च निदेशक डॉक्टर बसंत कुमार दास ने अपने विचार रखे. अतिथियों ने गांधी घाट जाकर बापू को नमन किया. अंत में पशु पालन स्वरूप 20000 छोटी रोहू, कतला आदि मछलियां गंगा में समर्पित की गयीं. समस्त कार्यक्रम के सुचारू रूप से संचालन में संदीप बेहेरा का महत्वपूर्ण योगदान रहा.

Dainik Jagran, 24.11.2021

প্রাইম টাইম

সঙ্গে থেকো, সঙ্গে রেখো

উত্তরাখন্ড থেকে 'গঙ্গা মশাল যাত্রা' পৌঁছল বঙ্গের ব্যারাকপুরে

নিজস্ব প্রতিনিধি, ব্যারাকপুর: গঙ্গা পরিষ্কার পরিচ্ছন্ন রাখতে সাধারণ মানুষের মধ্যে সচেতনতা বাড়াতে উত্তরাখণ্ড থেকে পশ্চিমবঙ্গের ব্যারাকপুরে এসে পৌঁছল 'গঙ্গা মশাল যাত্রা'। উত্তরাখণ্ডের ঋষিকেশ থেকে 'গঙ্গা মশাল যাত্রা' শুরু হয়ে বিহার, উত্তরপ্রদেশ, ঝাড়খণ্ড ঘুরে মঙ্গলবার বেলায় ব্যারাকপুরের কেন্দ্রীয় অন্তর্দেশীয় মৎস গবেষণা কেন্দ্রে এসে পৌঁছয়। উত্তরাখণ্ড থেকে আঞ্চলিক সেনাবাহিনীর একটি বিশেষ দল গঙ্গা দূষণ মুক্ত রাখার বার্তা নিয়ে ব্যারাকপুর মৎস গবেষণা কেন্দ্রে এসে পৌঁছলে তাদেরকে এনসিসি ক্যাডারদের বর্ণাঢ্য শোভাযাত্রার মাধ্যমে স্বাগত জানাতে উপস্থিত ছিলেন ভারতীয় কৃষি অনুসন্ধান পরিষদের মহানির্দেশক বিমল প্রসন্ন মহান্তি, ব্যারাকপুর কেন্দ্রীয় অন্তর্দেশীয় মৎস্য গবেষণা কেন্দ্রের মহা নির্দেশক বসন্ত কুমার দাস-সহ অন্যান্য অধিকারিকরা। এদিন সন্ধ্যায় ব্যারাকপুর গান্ধী ঘাটে প্রদীপ জ্বালিয়ে সন্ধ্যা আরতি করা হয় এবং গঙ্গায় ২০ হাজার মাছের চারা ছাড়া হয়।

Prime time, 25th November, 2021

गंगा की सुरक्षा को लेकर दिल्ली से शुरू की गयी मसाल यात्रा की मसाल पहुंची बैरकपुर के गांधी घाट। एनसीसी व सेना अधिकारियों ने मसाल की जोत को इस तरह से ही जलाये रखने का किया आह्वान

गंगा की सुरक्षा को लेकर दिल्ली से शुरू की गयी मसाल यात्रा की मसाल पहुंची बैरकपुर के गांधी घाट। एनसीसी व सेना अधिकारियों ने मसाल की जोत को इस तरह से ही जलाये रखने का किया आह्वान

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গঙ্গা দূষণ রোধে উত্তরাখন্ড থেকে 'গঙ্গা মশাল যাত্রা' পৌঁছল বাংলায়

নিজস্ব প্রতিবেদন,ব্যারাকপুর: গঙ্গা দূষণ নিয়ে সচেতনতা বাড়াতে উত্তরাখণ্ড থেকে বাংলায় এসে পৌঁছল ' গঙ্গা মশাল যাত্রা'। গঙ্গা দূষণ রোধে সাধারণ মানুষকে সচেতন করতে উত্তরাখণ্ডের ঋষিকেশ থেকে 'গঙ্গা মশাল যাত্রা' শুরু হয়ে বিহার, উত্তরপ্রদেশ, ঝাড়খণ্ড ঘুরে মঙ্গলবার বেলায় ব্যারাকপুরস্থিত ভারতীয় কৃষি অনুসন্ধান পরিষদের অধীনস্থ কেন্দ্রীয় অন্তর্দেশীয় মৎস গবেষণা কেন্দ্রে এসে পৌঁছয়। উত্তরাখণ্ড থেকে আঞ্চলিক সেনাবাহিনীর একটি বিশেষ দল গঙ্গা পরিষ্কার রাখার বার্তা নিয়ে বিভিন্ন রাজ্যে এই মশাল যাত্রা করছেন।

এদিন এন সি সি ক্যাডারদের বর্ণাঢ্য শোভাযাত্রার মাধ্যমে 'গঙ্গা মশাল যাত্রা'র বিশেষ দলটিকে স্বাগত জানাতে হাজির ছিলেন ভারতীয় কৃষি অনুসন্ধান পরিষদের মহানির্দেশক বিমল প্রসন্ন মহান্তি, ব্যারাকপুর কেন্দ্রীয় অন্তর্দেশীয় মৎস্য গবেষণা কেন্দ্রের মহা নির্দেশক বসন্ত কুমার দাস-সহ অন্যান্য অধিকারিকরা।

এদিন সন্ধেয় ব্যারাকপুর গান্ধী ঘাটে প্রদীপ জ্বালিয়ে সন্ধ্যা আরতি করে গঙ্গায় ২০ হাজার মাছের চারা ছাড়া হয়।

গঙ্গা মশাল যাত্রা নিয়ে ভারতীয় কৃষি অনুসন্ধান পরিষদের মহানির্দেশক বিমল প্রসন্ন মহান্তি বলেন, গঙ্গাকে দূষণ মুক্ত করা অত্যন্ত জরুরি। গঙ্গা দূষণ রোধে কেন্দ্রীয় সরকার প্রয়াস চালিয়ে যাচ্ছে। গঙ্গা দূষণ নিয়ে জাতীয় স্তরে প্রচার চলছে। গঙ্গাকে নির্মল রাখতে উত্তরাখণ্ড থেকে মশাল যাত্রা শুরু হয়ে বিহার, উত্তরপ্রদেশ, ঝাড়খণ্ড ঘুরে বাংলায় এসেছে। বকখালি গিয়ে মশাল যাত্রা শেষ হবে।

অপরদিকে ব্যারাকপুর কেন্দ্রীয় অন্তর্দেশীয় মৎস্য গবেষণা কেন্দ্রের মহানির্দেশক বসন্ত কুমার দাস বলেন, গঙ্গা দূষণ রোধে এবং গঙ্গাকে পরিষ্কার রাখতে মানুষের মধ্যে সচেতনতা বৃদ্ধিতে এই মশাল যাত্রা করা হয়েছে। এদিন গঙ্গাবক্ষে সন্ধ্যা আরতি করা হয়েছে এবং গঙ্গায় ২০ হাজার মাছ ছাড়া হয়েছে।

UttarbangaSambad, 24.11.2021

Ek din, Kolkata dated 24.11.2021

গঙ্গাকে দূষণমুক্ত করতে মশাল যাত্রা

নিজস্ব সংবাদদাতা, ফরাক্কা: জাতীয় নদী গঙ্গাকে দূষণ মুক্ত করতে কেন্দ্রীয় জলশক্তি মন্ত্রণালয়ের নমামি গঙ্গা প্রকল্পে উত্তরাখণ্ডের ঋষিকেশ থেকে ১ নভেম্বর শুরু হয়েছে গঙ্গা মশাল যাত্রা। উত্তরাখণ্ড, উত্তরপ্রদেশ, বিহার, ঝাড়খণ্ড অতিক্রম করে রবিবার বিকেলে ১১১৭ কিলোমিটার পথ অতিক্রম করে পশ্চিমবঙ্গের ফরাক্কার গান্ধীঘাটে মশাল যাত্রা এসে পৌঁছল। এদিকে, গঙ্গা দূষণমুক্ত মশাল যাত্রাকে কেন্দ্র করে ফরাক্কা বাঁধ প্রকল্পে সাজো সাজো রব। রংবেরঙের আলোক সজ্জায় সাজানো হয়েছে সমগ্র এলাকা। ঝাড়খণ্ডের পাকুড় থেকে ফরাক্কার গান্ধীঘাটে গঙ্গা মশাল যাত্রা নিয়ে হাজির হন টেডিটেরিয়াল আর্মির মেজর এন এন জোশি। স্বাগত জানান ফরাক্কা বাঁধ প্রকল্পের জেনারেল ম্যানেজার রংগস্বামী আজাগেসান। বিভিন্ন সাংস্কৃতিক অনুষ্ঠানের পাশাপাশি এদিন সন্ধ্যায় গান্ধীঘাট গঙ্গায় সন্ধ্যা আরতি অনুষ্ঠিত হয়। মশাল যাত্রার মূল উদ্দেশ্য, জাতীয় নদী গঙ্গাকে দূষণ মুক্ত করা। নদীর জলে ভেসে থাকা কঠিন বর্জ্য পদার্থের সমস্যার সমাধানের লক্ষ্যে নদীর জলকে পরিষ্কার করা। দূষণ নিয়ন্ত্রণে গ্রামীণস্তরে পরিচ্ছন্নতার কর্মসূচি। পুর ও শিল্প এলাকা থেকে দূষিত বর্জ্য পদার্থ নদীতে প্রবেশ নিয়ন্ত্রণ করা। এই উদ্দেশ্যকে বাস্তবায়িত করতে ঋষিকেশ থেকে ১ নভেম্বর গঙ্গা মশাল যাত্রা শুরু হয়েছে। ২৬ শে নভেম্বর এই যাত্রা শেষ হবে বঙ্গোপসাগরে। সোমবার সকালে গঙ্গা মশাল যাত্রা নদিয়ার মায়াপুরের উদ্দেশ্যে রওনা দেবে।

UttarbangaSambad, 24.11.2021

দূষণমুক্ত নদী: ঋষিকেশ থেকে 'গঙ্গা মশাল' এল বারাকপুরে

নিজস্ব প্রতিনিধি, বারাকপুর: গঙ্গাকে দূষণমুক্ত করতে অভিনব কর্মসূচি নিয়েছে কেন্দ্র। জলশক্তি মন্ত্রণালয়ের 'নমামি গঙ্গা' প্রকল্পে গত ১ নভেম্বর উত্তরাখণ্ডের ঋষিকেশ থেকে শুরু হয়েছিল 'গঙ্গা মশাল' যাত্রা। মঙ্গলবার ২৩ নভেম্বর সেই 'গঙ্গা মশাল' এসে পৌঁছল বারাকপুরের সিফরি'তে (আইসিএআর-সেন্ট্রাল ইনল্যান্ড ফিশারি রিসার্চ ইনস্টিটিউট)। এদিন দুপুরে গঙ্গা মশাল যাত্রার দলকে স্বাগত জানান সিফরির ডিরেক্টর ডঃ বসন্তকুমার দাস সহ অন্যান্য আধিকারিকরা। একটি সাংস্কৃতিক অনুষ্ঠানেরও আয়োজন করা হয়েছিল। দেশের আর্থ-সামাজিক প্রেক্ষাপটে গঙ্গার গুরুত্ব নিয়ে আলোচনা করা হয়। সন্ধ্যার মুখে বারাকপুরের গান্ধীঘাটে গঙ্গা মশাল যাত্রার দল পৌঁছয়। এই উপলক্ষে গঙ্গায় প্রায় ২০ হাজার মাছ ছাড়া হয়। প্রদীপ প্রজ্জ্বলনের মাধ্যমে গঙ্গাকে পুনরুজ্জীবিত ও গঙ্গা নদীর জীব বৈচিত্র্যের সংরক্ষণের অঙ্গীকার করা হয়।

এদিনের অনুষ্ঠানে টেরিটোরিয়াল আর্মির মেজর জেনারেল এন এন যোশি এবং ভারতীয় কৃষি অনুসন্ধান পরিষদের এডিজি ডঃ বি পি মোহান্তিও উপস্থিত ছিলেন। তাঁরা গঙ্গা নদীর দূষণ নিয়ন্ত্রণ এবং এই নদীর স্বাস্থ্য সুরক্ষিত রাখার কথা তুলে ধরেন। সিফরির ডিরেক্টর তাঁর ভাষণে গঙ্গা নদীর অবদান, বিশেষ করে দেশের মৎস্য সম্পদের পরিপ্রেক্ষিতে এর গুরুত্ব সম্পর্কে অবগত করেন। সকলকে এই বার্তা নিয়ে আরও বেশি করে জন-সচেতনতা গড়ে তোলার জন্য তিনি আহ্বান জানান। –নিজস্ব চিত্র

Ananda bazar Potrika, 24.11.2021

ইলিশের গায়ে চিহ্ন দিয়ে ছাড়া হচ্ছে উজানে

Ananda bazar Potrika

আরও খবর

উত্তরবঙ্গ সংবাদ ২২ নভেম্বর ২০২১

ইলিশ সংরক্ষণে জোর, ছোট মাছ না ধরার আর্জি

ওয়ার্ল্ড ফিশারি ডে-তে ফরাক্কায় সিফ্রির বৈঠক

অর্ণব চক্রবর্তী • ফরাক্কা

AaroKhabor

গঙ্গা বাঁচাতে গঙ্গা দূষণ নিয়ে সচেতনতা বাড়াতে উত্তরাখণ্ড থেকে শুরু হওয়া গঙ্গা মশাল অভিযান কয়েকটি রাজ্য ঘুরে মঙ্গলবার পৌঁছলো ব্যারাকপুরে। সচেতনতার বার্তা মানুষের কাছে পৌঁছে দিতে এ দিন সন্ধ্যায় ব্যারাকপুর গান্ধীঘাটে গঙ্গা আরতির আয়োজন করা হয় ব্যারাকপুরের কেন্দ্রীয় অন্তর্স্থলীয় মৎস্য গবেষণার পক্ষ থেকে। গঙ্গা মশাল অভিযান উপলক্ষে এদিন গঙ্গায় ২০ হাজার মাছও ছাড়া হয় — এই সময়

EiSamay, 24.11.2021

दबंग दुनिया | प्रादेशिक | नई दिल्ली, मंगलवार, 16 नवंबर 2021 | www.dabangdunia.co | 06

सिफरी द्वारा प्रयागराज में गंगा नदी में तीस हज़ार मत्स्य बीजों को छोड़ा गया

DabangDuniya newspaper, 16.11.2021

सिफरी द्वारा गंगा नदी में तीस हजार मत्स्य बीज को छोड़ा गया

DabangDuniya newspaper, 16.11.2021

सिफरी ने गंगा नदी में तीस हजार मत्स्य बीज छोड़ा

Allahabad express,16.11.2021

www.jagran.com

गंगा में छोड़े 30 हजार मत्स्य बीज

संरक्षण

- गंगा की स्वच्छता के लिए दिलाई गई शपथ
- जैव विविधता के संरक्षण के लिए लोगों का आह्वान

जागरण संवाददाता, प्रयागराज: मत्स्य प्रजातियों के संरक्षण एवं संवर्धन के मकसद से सोमवार को भारतीय कृषि अनुसंधान परिषद व केंद्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) प्रयागराज द्वारा संगम तट पर गंगा नदी में 30 हजार मत्स्य बीज छोड़ा गया। कतला, रोहू, मृगल मछलियों की अंगुलिका बीज को रैंचिंग कार्यक्रम के तहत छोड़ा गया।

राष्ट्रीय स्वच्छ गंगा मिशन के तहत आयोजित इस कार्यक्रम में बतौर मुख्य अतिथि भारतीय कृषि अनुसंधान परिषद की उप महानिदेशक डा. कृष्ण जेना ने गंगा नदी में मछली और रैंचिंग के महत्व व मछुआरों की आजीविका बढ़ाने के उपायों के बारे में जानकारी दी। मछुआरों को मछली पकड़ने के लिए जाल भी वितरित किया। विशिष्ट अतिथि समाजसेवी कविता त्रिपाठी ने गंगा की स्वच्छता एवं जैव विविधता के संरक्षण के लिए लोगों का आह्वान किया। संस्थान के केंद्राध्यक्ष डा. डीएन झा ने गंगा और निदेशक डा. बसंत कुमार दास ने नमामि गंगे परियोजना के बारे में जानकारी दी। नगर गंगा समिति के सदस्य राजेश शर्मा ने गंगा को स्वच्छ रखने के लिए शपथ दिलाई। संस्थान के वैज्ञानिक डा. वेंकटेश ठाकुर आदि मौजूद रहे।

Dainik Jagran, 16.11.2021

Thirty thousand fish seeds were released by ICAR-CIFRI in the river Ganga

Jeevan express,16.11.2021

सिफरी को सुंदरवन कृषि मेला-ओ-लोको संस्कृति उत्सव कुलतोली में मिला प्रथम पुरस्कार

DainikDabang Dunia, 12th February 2022

सिफरी के 76वें स्थापना दिवस पर संगम के पास गंगा नदी में मछलियों का बीज छोड़ते स्कूली बच्चे • साभार : सिफरी

76वें स्थापना दिवस पर गंगा में छोड़े 30 हजार मछली बीज

जासं, प्रयागराज: भारतीय कृषि अनुसंधान परिषद -केंद्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) प्रयागराज का 76वां स्थापना दिवस गुरुवार को मनाया गया। इस अवसर पर गंगा यमुना नदी में विलुप्त हो रहे मछली के प्रजातियों के संरक्षण एवं संवर्धन के लिए 30 हजार मछली के बीज संगम क्षेत्र में छोड़ा गया। कार्यक्रम के मुख्य अतिथि डा सुनंदा चतुर्वेदी रहीं। केंद्र प्रमुख डा. डीएन झा, डा. अबसार आलम, डा. अवधेश कुमार झा, मानवेंद्र सिंह, श्रवण शर्मा, डा. वेंकटेश ठाकुर ने धन्यवाद ज्ञापित किया। डा. संदीप कुमार मिश्र, शिवजनम वर्मा, संदीप मिश्रा, दुर्गेश वर्मा आदि रहे।

Published in Dainik Jagran,18-03-2022

ICAR-CIFRI ranched thirty thousand fishes on its 76th Foundation Day

JEEVAN EXPRESS NEWS

PRAYAGRAJ: On the occasion of 76th foundation day of ICAR-Central Inland Fisheries Research Institute released 30,000 (thirty thousand) IMC fishes into the Ganga river at Arail Ghat, Prayagraj. It comprises advance size fingerlings of Catla, Rohu, and Mrigal fishes. The ranching programme was conducted for conservation and restoration of fish species that are becoming extinct in the Ganga River. The event was organized under the National Mission for Clean Ganga (NMCG) project. Dr. D.N. Jha, the center head of the institute informed the audience about the river Ganga and Namami Gange programme in brief. Dr. A. Alam, scientist of the institute, told about fishes of river and its importance.

The chief guest Principal, HNB PG college, Naini, Prayagraj Dr. Sunanda Chaturvedi, while addressing the function, explained the importance of the river Ganga and called for keeping it clean. Professor, HNB PG College Dr Awadhesh Kumar Jha said about the importance of Ganga for human civilisation and to save it. Convenor, Ganga Vichar Manch, and National Mission for Clean Ganga Rajesh Sharma administered oath to all to keep Ganga clean. Dr. Shravan Kumar Sharma, Scientist of the institute, Manvendra Singh, the pilgrims, fishermen, and locals also kept their views in the meeting and everyone expressed their resolve to keep the Ganga clean.

The program was attended by the students of the HNB PG college, pilgrims, fishermen from nearby villages, fish traders, and local people living on the banks of Ganga. At the end of the program, Dr. Venkatesh R Thakur, Scientist, while expressing his vote of thanks, assured that with the participation of the society for successfully achieving the objectives of this project. Other Scientists, officers, research scholars, etc. participated in the program and addressed the gathering.

Published in Jeevan Express, 18-03-2022

दैनिक दबंग दुनिया

गंगा नदी में डॉल्फिन संरक्षण की दिशा में सिफरी के अभिनव प्रयास

मछुआरों को जागरूक किया

Dabang Dunia 27th April 2022

ইলিশের উৎপাদন বাড়াতে এবার ডাঙায় ডিমপোনা তৈরি করে গঙ্গায় ছাড়ছে সিফরি

Bartamanpatrika on 30th April 2022

बैरकपुर में गंगा में छोड़े गये दो लाख मत्स्य बीज

Dainik Jagran on 15.05.2022

2L fingerlings released in Ganga at Barrackpore

Times News Network on 15.05.2022

सरयू में छोड़े गए मछली के दो लाख बच्चे

दुबई में सम्मानित किए

Dainik Jagran on 18.05.2022

सिफरी ने सरयू नदी में दो लाख मछलियों को छोड़ा

Allahabad Express on 18.05.2022

मॉं सरयू की गोद में सिफरी ने दो लाख मछलियों को छोड़ा

20 को बैठक

Chetna Samachar Seva on 18.05.2022

सरयू में छोड़ी गईं कई प्रजाति की दो लाख मछलियां

मछलियों का नदी में होगा पुनर्स्थापन, जीविका सुधारने के लिए 25 मछुआरों को प्रदान की गई किट

नदी की स्वच्छता बनाए रखने में भी करेंगी मदद

Amrit Vichar on 18.05.2022

सिफरी द्वारा सरयू नदी में दो लाख मछलियों को छोड़ा गया

Awadhnama on 18.05.2022

West Bengal: Endangered Hilsa, Kajri, Vacha back, fish diversity up in Ganga

Subhro Niyogi / TNN / Updated: Jun 1, 2022, 05:51 IST

Times of India on 01.06.2022

THE TIMES OF INDIA

Fish diversity in Ganga up 36% in 10 years

Subhro Niyogi / TNN / Jun 1, 2022, 01:55 IST

Times of India on 01.06.2022

www.shilpaneernewspaper.news

সংস্কৃতির মাঠে ময়দানে আমরা আছি প্রথম থেকেই প্রথমে

নদীয়ায় ICAR এর উদ্যোগে গঙ্গা নদীর মৎস ও ডলফিন সংরক্ষণ সচেতনতা কর্মসূচী ও গঙ্গা বক্ষে মাছ ছাড়া কর্মসূচী পালন

Shilpaneer news on 26.05.2022

ICAR-NMCG ranching at Dakshineswar

ICAR-Central Inland Fisheries Research Institute paid homage to the 167th establishment year of Dakshineswar Kali Temple by commencing 'National Ranching Programme'. The aim was to conserve and restore Gangetic fish population and to also pay respect to one of the 10 incarnations of Lord Vishnu as well as build an economic bridge of fishers community and prime minister's vision of Artha Ganga under the funding support of National Mission for Clean Ganga. The fifth river ranching programme was organised at Dakshineswar where more than 2 lakhs wild Indian Major Carp germ plasm (*rohu, katla* and *mrigal*) were ranched in the main channel of the river. Present were Brijesh Sikka, senior

Times of India on 03.06.2022

'Ranching, seed production improve fish population'

Subhro Niyogi
@timesgroup.com

Kolkata: In earlier studies, 79 native Gangetic fish species were detected between Kanpur and Farakka. But the present study reported 103 species from there. The lower zone from Farakka to Tribeni in Bengal reported 123 species and freshwater tidal stretch of the river 72 fish species with hilsa and other small fish species, like chella, morari, Gangetic river sprat, Indian river shad dominating.

The improvement in fish diversity and population follows multiple initiatives taken by CIFRI, including ranching and seed production of indigenous Gangetic fish species. Over 47 lakh fingerlings of major Indian carps have been ranched.

Landing data from Ganga ghats showed a rise in fish stocks after ranching. The rise in fish population has helped improve water quality.

Fishermen Purna Patra from Godakhali and Binay Biswas from Tribeni say the catch has increased. "Local varieties that were rarely found in the catch are now being netted," said Biswas.

Farakka region in Bengal recorded 84 fish species, highest in the stretch, indicating congenial riverine environment supporting stable fish population. "In lower Bengal, four exotic species — crocodile fish, bighead carp, grass carp and silver carp — were reported, showing population stability largely due to riverine ecology change," said CIFRI director and project investigator Basanta Kr Das.

The decline between 1991 and 2012, CIFRI scientists said was due to deterioration in the river's water quality because of effluent from civic bodies and industries, and overfishing. ICAR-CIFRI, with other agencies engaged in Ganga Action Plan, rechristened National Mission for Clean Ganga, has managed to stem the decline and revive 50 species. But species like pangasius, pabda catfish, giant river goonch, chitala and silond catfish are less abundant in the river and require more effort.

Times of India on 01.06.2022

গঙ্গায় ছাড়া হল ইলিশ

নিজস্ব সংবাদদাতা

ফরাক্কা

গঙ্গায় মাছের জোগান বাড়াতে ফরাক্কা ব্যারাজে গঙ্গার উজানে ইলিশ-সহ বিভিন্ন মাছের দু'লক্ষ চারাপোনা ছাড়া হল। সেন্ট্রাল ইনল্যান্ড ফিশারিজ রিসার্চ ইনস্টিটিউট ও ফরাক্কা ব্লক প্রশাসনের তরফে সম্প্রতি ওই মাছ ছাড়া হয়েছে। কেন্দ্রীয় সরকার 'নমামি গঙ্গা' প্রকল্পের মাধ্যমে ফরাক্কা থেকে ইলাহাবাদ পর্যন্ত ইলিশ মাছের বিচরণ ক্ষেত্র গড়ে তুলতে কাজ শুরু করেছে। গঙ্গার ডাউনস্ট্রিম থেকে খোকা ইলিশ ধরে তা ট্যাগিং করে বিশেষ পদ্ধতির সাহায্যে আপ স্ট্রিমে ছাড়া হয়। আপস্ট্রিমে গঙ্গায় মাছের বিচরণক্ষেত্র গড়ে তুলতে মৎসজীবীদের সচেতন হওয়ার আবেদন করা হয়েছে সংস্থার তরফে। 'সেন্ট্রাল ইনল্যান্ড ফিশারিজ রিসার্চ ইনস্টিটিউট' এর অধিকর্তা বি কে দাস জানান, গঙ্গার আপস্ট্রিমে যে দু' লক্ষ মাছ ছাড়া হল, তার ১০ শতাংশ বাঁচলে সেগুলির একেকটির ওজন দাঁড়াবে এক কেজি করে। সেগুলি ডিম পাড়ার পর মাছের বংশবিস্তার ঘটবে। দেশে মাছের চাহিদার ঘাটতি মেটাতে তা সাহায্য করবে। তাছাড়া, এর ফলে মৎসজীবীদেরও আর্থিক উন্নতি হবে। অনুষ্ঠানে উপস্থিত ছিলেন কেন্দ্রীয় অন্তর্দেশীয় জলপথ নিগমের সহকারী অধিকর্তা বিনীত পণ্ডিত-সহ রাজ্য ও কেন্দ্রের একাধিক পদস্থ কর্তা।

Anandabazar Potrika on 26.06.2022

ছাড়া হল ২ লক্ষ মাছের চারা

নিজস্ব সংবাদদাতা, ফরাক্কা : মাছের চাহিদা মেটাতে বুধবার জাতীয় র‍্যানচিং দিবসে ফরাক্কা ব্যারেজ গঙ্গার আপস্ট্রিমে ইলিশ-সহ অন্য মাছের দু'লক্ষ চারা ছাড়া হল। সেন্ট্রাল ইনল্যাণ্ড ফিশারিজ রিসার্চ ইনস্টিটিউট ও ফরাক্কা ব্লক প্রশাসনের তরফ থেকে এই অনুষ্ঠানের আয়োজন করা হয়। কেন্দ্র সরকার নমামি গঙ্গা প্রকল্পের মাধ্যমে ফরাক্কা ব্যারেজের আপস্ট্রিম থেকে এলাহাবাদ পর্যন্ত ইলিশ মাছের বিচরণ ক্ষেত্র গড়ে তুলতে কাজ শুরু করা হয়েছে। সেন্ট্রাল ইনল্যান্ড ফিশারিজ রিসার্চ ইনস্টিটিউটের অধিকর্তা বি কে দাস জানান, যে মাছ ছাড়া হল তার ১০ শতাংশও যদি জীবিত থাকে তবে বংশবিস্তার ঘটবে। দেশে মাছের চাহিদার ঘাটতি অনেকটা কমবে। আপস্ট্রিমে গঙ্গায় মাছের বিচরণ ক্ষেত্র গড়ে তুলতে মৎসজীবীদের সচেতন করতে আলোচনা সভা অনুষ্ঠিত হয়। যাতে তাঁরা মাছ ছোটো থাকতেই না ধরেন। এদিন অনুষ্ঠানে ছিলেন কেন্দ্রীয় আন্তঃদেশীয় জলপথ নিগমের সহকারী অধিকর্তা বিনিত পণ্ডিত, মুর্শিদাবাদের অতিরিক্ত জেলাশাসক বেলাল পাল, মৎস্য দফতরের আধিকারিক অমলেন্দু বর্মন, ফরাক্কার বিডিও জুনাইদ আহমেদ প্রমুখ।

Sanbad Pratidin on 26.06.2022

दैनिक भास्कर भागलपुर 03-06-2022

भागलपुर आसपास

दौरा • सुल्तानगंज की कमरगंज पंचायत में नाव पर सवार होकर गंगा नदी के बीच पहुंचे जिलाधिकारी

डीएम ने गंगा में छोड़ीं दो लाख मछलियां, बोले- इससे पानी होगा साफ, प्रदूषण में आएगी कमी

सीआईसीएआर-सीआईएफआरआई के निदेशक भी रहे उपस्थित

डॉल्फिन के संरक्षण में भी लाभदायक होगी

ग्रामीणों ने ताली बजाकर किया स्वागत

Dainik Jagran,03.06.2022

गंगा में गिरायी गयीं दो लाख की मछलियां, डीएम बोले इससे सुदृढ़ होगा गंगा का पारिस्थितिकी तंत्र

सुलतानगंज. पकमरगंज के पास गंगा में केंद्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान बैरकपुर (कोलकाता) व नमामि गंगे परियोजना द्वारा 'राष्ट्रीय रैंचिंग कार्यक्रम-2022' के तहत भागलपुर के डॉलफिन आश्रयणी व पर्यावरण संवेदी क्षेत्र से बाहर करीब दो लाख मछलियों को गंगा में छोड़ा गया. इसकी शुरुआत डीएम सुब्रत कुमार सेन, केंद्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान के निदेशक व प्रधान अन्वेषक डॉ बसंत कुमार, बिहार मत्स्य उपनिदेशक शैलेंद्र कुमार ने छोटी मछलियों को गंगा में डाल कर की. डीएम ने कहा कि छोड़ी गयीं मछलियां गंगा की पारिस्थितिकी तंत्र को सुदृढ़ करेगी. और स्थानीय मछुआरों के जीवीकोपार्जन में सहायक होंगी. जलीये जीवों जैसे डॉलफिन के संरक्षण में भी लाभदायक होगी. कृषि विज्ञान केंद्र के डॉ जियाउल ने बताया कि मछलियां गंगा में बढ़ते प्रदूषण को कम करने में सहायक हैं. मौके पर सिफरी बैरकपुर के इंजीनियर डॉ हिमांशु स्वाइन, डॉ विकास कुमार, जिला मत्स्य अधिकारी कन्हैया कुमार, मत्स्य विकास पदाधिकारी राजकुमार, बीडीओ, सीओ, कमरगंज के मुखिया भरत कुमार, मत्स्यजीवी सहयोग समिति सुल्तानगंज के अध्यक्ष अरुण कुमार आदि मौजूद थे.

प्रभात खबर Fri, 03 June 2022 https://epaper.prabhatkhabar.com/c/

Prabhat Khabar, 03.06.2022


दैनिक भास्कर पटना 04-06-2022

पटना में नमामि गंगे द्वारा आयोजित "राष्ट्रीय रैंचिंग कार्यक्रम" में डिप्टी सीएम तारकिशोर प्रसाद शामिल हुए और अपने विचार रखे। इस दौरान गंगा नदी में छोटी मछलियों को भी डाला गया।

Dainik Jagran, 04.06.2022


पटना, शनिवार, 04 जून 2022

सन्मार्ग Live News & Epaper http://www.live7tv.com

मछलियों के संवर्धन के लिए गंगा में छोड़े गये मत्स्य बीज

रैंचिंग से नदी की जैव विविधता संरक्षण एवं मछुआरों के जीविकोपार्जन में मदद : उपमुख्यमंत्री

पटना/कार्यालय प्रतिनिधि। स्थानीय एनआईटी घाट पर गंगा नदी में राष्ट्रीय रैंचिंग कार्यक्रम 2022 का शुभारंभ बिहार के उपमुख्यमंत्री सह पशु एवं मत्स्य संसाधन मंत्री तारकिशोर प्रसाद ने किया। इस मौके पर मछलियों के संवर्धन के लिए गंगा नदी में इंडियन मेजर कॉर्प प्रजाति की अंगुलिकाओं को छोड़ा गया। इस अवसर पर अपने संबोधन में उपमुख्यमंत्री ने कहा कि गंगा नदी में भारतीय मेजर कॉर्प की प्रचुरता को बढ़ाने और संरक्षण के लिए मत्स्य संसाधनों का संरक्षण और मत्स्य जातियों का पुनरुद्धार एक उत्कृष्ट उपाय है। इस दिशा में राष्ट्रीय स्वच्छ गंगा मिशन के तहत आईसीएआर- केंद्रीय अंतर्राष्ट्रीय मत्स्यकी अनुसंधान संस्थान निरंतर कार्य कर रहा है। उन्होंने कहा कि गंगा की मछलियों के संरक्षण और पुनरुद्धार के लिए राष्ट्रीय रैंचिंग कार्यक्रम एक बेहतरीन पहल है, जिसके अंतर्गत देश के चयनित राज्यों में इंडियन मेजर कॉर्प प्रजातियों की रैंचिंग की जा रही है। रैंचिंग कार्यक्रम से नदियों में मत्स्य पालन के संरक्षण और बहाली में मदद मिलेगी तथा बड़ी संख्या में मछुआरों को आजीविका के साधन प्राप्त होंगे। उन्होंने कहा कि नमामि गंगे के इस कार्यक्रम के तहत उत्तराखंड, उत्तरप्रदेश, बिहार, झारखंड, पश्चिम बंगाल जैसे राज्यों में में 48 लाख से अधिक इंडियन मजर कॉर्प प्रजातियों की अंगुलिकाएं छोड़ी गई हैं।

Sanmarg, 04.06.2022


गंगा में मेजर कॉर्प प्रजाति की छोटी मछली छोड़ते उपमुख्यमंत्री तारकिशोर प्रसाद।

गंगा में छोटी मछलियों को छोड़ा गया

पटना। उपमुख्यमंत्री तारकिशोर प्रसाद ने शुक्रवार को एनआईटी घाट पर गंगा नदी में राष्ट्रीय रैंचिक कार्यक्रम का शुभारंभ किया। इस मौके पर भारतीय मेजर कॉर्प प्रजाति की छोटी मछलियों (अंगुलिकाओं) को छोड़ा। इस दौरान उन्होंने कहा कि गंगा की मछलियों के संरक्षण और पुनरुद्धार के लिए राष्ट्रीय रैंचिक कार्यक्रम एक बेहतरीन पहल है। नमामि गंगे के इस कार्यक्रम के तहत उत्तराखंड, उत्तरप्रदेश, बिहार, झारखंड और पश्चिम बंगाल जैरे राज्यों में गंगा नदी में 48 लाख से अधिक अंगुलिकाएं छोड़ी गई हैं।

Hindustan, 04.06.2022


डीएम ने नाव से गंगा नदी में छोड़ा मछली बीज

सुल्तानगंज, निज संवाददाता। प्रखंड के कमरगंज पंचायत स्थित दुर्गा मंदिर प्रांगण में गुरुवार को नमामि गंगे परियोजना के तहत राष्ट्रीय रैंचिंग कार्यक्रम-2022 आयोजित किया गया। कार्यक्रम में डीएम सुब्रत कुमार सेन सहित बीडीओ मनोज कुमार मुर्मू, सीओ शंभू शरण राय, आइसीएआर-सीआईएफआरआई बैरकपुर कलकत्ता के निदेशक डॉ बसंत कुमार दास, बिहार मत्स्य उपनिदेशक शैलेन्द्र कुमार, कृषि विज्ञान केन्द्र के डॉ.जियाउल एवं नमामि गंगे के अधिकारी व पंचायत के मुखिया भरत कुमार इत्यादि उपस्थित थे। कार्यक्रम में शामिल हुए डीएम सहित साथ चल रहे स्थानीय अधिकारी तथा आयोजक नाव पर मछली बीज साथ लेकर सवार होकर गंगा नदी में पहुंचे। बीज को गंगा नदी के धार में डीएम ने अपने हाथ से छोड़ा।

गुरुवार को गंगा में नाव चढ़कर मछली का बीज नदी में डालते डीएम व अन्य।

मछलियों से मजबूत होगा गंगा का पारिस्थितिकी तंत्र: इसके बाद डीएम ने कहा कि छोड़ी गई मछलियां गंगा नदी की पारिस्थितिकी तंत्र को सुदृढ़ करेगी। मछुआरों के जीविकोपार्जन से जुड़ी समस्या को काफी हद तक दूर करने में सहायक होगी व जलीय जीवों जैसे डाल्फिन के संरक्षण में लाभदायक होगी। डीएम ने कहा कि, सुल्तानगंज से लेकर कहलगांव तक डाल्फिन अभयारण्य केन्द्र हैं। छोड़े गए दो लाख मछलियों के बीज को एक्सपर्ट की राय को मानते हुए मछली नदी से बाहर निकाले। उन्होंने कहा कि मछली पालन में बहुत संभावना है। हमलोग यहां से मछली का निर्यात करें।

2018 में रैंचिंग कार्यक्रम की शुरुआत की गई है

आइसीएआर-सीआइएफआरआई के निदेशक एवं परियोजना के प्रधान अनुवेशक डॉ बसंत कुमार दास ने कहा कि संस्थान के द्वारा नमामि गंगे परियोजना के तहत रैंचिंग कार्यक्रम की शुरुआत 2018 से ही की गई है। इसके तहत लगभग 50 लाख से ज्यादा मछली की प्रजातियों की अंगुलिकाओं को गंगा नदी के मार्ग में आने वाले राज्यों के विभिन्न नदी घाटों से छोड़ा जा चुका है।

Dainik Bhaskar, 03.06.2022

नमामि गंगे परियोजना के तहत सिफरी ने पटना में गंगा नदी में किया रैन्चिंग

बैरकपुर, कोलकाता। नमामि गंगे परियोजना, भाकृअनुप-केन्द्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान, बैरकपुर कोलकाता के द्वारा राष्ट्रीय रैन्चिंग कार्यक्रम के तहत 3 जून को पटना, बिहार में एक रैन्चिंग कार्यक्रम आयोजित किया। भारतीय मेजर कार्प के 2 लाख मछली बीज को पटना के गंगा नदी में छोड़ा गया। इस रैन्चिंग का उद्देश्य गंगा नदी में मत्स्य प्रजातियों का संरक्षण और पुनरुद्धार करना है।

कार्यक्रम का आयोजन मुख्य अतिथि उपमुख्यमंत्री, बिहार सरकार तारकिशोर प्रसाद की पावन उपस्थिति में किया गया। इस अवसर पर कृत्रिम रूप से तैयार किए ब्रूड के निदेशक, डॉ. बसंत कुमार दास और प्रधान अन्वेषक नमामि गंगे, डॉ. रामेश्वर सिंह, कुलपति बिहार पशु विज्ञान विश्वविद्यालय पटना एवं डॉ. आशुतोष उपाध्याय, निदेशक भारतीय कृषि अनुसंधान परिषद का पूर्वी अनुसंधान परिसर पटना और निशात अहमद, निदेशक मत्स्य विभाग, बिहार सरकार ने स्थानीय मछुआरों को रैन्चिंग के महत्व तथा मछलियों के संरक्षण प्रति संवेदनशील बनाया। उन्होंने कहा इस रैन्चिंग कार्यक्रम का उद्देश्य नदी की 'अविरल धारा' और 'निर्मल धारा' को बनाए रखना है। कार्यक्रम में सिफरी के वैज्ञानिक, मत्स्य निदेशक, सचिव, पीएफसीएस,


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NAMAMI GANGE: HOLISTIC CONSERVATION AND REJUVENATION OF RIVER GANGA

G Asok Kumar

WORLD ENVIRONMENT DAY

Dabang Dunia, 05.06.2022

Employment News, 10.06.2022

मछुआरों को किया गया जागरूक

पटना/कार्यालय प्रतिनिधि। बीते 8 जून से 14 जून के बीच गंगा नदी की सफाई एवं हिल्सा और डॉल्फिन संरक्षण को लेकर जागरुकता कार्यक्रम का आयोजन किया गया। कार्यक्रम में विशेष रूप से मछुआरों को गंगा नदी की सफाई एवं हिल्सा और डॉल्फिन संरक्षण को लेकर जगारूक किया गया। मुख्य रूप से घाया घाट, राजा घाट, मछुआघाट, आलमगंज कंगन घाट, मूंद घाट, अदालत घाट तथा अन्य प्रमुख घाटों पर यह जागरुकता चलया गया। केंद्रीय अंतर्देशलीय मत्स्य अनुसंधान संस्थान, वैरकपुर कोलकाता एवं पटना के संयुक्त तत्तवावधान में कार्यक्रम चलाया गया। इस दौरान संस्थान के निदेशक डॉ वीके दास ने मछुआरों को सलाह दिया कि हिल्सा अगर किसी मछुआ भाइयों को टैंग वाली हिल्सा या छोटी हिल्सा मिले तो इसकी सूचना जिला मत्स्य कार्यालय या 'आईसीएआर और सिफरी' को दें। कहा कि सूचना देने वालों को पुरस्कृत किया जायेगा। डॉ दास ने बताया कि हिल्सा विकाशन परियोजना जो फरका में चलाया जा रहा है। इसके तहत लगभग 64000 से अधिक हिल्सा मछली ऊपरी गंगा मे छोड़ी जा चुकी है। स्वच्छे गंगा कार्यक्रम के लिए राष्ट्रीय मिशन के तहत आयोजित कार्यक्रम का मुख्य उद्देश्य मछुआरों को विशेष रूप से पटना के गंगा नदी की सफाई तथा गंगा नदी मे हिल्सा तथा डॉल्फिन के संरक्षण के प्रति शिक्षित करना था। गंगा मे मत्स्य पालन गतिविधियों में प्रत्यक्ष रूप से लगभग 250-300 मछुआरों ने भाग लिया।

ऑटोमेटिक एग्लूटिनेशन टेक्नोलॉजी की होगी स्थापना

युवक की सड़क दुर्घटना में मौत

Sanmarg, 15.06.2022

गंगा में 5.50 लाख मछली का जीरा डाला

साहिबगंज. भारतीय कृषि अनुसंधान परिषद व केंद्रीय अंतरस्थलीय अनुसंधान बैरकपुर की ओर से फरक्का बराज के ऊपरी फैलाव क्षेत्र के श्रीधर घाट तक डॉ वीके दास निदेशक व प्रधान अनुसंधानक प्रोजेक्ट के मार्गदर्शन में हिलसा मछली की रिवर रेचिंग की जा रही है. 64881 हिलसा मछली बुधवार तक गंगा नदी में छोड़ी जा चुकी है. फरक्का बराज के ऊपरी क्षेत्र के गंगा के फैलाव में 5.50 लाख हिलसा के अंडे छोड़े गये हैं. इसके तहत सर्वे व जागरुकता कार्यक्रम फरक्का में गंगा के फैलाव क्षेत्र में प्रयागराज अलाहाबाद तक चलाया जा रहा है. इसी संदर्भ में साहिबगंज के जिला मत्स्य पदाधिकारी, मत्स्य प्रसार पदाधिकारी झारखंड ईस्टर्न गंजेटिक फिशरमैन ऑपरेटिव सोसाइटी लिमिटेड के पदाधिकारियों ने मछुआ सोसाइटी में मीटिंग की. मीटिंग का मुख्य एजेंडा हिलसा मछली एवं गंगा में डॉल्फिन के संरक्षण तथा गंगा नदी को फिर से पहले की तरह स्वच्छ एवं निर्मल बनाना है. इस बैठक में डॉ सौरभ नंदी, अध्या कुमनी, देवलीना साधुखन स्मृति सामंत राय आदि थे थे.

हिलसा मछली व गंगेटिक डॉल्फिन के संरक्षण के लिए हुआ मंथन

साहिबगंज। संवाददाता।

हिलसा मछली व डॉल्फिन का संरक्षण कर गंगा नदी को स्वच्छ व निर्मल बनाने के लिए बुधवार को कॉलेज रोड स्थित मछुआ सोसाइटी में जिला मत्स्य पदाधिकारी, मत्स्य प्रसार पदाधिकारी, दी झारखण्ड ईस्टर्न गंजेटिक फिशरमैन कोऑपरेटिव सोसाइटी लिमिटेड के पदाधिकारी एवं भारतीय कृषि अनुसंधान परिषद, केंद्रीय अंतर स्थलीय मत्स्यकी अनुसंधान संस्थान, बैरकपुर के वैज्ञानिक व रिसर्च स्कॉलर ने बैठक की। बैठक में हिसला मछली व डॉल्फिन के संरक्षण को लेकर जागरूकता फलाने पर मंथन हुआ। मछुआ सोसाइटी के अध्यक्ष अशोक कुमार चौधरी ने बताया कि भारतीय कृषि अनुसंधान परिषद, केंद्रीय अंतरस्थलीय मत्स्यकी अनुसंधान संस्थान, बैरकपुर ने फरक्का बराज के ऊपरी फैलाव क्षेत्र के श्रीधर घाट तक एनएमजीसी निदेशक सह प्रधान अनुसंधानक डॉ वीके दास के मार्गदर्शन में लगातार हिलसा मछली की रिवर रेचिंग कर रही है। अभी तक 64881 हिलसा मछली गंगा नदी में रिवर रैचिंग के तहत छोड़ा गया है। इसके साथ ही फरक्का बराज के ऊपरी क्षेत्र के गंगा के फैलाव में 5.50 लाख हिलसा के अंडे छोड़े गए हैं। इसके तहत सर्वे एवं जागरूकता कार्यक्रम पूरे साल फरक्का के ऊपरी क्षेत्र के गंगा के फैलाव क्षेत्र में प्रयागराज, अलाहाबाद तक चलाया जा रहा है। मौके पर डॉ सौरभ नंदी, अध्या कुमनी, देवलीना साधुखन, स्मृति सामंत राय, अमित चौधरी, निखिल साहा सभी बैरकपुर, साहिबगंज मत्स्य पदाधिकारी संजय कुमार गुप्ता, मत्स्य प्रसार पदाधिकारी नवीन कुमार, मछुआ सोसाइटी सभापति अशोक कुमार चौधरी, मंत्री राजीव कुमार चौधरी, पूर्व मंत्री देवेंद्र कुमार चौधरी, नरेश कुमार निषाद, ओम प्रकाश चौधरी, केदार सिंह, पवन कुमार चौधरी, राजन चौधरी सहित अन्य मौजूद थे।

Pravat Barta, 16.06.2022

Indian Punch, 16.06.2022

फरक्का बराज के बाद विलुप्त हुआ राजमहल का हिलसा

राजमहल, प्रतिनिधि। राजमहल का हिलसा मछली कभी क्षेत्र में मशहूर था । हालांकि फरक्का बराज बनने के बाद राजमहल के गंगा नदी से हिलसा मछली विलुप्त सी हो गई है। मछली कारोबारी उज्जवल हालदार बताते हैं कि राजमहल का हिलसा पूरे क्षेत्र में प्रचलित था। राजमहल के अलावा बाहर क्षेत्रों में भी इसका पूरा डिमांड हुआ करता था। जलकर और मछुआरा भी बाहर से पहुंचते थे। फरक्का बराज बनने के बाद बराज का गेट बंद हो जाने से मछली ऊपरी इलाके में नहीं आ पाई । इससे पूरी तरह विलुप्त हो गई। विभाग के माध्यम से विगत कई सालों से ऊपरी इलाके में हिलसा संरक्षण को लेकर प्रयास किया जा रहा है।

राजमहल में जागरुकता कार्यक्रम चलाते भारतीय कृषि अनुसंधान परिषद केंद्रीय अंतर स्थलीय मत्स्य के अनुसंधान संस्थान (बैरकपुर) के वैज्ञानिक/रिसर्च स्कॉलर। • हिन्दुस्तान

छोड़ा गया मछली व जीरा (बीज) : बैरकपुर से पहुंची टीम ने फरक्का से ऊपरी इलाके में करीब 5.5लाख जीरा (बीज) व 100 से लेकर 500 ग्राम तक के करीब 66 हजार पीस हिलसा मछली फरक्का से लेकर साहिबगंज के बीच छोड़ा गया है। इसमें लगभग 7 हजार को टैंग कर टैगिंग किया गया।

हिलसा मछली संरक्षण के लिए चला जागरुकता कार्यक्रम : नमामि गंगे के तहत भारतीय कृषि अनुसंधान परिषद केंद्रीय अंतर स्थलीय मत्स्य के अनुसंधान संस्थान (बैरकपुर) के वैज्ञानिक/रिसर्च स्कॉलरों ने गंगा नदी में डाल्फिन व हिलसा मछली के संरक्षण को लेकर जागरुकता कार्यक्रम चलाया। कार्यक्रम का नेतृत्व डायरेक्टर डॉ बसंत कुमार दास ने किया। मौके पर राजमहल सहित आसपास ग्रामीण क्षेत्रों के गंगा तटीय इलाके में हिलसा मछली के संरक्षण को लेकर मछली व्यवसाई व मछुआरा को जागरुक किया गया। कार्यक्रम में डॉ सौरभ नंदी , देवलीना साधुकान, अर्घ कुणी, स्मृति समंतराय , उज्ज्वल हलदार सहित अन्य मौजूद थे।

হারিয়ে যাওয়া মাছেরা ফিরছে গঙ্গায়

পিয়ালি, কাজরি, গাড়ুয়ার মতো পুরনো প্রজাতির খোঁজ সিফরির সমীক্ষায়

মাছেদের প্রত্যাবর্তন

Bartaman on 04.07.2022

Home › India › 56 lakh fish seeds released in Ganga: Govt

India

56 lakh fish seeds released in Ganga: Govt

PTI 28 July, 2022 08:12 pm IST

Like 1

The Print on 28.07.2022

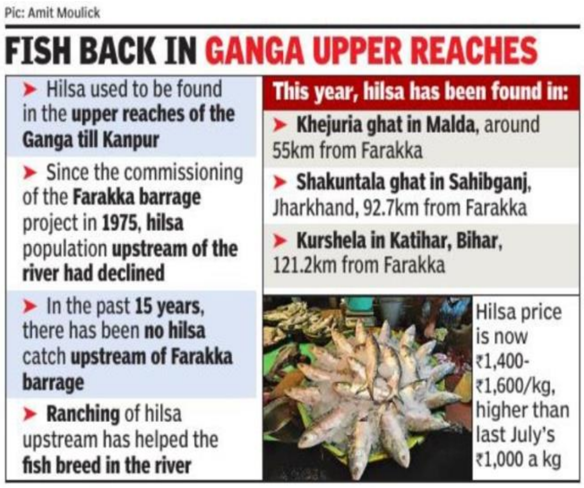
Decline in catch due to over-fishing, juvenile netting keep hilsa price high

CITY / Subhro Niyogi / Jul 27, 2022, 08:18 IST

TOI

Kolkata: Hilsa and the monsoon are as much synonymous in Bengali lexicon as they are in the kitchen. But this year, ilish continues to elude the average household with retail price still hovering around the Rs 1,400-1,600 per kg mark for fish weighing over a kilogram. Though the price has dipped from the first week of July, when it was Rs 1,800-Rs 2,000 per kg, it is still considerably high[...]ar's late-July price of Rs 1,000-Rs 1,200 per kg.

OPEN IN APP



Pic: Amit Moulick

FISH BACK IN GANGA UPPER REACHES

- Hilsa used to be found in the upper reaches of the Ganga till Kanpur
- Since the commissioning of the Farakka barrage project in 1975, hilsa population upstream of the river had declined
- In the past 15 years, there has been no hilsa catch upstream of Farakka barrage
- Ranching of hilsa upstream has helped the fish breed in the river

This year, hilsa has been found in:

- Khejuria ghat in Malda, around 55km from Farakka
- Shakuntala ghat in Sahibganj, Jharkhand, 92.7km from Farakka
- Kurshela in Katihar, Bihar, 121.2km from Farakka

Hilsa price is now ₹1,400-₹1,600/kg, higher than last July's ₹1,000 a kg

Times of India on 27.07.2022

संथाल हूल एक्सप्रेस | साहिबगंज | 03

उपायुक्त ने गंगा नदी में छोड़े कतला, रेहू, मृगल, कालबासु का 2 लाख भारतीय कार्प मत्स्य इयरलिंग

नदी में जैव पारिस्थितिकी व गंगा को स्वच्छ बनाए रखने में मदद करेंगे मत्स्य इयरलिंग

Santhal Hool Express, Sahibganj on

इंडियन पंच | साहिबगंज/पाकुड़ पंच

उपायुक्त ने गंगा नदी में छोड़ा विभिन्न प्रजातियों का कॉर्प मत्स्य इयरलिंग

Indian Punch, Sahibganj on 3rd August,2022

3rd August,2022

Hindustan Times, Varanasi on 20th August 2022

Jansandesh Times, Varanasi on 20th August 2022

Dainik Amar Stambh dated 20th August 2022

गंगा में छोड़ी गईं दो लाख मछलियां

जागरण संवाददाता, वाराणसी : नमामि गंगे योजना के तहत गंगा को प्रदूषण मुक्त करने के लिए केंद्र व प्रदेश सरकार रिवर रैंचिंग (नदी पशुपालन) की भी मदद ले रही है। इस क्रम में शुक्रवार को गंगा में देसी मेजर कार्प, कतला, रोहू व नैना नस्ल की मछलियां छोड़ी गई हैं। सेंट्रल इनलैंड फिशरी रिसर्च इंस्टीट्यूट प्रयागराज और मत्स्य विभाग के सहयोग से प्रदूषण को नियंत्रित करने के लिए गंगा नदी में विभिन्न प्रजातियों की दो लाख मछलियों को छोड़ा गया है। यह मछलियां नाइट्रोजन की अधिकता बढ़ाने वाले कारकों को नष्ट करेंगी और बड़ी तादात में मछुआरों की आजीविका में सहायक होंगी। कार्यक्रम में केंद्रीय मत्स्य पालन, पशु पालन एवं डेयरी मंत्री पुरुषोत्तम रुपाला भी मौजूद थे। मत्स्य विभाग के उपनिदेशक अनिल कुमार ने बताया कि गंगा में प्रदूषण को नियंत्रित करने और नदी का इको सिस्टम बरकरार रखने के लिए रिवर रैंचिंग प्रक्रिया अपनाई जाती है। बताया कि हर दिन गंगा में काफी संख्या में नाइट्रोजन गिरता है।

Dainik Jagran dated 20th August 2022

Rashtriya Sahara dated 20th August 2022

नदियों को लुप्त न होने देने का लिया संकल्प

जासं, प्रयागराज : भाकृअनुप-केंद्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान की ओर से यमुना नदी के तट पर 'विश्व नदी दिवस' का आयोजन किया गया। इसमें नदी को बचाने के लिए किए जा रहे प्रयासों को बताया गया। सभी ने संकल्प लिया कि नदियों को लुप्त नहीं होने देंगे। इस मौके पर डा. धर्म नाथ झा, डा. अबसार आलम, डा. वीआर ठाकुर, नंदलाल निषाद, नमामि गंगे के प्रतिनिधि राजेश शर्मा आदि मौजूद रहे।

Published in Dainik jagran, 26-09-2022

प्रयागराज सिफरी द्वारा 'विश्व नदी दिवस' का आयोजन

मंत्र भारत संवाददाता

प्रयागराज। भाकृ अनुप-केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान, प्रयागराज के द्वारा 25 सितंबर 2022 को यमुना नदी के तट पर 'विश्व नदी दिवस' का आयोजन किया गया। यह कार्यक्रम प्रयागराज के करैला बाग घाट पर तथा दिल्ली में सोनिया विहार, यमुना घाट पर मनाया गया। इसमें नदी की महत्ता और बचाने के प्रयास पर संस्थान के वैज्ञानिकों द्वारा विचार व्यक्त किया गया साथ ही नदियों को लुप्त न होने देने का संकल्प लिया गया। इस वर्ष के विश्व नदी दिवस का मूल विषय (थीम) था : जैव विविधता के लिए नदियों का महत्व। संस्थान के केंद्राध्यक्ष डॉ धर्म नाथ झा ने उपस्थित लोगों से कहा कि नदियाँ प्रकृति का उपहार है जिसमें जैव विविधता पोषण और संरक्षण होता है। इसलिए इसे बनाए रखने का सतत प्रयास होना चाहिए। इसके लिए नदियों के जलग्रहण क्षेत्रों में कीटनाशकों और प्लास्टिक उपयोग को कम करें, अधकचरा जैविक और अकार्बनिक कचरे को नदियों में न बहने दें, कृषि, औद्योगिक एवं घरेलू उपयोगों के लिए अनावश्यक जल की खपत को कम करें, वनरोपण कर के नदियों के कटाव को रोकें आदि का प्रयास करना चाहिए। संस्थान के वैज्ञानिक डॉ अबसार आलम एवं डॉ वी आर ठाकुर ने लोगों से मत्स्य विविधता के महत्व और संरक्षण के उपाय के बारे में बताया। समारोह में करैला बाग के सभापति नंदलाल निषाद नंदा ने लोगों से जल और मत्स्य संरक्षण पर ध्यान देने के लिए कहा। कार्यक्रम में नमामि गंगे के प्रतिनिधि राजेश शर्मा उपस्थित थे तथा सभा को संबोधित करते हुए उन्होंने नदियों को स्वच्छ रखने का संकल्प दिलाया। इस अवसर पर नदी तट पर निवास करने वाले सामान्य जन, मछुआरे, व्यवसायी, सननार्थी, विद्यार्थी आदि ने भाग लिया और अपना विचार रखा। उपस्थित सभी श्रोताओं ने नदी को स्वच्छ रखने और बचाने के प्रति अपनी प्रतिबद्धता को व्यक्त किया।

Published in Mantra Bharat, 26-09-2022

{ WORLD RIVER DAY }

Central Inland Fisheries Research Institute scientists stress need to protect water bodies

HT Correspondent
allahabad.htdesk@hindustantimes.com

PRAYAGRAJ : World River Day was observed by Indian Council of Agricultural Research (ICAR)- Central Inland Fisheries Research Institute (CIFRI), Prayagraj on the banks of Yamuna on Sunday.

The event was held at Karela Bagh Ghat in Prayagraj and Sonia Vihar Yamuna Ghat in New Delhi. The scientists of the institute expressed their views on the importance of the river and the effort to save it. A pledge to not allow the rivers to disappear was also administered to all present.

This year's theme was "the importance of rivers for biodiversity". Dharam Nath Jha, the centre head of the institute, informed the people present that rivers are a gift of the nature in which biodiversity is nurtured and conserved.

"So, there should be a continuous effort to maintain it and for this the use of pesticides and plastics in catchment areas of rivers should be reduced. Do not allow waste, both organic and inorganic, to flow into rivers and reduce unnecessary water consumption for agricultural, industrial and domestic uses. There is also a need to stop erosion of rivers through afforestation and other steps," he said.

A pledge to protect rivers being administered during an event in Prayagraj on Sunday. HT PHOTO

Scientists of the Institute Absar Alam and DR Thakur interacted with people and informed them about the importance of diversity of fish and the measures to be taken to save them.

Rajesh Sharma, representative of Namami Gange Mission, administered the pledge to keep the rivers clean.

On this occasion, large number of people, including fishermen, businessmen and students residing on the banks of the river also expressed their views. All people present promised to keep the rivers clean and save them from extinction.

Published in Hindustan Times, 26-09-2022

विश्व नदी दिवस का आयोजन हुआ

लोकमित्र ब्यूरो

प्रयागराज । केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान प्रयागराज के तत्वावधान में रविवार को यमुना नदी के तट पर विश्व नदी दिवस का आयोजन किया गया। यह कार्यक्रम प्रयागराज के करैलाबाग घाट पर तथा दिल्ली में सोनिया विहार, यमुना घाट पर मनाया गया । इसमें नदी की महत्ता और बचाने के प्रयास पर संस्थान के वैज्ञानिकों द्वारा विचार व्यक्त किया गया। साथ ही नदियों को लुप्त न होने देने का संकल्प लिया गया। इस वर्ष के विश्व नदी दिवस का मूल विषय (थीम) था जैव विविधता के लिए नदियों का महत्व। संस्थान के केंद्राध्यक्ष डॉ० धर्म नाथ झा ने उपस्थित लोगों से कहा कि नदियाँ प्रकृति का उपहार है। जिसमें जैव विविधता पोषण और संरक्षण होता है। इसलिए इसे बनाए रखने का सतत प्रयास होना चाहिए। इसके लिए नदियों के जलग्रहण क्षेत्रों में कीटनाशकों और प्लास्टिक उपयोग को कम करें, अधकचरा जैविक और अकार्बनिक कचरे को नदियों में न बहने दें, कृषि, औद्योगिक एवं घरेलू उपयोगों के लिए अनावश्यक जल की खपत को कम करें, वनरोपण कर के नदियों के कटाव को रोकें आदि का प्रयास करना चाहिए। संस्थान के वैज्ञानिक डॉ० अबसार आलम एवं डॉ० बी० आर० ठाकुर ने लोगों से मत्स्य विविधता के महत्व और संरक्षण के उपाय के बारे में बताया। समारोह में करैलाबाग के सभापति नंदलाल निषाद नंदाजी ने लोगों से जल और मत्स्य संरक्षण पर ध्यान देने के लिए कहा। कार्यक्रम में नमामि गंगे के प्रतिनिधि राजेश शर्मा भी कार्यक्रम में सहभागिता करते हुए अपने सम्बोधन में कहा कि नदियों को स्वच्छ रखने का संकल्प दिलाया। इस अवसर पर नदी तट पर निवास करने वाले सामान्य जन, मछुआरे, व्यवसायी, स्नानार्थी, विद्यार्थी आदि ने प्रतिभाग किया। उपस्थित सभी श्रोताओं ने नदी को स्वच्छ रखने और बचाने के प्रति अपनी प्रतिबद्धता को व्यक्त किया।

Published in Lok Mitra, 26-09-2022

हिल्सा व डॉल्फिन संरक्षण को लेकर लोगों को किया गया जागरूक

पटना/कार्यालय प्रतिनिधि। इन दिनों गंगा नदी के किराने स्थित विभिन्न घाटों पर हिल्सा एंव डॉल्फिन संरक्षण को लेकर जागरुकता कार्यक्रम चलाया जा रहा है। बीते 13 और 14 सितंबर को पटना के राजा घाट एवं गोसाई घाट पर मधुमारों को गंगा नदी की सफाई एवं हिल्सा तथा डॉल्फिन संरक्षण को लेकर जगारूक किया गया। इस कार्यक्रम का आयोजन केन्द्रीय अवस्थी केन्द्रीय अन्तस्थलीय मात्स्यिकी अनुसंधान संस्थान, बैरकपुर कोलकता के द्वारा चलाया जा रहा है। यह कार्यक्रम संस्थान के निदेशक डा.बीके दास के मार्गदर्शन मे किया जा रहा है।

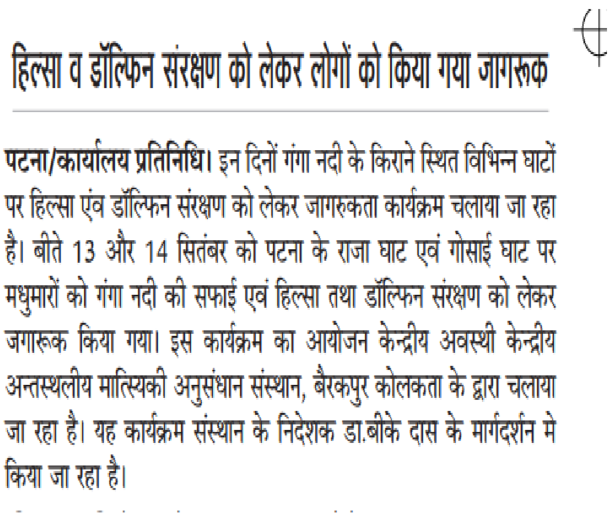
Published in Sanmarg, Patna, 20-09-2022

Sari Katha News, Sahibganj, Jharkhand
22.9.2022

हिलसा एवं डॉल्फिन संरक्षण को लेकर जागरूकता कार्यक्रम

साहिबगंज : दिनांक 22 सितम्बर 2022 को शहर के शकुंतला घाट के किनारे एक दिवसीय हिलसा एवं डॉल्फिन संरक्षण को लेकर जागरूकता कार्यक्रम का आयोजन किया गया जिसमें मुख्य रूप से मछुआरा बंधुओं ने भाग लिया. आपको बता दें कि राष्ट्रीय स्वच्छ गंगा मिशन के तहत फरक्का में हिलसा विकास परियोजना चलाया जा रहा है जिसमें अभी तक 68000 से अधिक हिलसा मछली फरक्का के ऊपरी हिस्से में छोड़ा जा चुका है, मछली छोड़ने के दौरान कुछ मछलियो को टैग किया जाता है अगर किसी मछुआरा भाइयों को छोटी हिलसा या टैग किए गए हिलसा मिले तो इसकी सूचना मत्स्य विभाग, आईसीएआर-सीआईएफ आरआई अथवा मछुआ सोसाइटी साहिबगंज को दे, सूचना देने वाले को पुरस्कृत किया जाएगा. डॉल्फिन एवं गंगा नदी को स्वच्छ एवं निर्मल रखने को लेकर भी मछुआरा भाइयों को जागरूक किया गया. युवा शक्ति

Published in Yuva Shakti, Sahibganj dated 22-09-2022



हिल्सा व डॉल्फिन संरक्षण को लेकर लोगों को किया गया जागरूक

पटना/कार्यालय प्रतिनिधि। इन दिनों गंगा नदी के किराने स्थित विभिन्न घाटों पर हिल्सा एंव डॉल्फिन संरक्षण को लेकर जागरुकता कार्यक्रम चलाया जा रहा है। बीते 13 और 14 सितंबर को पटना के राजा घाट एवं गोसाई घाट पर मधुमारों को गंगा नदी की सफाई एवं हिल्सा तथा डॉल्फिन संरक्षण को लेकर जगारूक किया गया। इस कार्यक्रम का आयोजन केन्द्रीय अवस्थी केन्द्रीय अन्तस्थलीय मात्स्यिकी अनुसंधान संस्थान, बैरकपुर कोलकता के द्वारा चलाया जा रहा है। यह कार्यक्रम संस्थान के निदेशक डा.बीके दास के मार्गदर्शन मे किया जा रहा है।

Published in Sanmarg, Patna dated 20-09-2022

৫ অক্টোবর জাতীয় ডলফিন দিবস হিসাবে ঘোষিত

গঙ্গার শুশুক বাঁচাতে দিনভর প্রচার চালাল কেন্দ্রীয় সংস্থা

Published in Ei Samay (Bengali newspaper) on 07.10.2022

০.৮ লক্ষ মাছের পোনা গঙ্গা ছাড়া হলো গঙ্গায়

Published in NayaZamana (Bengali newspaper at Farakka) on 23.10.2022

০.৮ লক্ষ মাছের পোনা ছাড়া হল গঙ্গায়

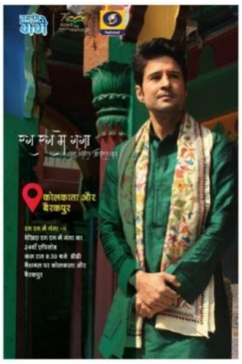
দিন দর্পণ, বহরমপুর: আইসিএআর-সেন্ট্রাল ইনল্যান্ড ফিশারিজ রিসার্চ ইনস্টিটিউট, ব্যারাকপুর গঙ্গা নদী সংরক্ষণ ও পুনরুদ্ধারের জন্য এনটিপিসি, ফারাক্কার সহযোগিতায় পশ্চিমবঙ্গে ফারাক্কা গাঙ্গেয় প্রোগ্রামের অধীনে 'ন্যাশনাল রেঞ্চিং প্রোগ্রাম-২০২২' অনুষ্ঠিত হয়।

এই মেগা রেঞ্চিং অনুষ্ঠানের অংশ হিসাবে, মুর্শিদাবাদের ফারাক্কার গান্ধি ঘাটে আরডি দেশপান্ডে, জিএম ফারাক্কা ব্যারেজ, অভিজিৎ কুমার ডিজিএম, এদের মতো বেশ কয়েকজন বিশিষ্ট সরকারি কর্মকর্তার উপস্থিতিতে একটি পশুপালন ও সচেতনতামূলক অনুষ্ঠান অনুষ্ঠিত হয়। ইজিএন, এনটিপিসি, সন্দীপ কুমার, ইঞ্জিনিয়ার ফারাক্কা দীপক নায়ক, ভারপ্রাপ্ত, কেভিকে মালদা ডা.বসন্ত কুমার দাস, ডিরেক্টর সিআইএফআরআই, ডা. এ.কে. প্রকল্পের সাহু (বিজ্ঞানী) এবং ড. বিকাশ কুমার (বিজ্ঞানী) বর্তমান নমামি গঙ্গে মাছ সংরক্ষণ মডিউল সম্পর্কে স্থানীয় মৎস্যজীবীদের মাছ ও ডলফিনকে টিকিয়ে রাখার জন্য প্রয়োজনীয় গাঙ্গেয় স্বাস্থ্যের গুরুত্ব সম্পর্কে সম্বোধন করেন। নমামি গঙ্গে কর্মসূচির সঙ্গে এনটিপিসি সিএসআর স্কিমের অধীনে ফারাক্কায় রুই, কাতলা এবং মৃগেল বীজের কৃত্রিমভাবে প্রজননকৃত বন্য মাছের জার্মপ্লাজম ০.৮ লক্ষেরও বেশি নদীতে ছেড়ে দেওয়া হয়।

এনটিপিসি এবং সিআইএফআরআই-এর যৌথ প্রচেষ্টায় দেশীয় মাছ সংরক্ষণের পাশাপাশি, জেলেদের জীবিকা বৃদ্ধিতে এগুলি বিকাশ করবে। রেঞ্চিংয়ের পাশাপাশি, সিআইএফআরআই বিজ্ঞানী এবং অন্যান্য সরকারি কর্মকর্তাদের মধ্যে ইলিশ পালন এবং এলাকায় সংরক্ষণের বিষয়ে একটি বৈঠকও অনুষ্ঠিত হয়। ভবিষ্যতে মাছ ও অন্যান্য জলজ প্রাণী সংরক্ষণের জন্য ব্যারেজ ফিশ পাসকে আরও কার্যকর করার প্রচেষ্টাও নেওয়া হয়েছে। এই অনুষ্ঠানের অধীনে প্রতিষ্ঠানটি ফারাক্কায় গঙ্গার উজানে ৫ লক্ষেরও বেশি ফিশ ফিঙ্গারলিং এবং ০.৭ লক্ষ ইলিশ পালন করেছে। যার ফলে আরও সামগ্রিক উপায়ে গাঙ্গেয় মৎস্যসম্পদ পুনরুদ্ধার করা হয়েছে। অভিজিৎ কুমার, ডিজিএম, এনটিপিসিও যৌথভাবে উল্লেখ করেছেন যে, কৃত্রিম প্রজনন সম্পর্কিত এনটিপিসি-সিআইএফআরআই প্রশিক্ষণের প্রকল্পটিও সামগ্রিক জীবিকা কাঠামো বৃদ্ধির জন্য এলাকার স্থানীয় জেলেদের দেওয়া হয়েছিল। এই বর্তমান কর্মসূচিতে, বিভিন্ন গঙ্গা তীরে সমাজের সকল শ্রেণির মধ্যে সক্রিয় অংশগ্রহণ লক্ষ্য করা গিয়েছে এবং ১০০ জনেরও বেশি জেলেকে গঙ্গার পুনরুজ্জীবন এবং মূল্যবান গাঙ্গেয় মাছের পুনরুদ্ধারের বিষয়ে সংবেদনশীল করা হয়েছে।

Published in Din Darpan (Bengali newspaper at Berhampore) on 25.10.2022

Social Media



https://m.facebook.com/story.php?story_fbid=2939699782915375&id=1502674319951269&sfnsn=wiwspwa

https://youtu.be/i3wrG2l7vNs

https://fb.watch/8-zzaitDym/

https://fb.watch/8-zEGlJ6rW/

https://fb.watch/9p-PxQOXmx/

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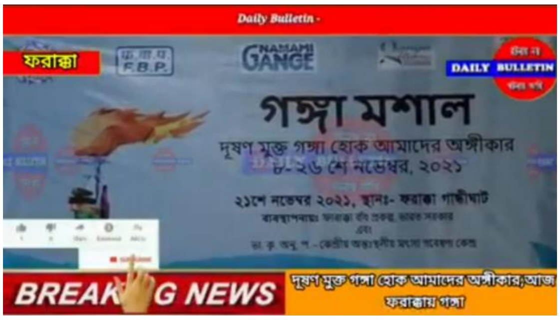

https://fb.watch/9qCJkZ5prF/

https://fb.watch/9qP9kDo2FI/

Home › দক্ষিণবঙ্গ

দক্ষিণবঙ্গ রাজ্য

‘নমামী গঙ্গে’ প্রকল্পের তিনদিনের উৎসব শুরু ফরাক্কায়

By **UBS Portal** - November 1, 2021 94

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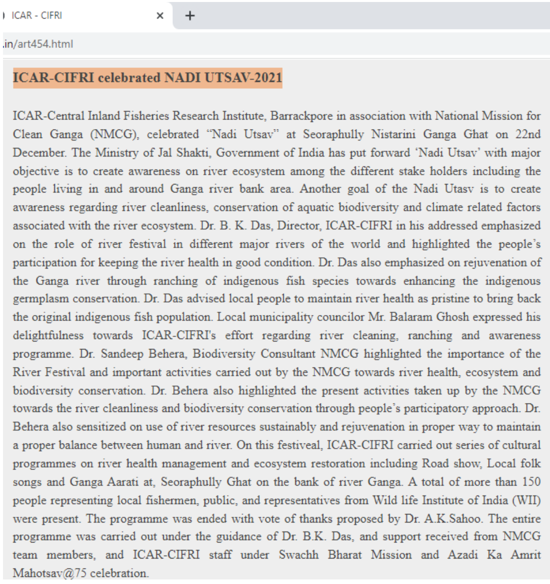
ফরাক্কা: ফরাক্কাতে শুরু হয়েছে এ বছরের গঙ্গা উৎসব। কেন্দ্রের নমামি গঙ্গে প্রজেক্টে অন্তর্ভুক্ত গঙ্গাকে কেন্দ্র করে যে সমস্ত প্রকল্প গ্রহণ করা হয়েছে সেগুলো ইতিবাচক রূপে প্রতিফলিত করার উদ্দেশ্য নিয়েই এই উৎসব শুরু হয়েছে ফরাক্কা, কলকাতা সহ ভারতবর্ষের বিভিন্ন প্রান্তে। তিনদিন ব্যাপী উৎসবে সোমবার সকালে ফরাক্কা গান্ধি ঘাটে গঙ্গা পুজোর মধ্য দিয়ে অনুষ্ঠানের শুভারম্ভ হয়। উপস্থিত ছিলেন ফারাক্কা ব্যারেজ প্রজেক্টের জেনারেল ম্যানেজার রঙ্গস্বামী আজাগেসন। উদ্যোগী সংস্থা সিফ্রি-এর তরফে দায়িত্বে থাকা বৈজ্ঞানিক সঞ্জীব কুমার সহ সেন্ট্রাল ইনল্যান্ড ফিশ রিসার্চ ইনস্টিটিউট ব্যারাকপুরের বিভিন্ন কর্মকর্তারা। এছাড়াও ছিলেন ব্যারেজ প্রোজেক্টের সুপারিন্টেন্ডেন্ট ইঞ্জিনিয়ার অজিত কুমার সহ আরও অনেকে।

https://www.facebook.com/414610078568705/posts/5047588131937520/?sfnsn=wiwspwa



ICAR - CIFRI

.in/art454.html

ICAR-CIFRI celebrated NADI UTSAV-2021

ICAR-Central Inland Fisheries Research Institute, Barrackpore in association with National Mission for Clean Ganga (NMCG), celebrated "Nadi Utsav" at Seoraphully Nistarini Ganga Ghat on 22nd December. The Ministry of Jal Shakti, Government of India has put forward 'Nadi Utsav' with major objective is to create awareness on river ecosystem among the different stake holders including the people living in and around Ganga river bank area. Another goal of the Nadi Utasv is to create awareness regarding river cleanliness, conservation of aquatic biodiversity and climate related factors associated with the river ecosystem. Dr. B. K. Das, Director, ICAR-CIFRI in his addressed emphasized on the role of river festival in different major rivers of the world and highlighted the people's participation for keeping the river health in good condition. Dr. Das also emphasized on rejuvenation of the Ganga river through ranching of indigenous fish species towards enhancing the indigenous germplasm conservation. Dr. Das advised local people to maintain river health as pristine to bring back the original indigenous fish population. Local municipality councilor Mr. Balaram Ghosh expressed his delightfulness towards ICAR-CIFRI's effort regarding river cleaning, ranching and awareness programme. Dr. Sandeep Behera, Biodiversity Consultant NMCG highlighted the importance of the River Festival and important activities carried out by the NMCG towards river health, ecosystem and biodiversity conservation. Dr. Behera also highlighted the present activities taken up by the NMCG towards the river cleanliness and biodiversity conservation through people's participatory approach. Dr. Behera also sensitized on use of river resources sustainably and rejuvenation in proper way to maintain a proper balance between human and river. On this festiveal, ICAR-CIFRI carried out series of cultural programmes on river health management and ecosystem restoration including Road show, Local folk songs and Ganga Aarati at, Seoraphully Ghat on the bank of river Ganga. A total of more than 150 people representing local fishermen, public, and representatives from Wild life Institute of India (WII) were present. The programme was ended with vote of thanks proposed by Dr. A.K.Sahoo. The entire programme was carried out under the guidance of Dr. B.K. Das, and support received from NMCG team members, and ICAR-CIFRI staff under Swachh Bharat Mission and Azadi Ka Amrit Mahotsav@75 celebration.

http://www.cifri.res.in/art454.html

Posted on *Namami Gange* official Facebook page

Atal Bharat tv, Sahibganj

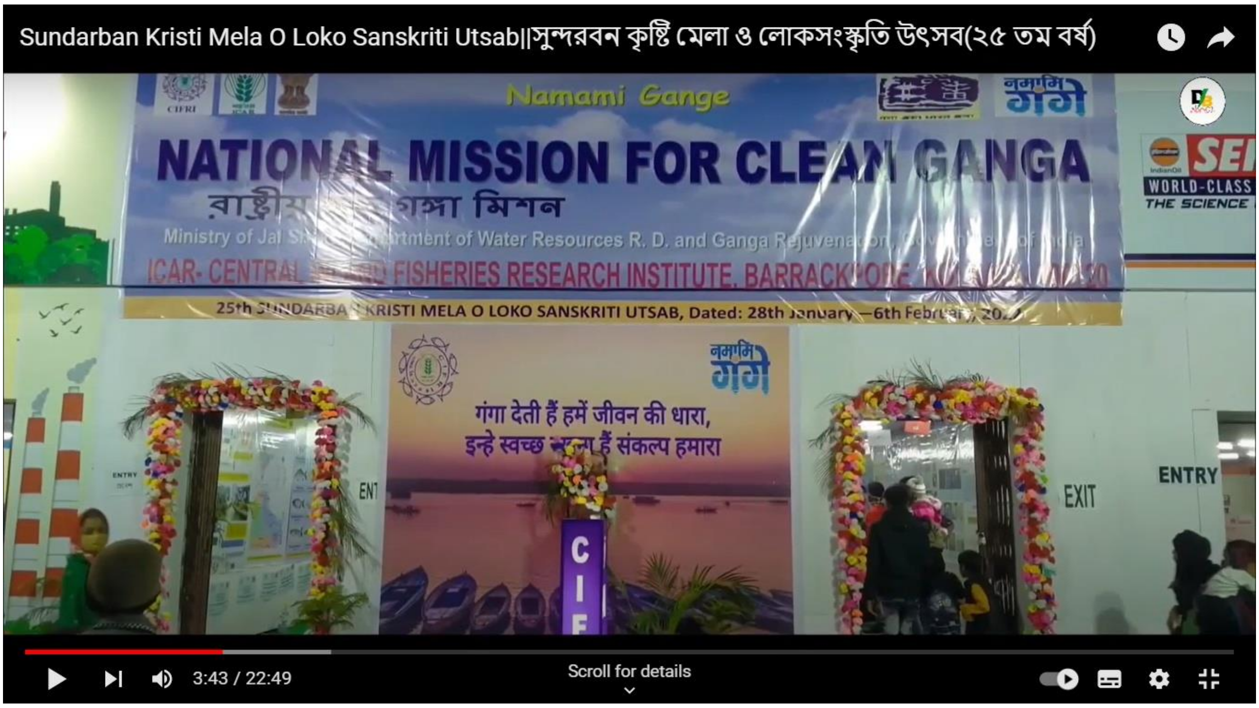
Atal Bharat tv, Sahibganj

https://fb.watch/eG3ks%mvZt/

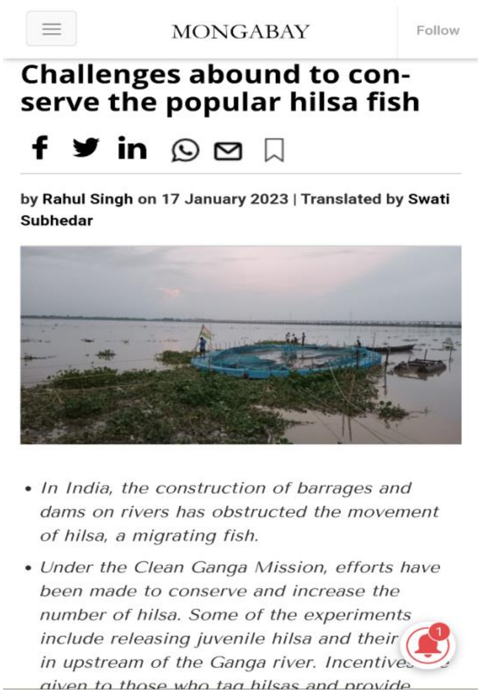
Varanasi Siti live 19 Aug 2022 https://youtu.be/-kYaABZiB1S

DEN kasha Purvanchal News 19-08-2022 https://youtu.be/zTMVNYATGso

25th National Science & Technology Exhibition Kolkata 27-08-2022
https://youtu.be/C4y8YEUE6Mg



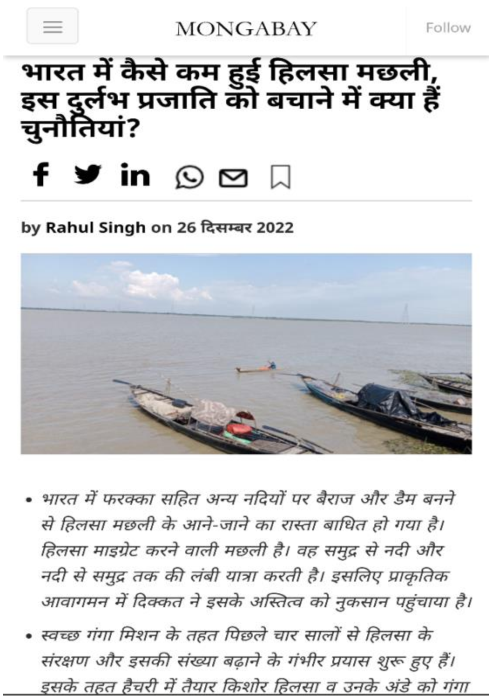
Sundarban Kristi Mela O LokoSanskritiUtsab 2022 NMCG Stall
https://youtu.be/ReEF18gX5l8


MONGABAY Follow

Challenges abound to conserve the popular hilsa fish

by Rahul Singh on 17 January 2023 | Translated by Swati Subhedar

- *In India, the construction of barrages and dams on rivers has obstructed the movement of hilsa, a migrating fish.*
- *Under the Clean Ganga Mission, efforts have been made to conserve and increase the number of hilsa. Some of the experiments include releasing juvenile hilsa and their in upstream of the Ganga river. Incentives given to those who tag hilsas and provide*


MONGABAY Follow

भारत में कैसे कम हुई हिलसा मछली, इस दुर्लभ प्रजाति को बचाने में क्या हैं चुनौतियां?

by Rahul Singh on 26 दिसम्बर 2022

- *भारत में फरक्का सहित अन्य नदियों पर बैराज और डैम बनने से हिलसा मछली के आने-जाने का रास्ता बाधित हो गया है। हिलसा माइग्रेट करने वाली मछली है। वह समुद्र से नदी और नदी से समुद्र तक की लंबी यात्रा करती है। इसलिए प्राकृतिक आवागमन में दिक्कत ने इसके अस्तित्व को नुकसान पहुंचाया है।*
- *स्वच्छ गंगा मिशन के तहत पिछले चार सालों से हिलसा के संरक्षण और इसकी संख्या बढ़ाने के गंभीर प्रयास शुरू हुए हैं। इसके तहत हैचरी में तैयार किशोर हिलसा व उनके अंडे को गंगा*

Mongbay, 17.03.2023


दैनिक भास्कर मुंगेर 18-02-2023

नमामि गंगे कार्यक्रम के तहत सर्वे व जागरूकता कार्यक्रम आयोजित होगी

सर्वेक्षण कार्यक्रम मुंगेर फिसरीज कार्यालयों में होता है आयोजित

कार्यक्रम की जानकारी देते समिति के मंत्री।

‘Dainik Bhaskar’, Munger, 18.02.2023


मत्स्य अनुसंधान केंद्र ने गंगा में छोड़ा हिलसा मछली स्पान

युवा शक्ति

साहिबगंज: जिला के दी झारखंड ईस्टर्न गंगेटिक फिशर मेंस कॉपरेटिव सोसाइटी लिमिटेड के तत्वधान में मत्स्य अनुसंधान केंद्र, बैरकपुर, कोलकाता के रिसर्च स्कॉलर ने वरिष्ठ वैज्ञानिक एके साहू के निर्देश पर नमामि गंगे अभियान के तहत शुक्रवार को ओझा टोली घाट के समीप गंगा में 1.60 लाख हिलसा मछली का निषेचित अंडा व 3 हजार का स्पान छोड़ा। मत्स्य अनुसंधान केंद्र शोधकर्ता दीपक गुप्ता ने बताया कि गंगा नदी में विलुप्त हिलसा मछली के विकास एवं अनुसंधान के लिए स्पान छोड़ा गया है। इस दौरान मछुआरों को भी कई जानकारी दी गयी। मौके पर मछुआ के सोसाइटी के अध्यक्ष अशोक चौधरी, उपाध्यक्ष छोटे लाल चौधरी, मंत्री राजीव कुमार चौधरी, अनुसंधान केंद्र के रिसर्च स्कॉलर नवो कुमार आचार्य, सहयोगी अतुल कुमार, अमित कुमार, प्रभात चंद्र साह व अन्य मौजूद थे।

‘Yuva Shakti’,Sahibganj, 18.02.2023


गंगा में बृहत पैमाने पर हिल्सा मछलियों के उत्पादन को लेकर छोड़ा गया हिलसा मछली का स्पॉन

हिल्सा मछली के संरक्षण और गंगा की स्वच्छता को लेकर भी मछुआरों को किया जागरूक

साहिबगंज जिले में भी होगा हिल्सा मछली का उत्पादन

‘Abaz’,Sahibganj, 18.02.2023


देश-प्रदेश 02

साहिबगंज, शनिवार 18 फरवरी 2023

मत्स्य अनुसंधान केंद्र ने गंगा में छोड़ा हिलसा मछली का अंडा व स्पान

‘Desh Pradesh’, Sahibganj, 18.02.2023


KRISHI JAGRAN

Home / News

ICAR-CIFRI Releases 2,000 Hilsa Spawn into Ganga Under the National Mission for Clean Ganga Project

On February 22, 2023, at Suryadev Ghat in Rajmahal, Jharkhand, ICAR-Central Inland Fisheries Research Institute released 2,000 hilsa spawn and 2,00,000 fertilised eggs into the Ganga as part of the National Mission for Clean Ganga (NMCG).

Eashani Chettri

Updated 23 February, 2023 4:40 PM IST

‘Krishi Jagran’, New Delhi, 23.02.2023


দুরন্ত বার্তা

গঙ্গায় ইলিশ মাছের বৃদ্ধি ঃ সিফ্রির প্রয়াস

‘Duronto Barta’, Kolkata, 22.02.2023


বর্তমান

কৃত্রিম পদ্ধতিতে তৈরি ইলিশের পৌনে দুই লক্ষ ডিমপোনা ছাড়া হল ঝাড়খণ্ডের গঙ্গায়

নয়া উদ্যোগ সিফরির

‘Bartaman’, Kolkata, 27.02.2023


सिफरी द्वारा दस हजार मछलियों को संरक्षण के लिए गंगा नदी में छोड़ा गया

‘Dainik Jagran’,Praygraj, 27.02.2023


आईसीएआर-सिफरी और एनजीबी (डीयू) द्वारा दो दिवसीय राष्ट्रीय संगोष्ठी का समापन

'Dainik Bhaskar',Prayagraj, 27.02.2023


गंगा में मछलियों के प्रभाव पर डाला प्रकाश

जासं, प्रयागराज : नेहरू ग्राम भारती मानित विश्वविद्यालय और आइसीएआर-केंद्रीय अंतरस्थली मात्स्यिकी संस्थान सिफरी के संयुक्त तत्वावधान में दो दिवसीय राष्ट्रीय संगोष्ठी हुई। पारिस्थितिकी बनाम आर्थिक विकास गंगा बेसिन पर आयोजित संगोष्ठी में सिफरी बैरमपुर के निदेशक डा. बीके दास ने गंगा जल की रासायनिक तत्वों तथा मछलियों पर पड़ने वाले प्रभाव को बताया। मुख्य अतिथि सीइएफई के पूर्व निदेशक डा. दिलीप कुमार ने परिस्थितिकी एवं अर्थव्यवस्था पर प्रकाश डाला।

दैनिक जागरण

'Dainik Jagran', Praygraj, 27.02.2023


अमर उजाला

नैनी-झूंसी-फाफामऊ

प्रकृति को जितना सुंदर रखेंगे प्रकृति उतना ही देगी

'Amar Ujala', Praygraj, 27.02.2023


संथाल हूल एक्सप्रेस

साहिबगंज, शनिवार 25 मार्च 2023

04

राजमहल गंगा घाट में छोड़ा गया हिल्सा के स्पॉन

सिफरी की टीम ने साढ़े तीन लाख अंडे व साढ़े तीन हजार स्पॉन गंगा में छोड़ा

Santhal Hool Express (Hindi), 25.03.2023


सिफरी की टीम पहुंची राजमहल गंगा घाट, टीम ने साढ़े तीन लाख मछली के अंडे और साढ़े तीन हजार स्पॉन को गंगा में छोड़ा

हिल्सा मछली के उत्पादन से राजमहल और साहिबगंज के मछुआरों को होगा खासा लाभ

राजमहल गंगा घाट में छोड़ा गया बृहत पैमाने पर हिल्सा के स्पॉन

पूर्व में भी 22 फरवरी को भी गंगा में छोड़ा गया था हिल्सा का स्पॉन:-

Desh Pradesh (Hindi), 25.03.2023


हिल्सा मछली के उत्पादन से राजमहल और साहेबगंज के मछुआरों को होगा खासा लाभ

राजमहल गंगा घाट में छोड़ा गया बृहत पैमाने पर हिल्सा के स्पॉन

सिफरी की टीम पहुंची राजमहल गंगा घाट

आवाज प्रतिनिधि।

साहेबगंज। जिले के राजमहल में एक बार फिर आईसीएआर-सेंट्रल इनलैंड फिशरीज रिसर्च इंस्टीट्यूट, बैरकपुर के द्वारा शुक्रवार को साहिबगंज में हिलसा स्पॉन और हिलसा फर्टिलाइज्ड एग रेंचिंग प्रोग्राम' का आयोजन किया गया। जहां सिफरी शोधकताओं द्वारा एक बार फिर साहिबगंज जिले में राजमहल क्षेत्र के सूर्यदेव घाट में हजारों हिलसा मछली का स्पॉन छोड़ा गया, ताकि बृहत पैमाने कर हिल्सा मछली का उत्पादन साहिबगंज जिले में हो सके, और यहां के मछुआरों को खासा लाभ मिले।

वहीं मौके पर मत्स्य अनुसंधान केंद्र के रिसर्च एसोसिएट डॉ विनोद कुमार ने बताया कि आईसीएआर-सिफरी और परियोजना के निदेशक डॉ. बसंत कुमार दास और वरिष्ठ वैज्ञानिक डॉ. ए. के. साहू के निर्देश पर गंगा नदी में विलुप्त हो रही हिलसा मछली के विकास एवं अनुसंधान के लिए स्पॉन छोड़ा गया है। जिससे गंगा में प्रवास कर रहे जीव जंतु में हिस्सा मछली का भी तादाद बढ़े। बताया कि मछली के निषेचित अंडे को गोदा खली जगह से मंगवाया गया है। तकरीबन साढ़े तीन लाख हिल्सा मछली के निषेचित अंडे और हिल्सा मछली के साढ़े तीन हजार स्पॉन को गंगा नदी में एक जगह का चयन करने के बाद गंगा में छोड़ा गया। बताया कि इन दिनों फरक्का बेराज में हिल्सा मछली की तादाद काफी कम हो चुकी है, जिसे देखते हुए गंगा में हिल्सा के स्पॉन को छोड़ा गया।

वही मौके कर मौजूद कई मछुआरों, जिसमे अर्जुन मंडल, रतन मंडल विश्वजीत मंडल, मंटू दस, मोना हलदर समेत अन्य ने बताया कि भारत सरकार के प्रयास से गंगा में लाखों मछलियों के अंडा को छोड़ा जाता है, इससे यहां के मछुआरों को इसका खासा लाभ मिलता है। बताया कि हमारे क्षेत्र में हिल्सा मछली नहीं के बराबर देखने को मिलता है, जिसको लेकर सिफरी की टीम साहिबगंज जिले के राजमहल पहुंची, और साढ़े तीन लाख मछली के अंडा और साढ़े तीन हजार के करीब हिल्सा मछली के स्पॉन को गंगा में छोड़ा गया।

वहीं सिफरी की टीम में शोधकर्ता दीपक कुमार गुप्ता, नवो कुमार आचार्य, समेत अन्य सहयोगी मौजूद रहें।

पूर्व में भी 22 फरवरी को भी गंगा में छोड़ा गया था हिल्सा का स्पॉन

बता दें कि इससे पूर्व 22 फरवरी को भी सिफरी की टीम ने साहिबगंज जिले के राजमहल गंगा घाट में जगह का चयन कर करीब दो लाख मछली के निषेचित अंडे और हिलसा मछली के ढाई हजार स्पॉन को गंगा में छोड़ा गया था, ताकि बृहद पैमाने पर साहिबगंज जिला में भी हिलसा मछली का उत्पादन किया जा सके।

Awaz (Hindi), 25.03.2023

Jagran (Hindi), 24.03.2023

Dainik Bhaskar (Hindi), 7.03.2023

Yuva Jagran (Hindi), 7.03.2023

Atal Bhrat News (Sahibganj, Jharkhand, 25.03.2023)

गंगा में छोड़ी गईं 30 हजार मछलियां

फतेहपुर। नमामि गंगे एवं मत्स्य विभाग ने देवघाट में 30 हजार मछलियां छोड़कर स्वच्छता का संदेश दिया। साथ ही गंगा नदी को स्वच्छ बनाने का आह्वान किया। इसमें कतला, रोहू, मृगल प्रजाति की मछलियां छोड़ी गई हैं। नमामि गंगे के जिला संयोजक शैलेंद्र शरन सिंपल, क्षेत्रीय सह संयोजक पंकज त्रिवेदी, मत्स्य विभाग के अधिकारी आरडी यादव ने देवघाट में 30 हजार मछलियों को छोड़ा। नमामि गंगे के जिला संयोजक शैलेंद्र शरण सिंपल ने कहा कि गंगा नदी को अविरल निर्मल बनाए रखना सभी का दायित्व है। (संवाद)

Scanned with OKEN Scanner

Amar Ujala, 03.04.2023

सिफरी प्रयागराज द्वारा तीस हजार मछली को देव घाट से गंगा नदी में छोड़ा गया

Jagran, 03.04.2023

सिफरी ने गंगा नदी मे तीस हजार मछली छोड़ी

फतेहपुर, 02 अप्रैल। राष्ट्रीय नदी रैंचिंग कार्यक्रम के तहत गंगा नदी में विलुप्त हो रहे मत्स्य प्रजातियों के संरक्षण एवं संवर्धन हेतु रविवार को भारतीय कृषि अनुसंधान परिषद केन्द्रीय अन्तस्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी), प्रयागराज के द्वारा भिटौरा गंगा नदी मे तीस हजार भारतीय प्रमुख कार्प- कतला, रोहू, मृगल मछलियों को छोड़ा। कार्यक्रम में संस्थान के प्रभारी डॉ? धर्म नाथ झा, ने उपस्थित लोगों को गंगा नदी में मछली और रैंचिंग के महत्व को बताया। उन्होंने कहा कि इस वर्ष पूरे गंगा नदी में कम हो रहे महत्वपूर्ण मत्स्य प्रजातियों के 22 लाख से ज्यादा बीज का रैंचिंग होना रखा गया है। कार्यक्रम के मुख्य अतिथि सहायक निदेशक मत्स्य जीसी यादव ने गंगा को स्वच्छ रखने एवं जीव विविधता को बचाने के लिए उपस्थित लोगों से आह्वान किया। गंगा विचार मंच के सह संयोजक राजेश शर्मा ने नमामि गंगे परियोजना के बारे में जानकारी दी साथ ही लोगो को गंगा को स्वच्छ रखने का संकल्प दिलाया। इस मौके पर डॉ? अबसार आलम, गोविंद तिवारी, पंकज तिवारी डा0 वीआर ठाकुर सहित तमाम लोग मौजूद रहे।

Hindi News Paper 03.04.2023

हिन्दुस्तान

30 हजार मछलियां छोड़ स्वच्छता का संदेश

अपील

- नमामि गंगे एवं मत्स्य विभाग का संयुक्त कार्यक्रम आयोजित
- पदाधिकारियों ने गंगा को स्वच्छ बनाए रखने की अपील

रविवार को गंगा नदी में मछलियां छोड़ते संगठन के पदाधिकारी।

फतेहपुर, संवाददाता। नमामि गंगे एवं मत्स्य विभाग ने रविवार को देवघाट में 30 हजार मछलियां छोड़कर स्वच्छता का संदेश दिया है। वहीं लोगों को गंगा को स्वच्छ बनाए रखने की अपील भी की गई। बताया गया कि गंगा में मछलियों का रहना आवश्यक होता है।

पदाधिकारियों ने लोगों से गंगा नदी को स्वच्छ बनाए रखने का आहवान किया। नमामि गंगे के जिला संयोजक शैलेंद्र शरन सिंपल, क्षेत्रीय सह संयोजक पंकज त्रिवेदी, मत्स्य अधिकारी आरडी यादव ने देवघाट में 30 हजार मछलियों के बैग लेकर देवघाट भिटौरा पहुंचे। जहां सभी ने मिल कर गंगा नदी में मछलियों को छोड़ा। नमामि गंगे के जिला संयोजक शैलेंद्र शरण सिंपल ने कहा कि गंगा नदी को अविरल निर्मल बनाए रखना, हम सभी का उत्तरदायित्व है। इसके लिए गंगा नदी में मछलियों का रहना अति आवश्यक है। मछलियां नदियों की मित्र होती हैं। इस मौके पर नमामि गंगे के सह संयोजक गोविन्द तिवारी, पूर्व नगर अध्यक्ष सुशील तिवारी बच्चा, गंगा बचाओ सेवा समिति के विनोद गुप्ता, उमेश तिवारी, सुरेन्द्र पाठक, दिनेश साहू, महेन्द्र गुप्ता आदि गंगा भक्त मौजूद रहे।

Hindustan, 03.04.2023

नदिया/ अन्य जेला

कुड़मि विक्षोभे तृणमूलेर कारा, नजर राखछे नबान्न

नबद्वीपे गङ्गाय दु'लक्षेर बेशि चारा

कुड़मि आन्दोलने बातिल ८४टि ट्रेन

Ananda Bazar Patrika, 06.04.2023

गंगा में विलुप्त हो रही मत्स्य प्रजातियों का बढ़ेगा कुनबा

नारघाट स्थित गंगा नदी में मत्स्य बीज डालते केंद्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) के वैज्ञानिक ● जागरण

जागरण संवाददाता, मीरजापुर : गंगा में विलुप्त हो रही मत्स्य प्रजातियों का अब कुनबा बढ़ेगा। केंद्रीय अंतरस्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) संरक्षण और संवर्धन में जुट गया है। इसी के मद्देनजर सिफरी ने नारघाट स्थित गंगा नदी में मंगलवार को 20 हजार मत्स्य बीज को छोड़ा।

राष्ट्रीय नदी रैंचिंग कार्यक्रम 2023 के तहत गंगा नदी में विलुप्त हो रहे मत्स्य प्रजातियों का संरक्षण एवं संवर्धन किया जा रहा है। इसके तहत सिफरी प्रयागराज ने गंगा में भारतीय प्रमुख कार्प कतला, रोहू, मृगल मछलियों के बीस हजार मत्स्य बीज को छोड़ा। संस्थान प्रभारी डा. धर्मनाथ झा ने लोगों को गंगा में मछली और रैंचिंग के महत्व को बताया।

मत्स्य अधिकारी अभिषेक वर्मा ने गंगा को स्वच्छ रखने एवं जैव विविधता को बचाने का आह्वान किया। संयोजक गंगा विचार मंच के राजेश शर्मा ने नमामि गंगे परियोजना के बारे में जानकारी दी।

Dainik Jagran, 12.04.2023

गंगा में छोड़े गए 20,000 मत्स्य बीज

मिर्जापुर। राष्ट्रीय नदी रैंचिंग कार्यक्रम के तहत मंगलवार को गंगा नदी में विलुप्त हो रहे प्रजाति के 20000 मत्स्य बीज छोड़े गए। भारतीय कृषि अनुसंधान परिषद व केंद्रीय अंतरस्थलीय मत्स्यिकी अनुसंधान संस्थान (सिफरी) प्रयागराज की तरफ से मंगलवार को गंगा नदी में 20 हजार मत्स्य बीज छोड़े गए। इस दौरान संस्थान के प्रभारी डॉ. धर्मनाथ झा ने मौके पर मौजूद लोगों को गंगा नदी में मछली और रैंचिंग के महत्व के बारे में जानकारी दी। इस दौरान मत्स्य विकास अधिकारी अभिषेक वर्मा के अलावा राजेश शर्मा, डॉ. जितेन्द्र कुमार, देव प्रकाश पाठक, रतनेश दुबे आदि मौजूद थे। संवाद

Amar Ujala, 12.04.2023

गंगा में डालीं 2.12 लाख छोटी मछलियां

वाराणसी। संत रविदास घाट पर बुधवार को दो लाख 12 हजार छोटी मछलियां (मत्स्य अंगुलिकाएं) गंगा में छोड़ी गईं। इनमें कतला, रोहू, मृगल आदि प्रजातियां शामिल हैं।

अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) के अतिरिक्त महानिदेशक डॉ. बीपी मोहंती ने कहा कि नमामि गंगे योजना के तहत गंगा की स्वच्छता व भूगर्भ जल संरक्षण के समग्र प्रयास का यह एक हिस्सा है। इस मौके पर नमामि गंगे (गंगा विचार मंच) के प्रांत सह संयोजक राजेश शुक्ला, मत्स्य उप निदेशक अनिल कुमार, डॉ. वीआर ठाकुर, डॉ. मितेश रामटेक, डॉ. विकास, डॉ. जितेन्द्र, लेफ्टिनेंट कर्नल सुनील गुहानी, सुबेदार शिवेंद सिंह आदि थे।

Hindustan, 20.04.2023

गंगा नदी में छोड़ी गई 2.12 लाख मछलियां

» रविदास घाट पर एनएमसीजी के तहत हुआ कार्यक्रम

वाराणसी(रणभेरी सं.)। राष्ट्रीय स्वच्छ गंगा मिशन के अंतर्गत गंगा नदी में मछलियों के संरक्षण एवं संवर्धन के लिए केन्द्रीय अन्तस्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) द्वारा जन जागरूकता सह रैंचिंग कार्यक्रम चल रहा है। इसके अंतर्गत वाराणसी के रविदास घाट पर 2 लाख 12 हजार? मछलियों के बच्चे छोड़े गये। इस कार्यक्रम में विभिन्न सामाजिक संस्थाओं ने भी हिस्सा लिया। डॉ. बीके राय ने बताया कि हम हर साल गंगा में रैंचिंग करते हैं। इस बार रैंचिंग मिशन टू है, जिसमें 25 लाख वेस्ट बंगाल से लेकर उत्तर प्रदेश तक 12 स्टेशन में रैंचिंग कर रहे हैं। हर स्टेशन पर 2 लाख 10 हजार के करीब मछलियों को छोड़ा जा रहा है। उन्होंने बताया कि अगस्त माह में वाराणसी में 2 लाख मछलियां छोड़ी गई थी। इस बार 2 लाख 12 हजार मछलियां छोड़ी गई हैं। उन्होंने कहा कि मछली छोड़ने का उद्देश है कि मछलियों का अनुवांशिक विकास हो और मछुआरों को फायदा हो। मत्स्य विज्ञान के उप महानिदेशक डॉ. जेके जेना ने कहा कि मछलियां गंगा नदी की स्वच्छता को बनाए रखने में मदद करेंगी। इस कार्यक्रम में स्थानीय मछुआरों को गंगा नदी में पाई जाने वाली मछलियों के स्वास्थ्य व संरक्षण के बारे में जागरूक किया गया है। नदी प्रदूषण मुक्त और स्वच्छ रहेगी तो उसका एक बड़ा लाभ स्थानीय मछुआरों को मिलता है।

बीएचयू ट्रॉमा सेंटर में खुला यूपी का पहला बोन एंड टीशु बैंक

वाराणसी(रणभेरी सं.)। चिकित्सा विज्ञान संस्थान बीएचयू के ट्रॉमा सेंटर में प्रदेश का पहला बोन एंड टिशु बैंक बनकर तैयार हो गया है। मशीनें आ चुकी हैं और अब उनका ट्रायल हो रहा है। सड़क व अन्य दुर्घटना में घायलों के ऑपरेशन के दौरान निकल जाने वाली हड्डियों और टिशू को इस बैंक में जमा किया जाएगा। ताकि भविष्य में ये किसी जरूरतमंद के काम आ सकें और उन्हें नया जीवन दिया जा सके। बीएचयू ट्रॉमा सेंटर में हर दिन वाराणसी और आसपास के जिलों के साथ ही बिहार, झारखंड आदि प्रदेशों से घायल इलाज के लिए आते हैं। इनमें कई ऐसे होते हैं, जिनके हाथ, पैर व शरीर के अन्य हिस्से की हड्डियां टूट जाती हैं। ऑपरेशन के दौरान जो हड्डियां जुड़ नहीं पातीं, उन्हें मजबूरी में निकालना पड़ता है। यही टिशु के साथ भी होता है। अब इन हड्डियों और टिशु को ट्रॉमा सेंटर में बने बोन एंड टिशु बैंक में जमा किया जा सकेगा। जानकारी के मुताबिक नई दिल्ली स्थित एम्स के बाद बीएचयू में खुलने वाला बोन एंड टिशु बैंक दूसरा बैंक है।

Ranbheri, 20.04.2023

दस अंगुलियां "हिन्दी दैनिक"

संत रविदास घाट से गंगा में छोड़ी गई दो लाख मछलियां

दस अंगुलियां

Das Ungliya, 20.04.2023

हिन्दुस्तान

गंगा में डालीं 2.12 लाख छोटी मछलियां

वाराणसी। संत रविदास घाट पर बुधवार को दो लाख 12 हजार छोटी मछलियां (मत्स्य अंगुलिकाएं) गंगा में छोड़ी गईं। इनमें कतला, रोहू, मृगल आदि प्रजातियां शामिल हैं।

अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) के अतिरिक्त महानिदेशक डॉ. बीपी मोहंती ने कहा कि नमामि गंगे योजना के तहत गंगा की स्वच्छता व भूगर्भ जल संरक्षण के समग्र प्रयास का यह एक हिस्सा है। इस मौके पर नमामि गंगे (गंगा विचार मंच) के प्रांत सह संयोजक राजेश शुक्ला, मत्स्य उप निदेशक अनिल कुमार, डॉ. वीआर ठाकुर, डॉ. मितेश रामटेक, डॉ. विकास, डॉ. जितेन्द्र, लेफ्टिनेंट कर्नल सुनील गुहानी, सुबेदार शिवेंद सिंह आदि थे।

Hindustan , 20.04.2023

...गंगा में विलुप्त न हो जाएं मछलियां

पहल

केंद्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान ने गंगा में छोड़े दो लाख मत्स्य बीज

जनसंदेश न्यूज

केंद्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान यानि सिफरी की ओर से बुधवार को गंगा मे दो लाख से ज्यादा मत्स्य बीज छोड़े गये

वाराणसी। गंगा में विलुप्त हो रहीं मछली की प्रजातियों के संरक्षण और संवर्द्धन के लिए विभिन्न स्तर पर प्रयास किये जा रहे हैं। इसी क्रम में राष्ट्रीय नदी रैंचिंग कार्यक्रम-2023 के अवसर पर भारतीय कृषि अनुसंधान परिषद के केंद्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान यानि सिफरी की ओर से बुधवार को दो लाख से अधिक मत्स्य बीज गंगा में छोड़े गये। संत रविदास घाट यह आयोजन था। इस अवसर पर कुल मिलाकर दो लाख 12 हजार कतला, रोहू, मृगल मछलियों के बीज जनजागरूकता के अंतर्गत छोड़े गये। राष्ट्रीय स्वच्छ गंगा मिशन के तहत आयोजित कार्यक्रम में संस्थान के निदेशक डॉ. बीके दास की मुख्य उपस्थिति रही। इस मौके पर डॉ. दास ने गंगा में मछली और रैंचिंग के महत्व पर प्रकाश डालते हुए कहा कि इस साल गंगा में कम हो रही महत्वपूर्ण मत्स्य प्रजातियों के 22 लाख से ज्यादा बीजों की रैंचिंग का लक्ष्य है। विशिष्ट अतिथि अतिरिक्त महानिदेशक अंतर्स्थलीय मात्स्यिकी आईसीएआर नई दिल्ली डॉ. बीपी मोहंती ने लोगो को गंगा का महत्व बताते हुए इसे स्वच्छ रखने का आह्वान किया।

सूबे के उप निदेशक मत्स्य अनिल कुमार विभागीय योजनाओं की जानकारी दी। बीएचयू की प्रो. राधा चौबे, मत्स्यनिरीक्षक राजेंद्र कुमार, गंगा टास्क फोर्स के सुबेदार शीवेंद्र सिंह और नमामि गंगे के राजेश शुक्ला आदि ने जैव विविधता और मछलियों के बारे में लोगों को जागरूक किया। आयोजन में संस्थान के वैज्ञानिक डॉ. वीआर ठाकुर, डॉ. मितेश रामटेक, डॉ. विकास कुमार, डॉ. जितेंद्र कुमार आदि की प्रमुख उपस्थिति रही।

Jan Sandesh, 20.04.2023

गंगा नदी में छोड़ी गईं 2 लाख 12 हजार मछलियां

शकुन टाइम्स संवाददाता

वाराणसी। राष्ट्रीय स्वच्छ गंगा मिशन के अंतर्गत गंगा नदी में मछलियों के संरक्षण एवं संवर्धन के लिए केन्द्रीय अन्तस्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) द्वारा जन जागरूकता सह रैंचिंग कार्यक्रम चल रहा है। इसके अंतर्गत वाराणसी के रविदास घाट पर 2 लाख 12 हजार? मछलियों के बच्चे छोड़े गये।

इस कार्यक्रम में विभिन्न सामाजिक संस्थाओं ने भी हिस्सा लिया। डॉ. वीके राय ने बताया कि हम हर साल गंगा में रैंचिंग करते हैं। इस बार रैंचिंग मिशन टू है, जिसमें 25 लाख वेस्ट बंगाल से लेकर उत्तर प्रदेश तक 12 स्टेशन में रैंचिंग कर रहे हैं। हर स्टेशन पर 2 लाख 10 हजार के करीब मछलियों को छोड़ा जा रहा हैं। उन्होंने बताया कि अगस्त माह में वाराणसी में 2 लाख मछलियां छोड़ी गई थी ।इस बार 2 लाख 12 हजार मछलियां छोड़ी गई हैं। उन्होंने कहा कि मछली छोड़ने का उद्देश है कि मछलियों का अनुवांशिक विकास हो और मछुआरों को फायदा हो। मत्स्य विज्ञान के उप महानिदेशक डॉ. जेके जेना ने कहा कि मछलियां गंगा नदी की स्वच्छता को बनाए रखने में मदद करेंगी। इस कार्यक्रम में स्थानीय मछुआरों को गंगा नदी में पाई जाने वाली मछलियों के स्वास्थ्य व संरक्षण के बारे में जागरूक किया गया है।

नदी प्रदूषण मुक्त और स्वच्छ रहेगी तो उसका एक बड़ा लाभ स्थानीय मछुआरों को मिलता है।

Shakun Times, 20.04.2023

गंगा में मछलियों की भारतीय प्रजाति छोड़ते मत्स्य विभाग के कर्मचारी • सूचना विभाग

गंगा में छोड़ा गया 2.12 लाख मत्स्य बीज

जागरण संवाददाता, वाराणसी : राष्ट्रीय नदी रैंचिंग कार्यक्रम के अवसर पर विलुप्त हो रहीं मत्स्य प्रजातियों के संरक्षण-संवर्धन को भारतीय कृषि अनुसंधान परिषद केंद्रीय अंतरस्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) की ओर से बुधवार को संत रविदास घाट पर गंगा में 2,12,000 भारतीय प्रमुख कार्प-कतला, रोहू, मृगल मछलियों के बीज छोड़े गए। राष्ट्रीय स्वच्छ गंगा मिशन (एनएमसीजी) के अंतर्गत आयोजित कार्यक्रम में संस्थान के निदेशक डा. बीके दास ने कहा कि इस वर्ष गंगा में 22 लाख से ज्यादा बीज छोड़ने का लक्ष्य है। अतिरिक्त महानिदेशक आइसीएआर डा. बीपी मोहंती ने सभी से गंगा को स्वच्छ रखने का अह्वान किया। इसमें अनिल कुमार, राधा चौबे, राजेंद्र कुमार, राजेश शुक्ला ने गंगा को साफ रखने के लिए की अपील की। संस्थान के वैज्ञानिक डा. वीआर ठाकुर ने धन्यवाद दिया।

Dainik Jagran, 20.04.2023

মুর্শিদাবাদ

আনন্দবাজার পত্রিকা

পুলকার দুর্ঘটনায় জখম ১৭

ফের করোনা আক্রান্তের খোঁজ জেলায়

এক অঞ্চলে জোড়া কমিটিতে দ্বন্দ্ব

গলা কেটে খুনে অভিযুক্ত ধৃত

তিন মাসে ম্যালেরিয়ায় আক্রান্ত ৭৫

বৃষ্টিতে স্বস্তি মরসুমি আনাজে

পরপর বড় অগ্নিকাণ্ডে উদ্বেগ বাড়ছে

Ananda Bazar Patrika, 26.04.2023

केंद्रीय मंत्री ने गंगा में छोड़ी मछलियां, लाइफ जैकेट व जाल का किया वितरण

संथाल हूल एक्सप्रेस संवाददाता।

साहिबगंज: दी झारखंड ईस्टर्न गंजेटिक फिशर मैंस कॉपरेटिव सोसाइटी लिमिटेड के तत्वाधान में मत्स्य अनुसंधान केंद्र बैरकपुर कोलकाता ने नमामि गंगे अभियान के तहत बुधवार को रैन्चिंग कार्यक्रम का आयोजन किया। कार्यक्रम में मुख्य अतिथि के रूप में केंद्रीय बंदरगाह जहाजरानी और जलमार्ग राज्य मंत्री शांतनु ठाकुर जबकि विशिष्ट अतिथि के रूप में उपायुक्त रामनिवास यादव शामिल हुए। इस दौरान अतिथियों ने गंगा नदी में रेहु, कतला व मृगल मछली छोड़ा। मंत्री ने कहा कि इस योजना से गंगा नदी में मछलियों की संख्या में इजाफा होगा। साथ ही नदी का इको सिस्टम भी बरकरार रहेगा। लोगों को रोजगार मिलेगा। अनुसंधान केंद्र के डायरेक्टर बीके दास ने बताया कि इस वर्ष फरक्का से यूपी तक गंगा में 25 लाख मछली छोड़ने का लक्ष्य रखा गया है। रैन्चिंग कार्यक्रम से गंगा में मछलियों की संख्या में बढ़ोत्तरी दर्ज की गई है। मंत्री ने अनुसंधान केंद्र की ओर से दिए गए 10 जाल व 15 लाइफ जैकेट मछुआ सोसाइटी के अध्यक्ष अशोक चौधरी को सौंपा। मौके पर डीएफओ मनीष तिवारी, डीटीओ सन्तोष गर्ग, मछुआ सोसाइटी के उपाध्यक्ष छोटे लाल चौधरी, मंत्री राजीव चौधरी, भाजपा जिला अध्यक्ष रामदरश यादव, रामानंद साह व अन्य मौजूद थे।

Santhal Hool Express, 27.04.2023

गंगा में मछली छोड़ने का कार्यक्रम काफी इनोवेटिक ओर ग्रेट, गंगा का बैलेंस मछली रखेगा : मंत्री

प्रात: आवाज

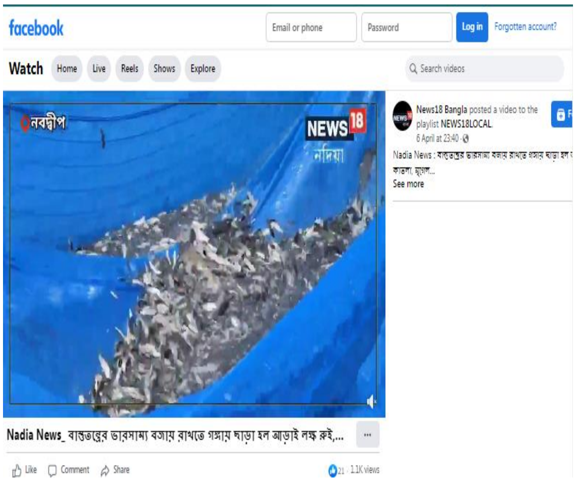
साहिबगंज : केन्द्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान, बैरकपुर, कोलकाता एवं नमामि गंगे ने राष्ट्रीय रैन्चिंग कार्यक्रम के तहत बुधवार को ओझा टोली, पुरानी साहिबगंज गंगा घाट पर भारत सरकार के पोर्ट, शिपिंग, एवं जलमार्ग राज्य मंत्री शान्तनु ठाकुर सहित अन्य ने करीब साठ हजार मछलियों जिसमे रेहू कतला सहित अन्य प्रजाति के मछलियों के बीज को गंगा नदी में छोड़ा। कार्यक्रम का उद्देश्य गंगा नदी की जैव विविधता को बनाये रखना एवं मछुआरों के बेहतर जीवीकोपार्जन की उचित दिशा देना है। मछलियां गंगा में बढ़ते प्रदुषण को कम करने में और नादिये पारिस्थितिकी को बनाये रखने में सहायक है। वही मंत्री श्री ठाकुर ने कहा कि गंगा में मछली छोड़ने का कार्यक्रम काफी इनोवेटिक ओर ग्रेट, गंगा का बैलेंस मछली रखेगा। गंगा में प्रदूषण नही होगा। वही कार्यक्रम से पूर्व अतिथियों का स्वागत बुके देकर किया। वही आईसीएआर सिफरी के निदेशक डॉ. बसंत कुमार दास ने कार्यक्रम के बारे में विस्तार से बताया। वही मुख्य अतिथि मंत्री श्री ठाकुर ने समिती सदस्य को लाइव जैकेट दिया। मौके पर डीसी रामनिवास यादव, वन प्रमंडल पदाधिकारी मनीष तिवारी, भारतीय अंतदेर्शीय जलमार्ग प्राधिकरण के सहायक निदेशक संजीव कुमार, दी झारखंड ईस्टर्न गंजेटिक फिशरमैन कॉपरेटिव सोसाइटी के अध्यक्ष अशोक चौधरी, भाजपा जिलाध्यक्ष रामदरश यादव, नप उपाध्यक्ष रामानंद साह, धर्मेंद्र कुमार सहित अन्य थे।

Awaz, 27.04.2023

Ranching at Sahibganj, Jharkhand by official Facebook page of NMCG at 26.04.2023

V Khabar News 25.04.2023

Modhya Banga News 25.04.2023



News 18 Bangla 05.04.2023

नमामि गंगे परियोजना के तहत से फ्री द्वारा गंगा नदी में 60000 मछलियां छोड़ा गया

साहिबगंज। बुधवार को दी झारखंड ईस्टर्न गंजेटिक फिशर मेंस कॉपरेटिव सोसाइटी लिमिटेड के तत्वाधान में केंद्रीय अन्तस्थलीय मत्स्य अनुसंधान संस्थान बैरकपुर कोलकाता ने नमामि गंगे अभियान के तहत रैन्चिंग कार्यक्रम का आयोजन किया। कार्यक्रम के मुख्य अतिथि केंद्रीय बंदरगाह जहाजरानी और जलमार्ग राज्य मंत्री शांतनु ठाकुर व उपायुक्त रामनिवास यादव विशिष्ट अतिथि के रूप में उपस्थित हुए। इस दौरान अतिथियों ने गंगा नदी में 60000 मछलियां को छोड़ा गया।जैसे रेहू, कतला व मृगल मछली को छोड़ा गया। वहीं मंत्री ने कहा कि इस योजना से गंगा नदी में मछलियों की संख्या बढ़ोतरी होगी। नदी का इको सिस्टम भी बरकरार रहेगी,लोगों को रोजगार मिलेगा। अनुसंधान केंद्र के डायरेक्टर बीके दास ने बताया कि इस वर्ष फरक्का से यूपी तक गंगा में 25 लाख मछली छोड़ने का लक्ष्य रखा गया है। रैन्चिंग कार्यक्रम से गंगा में मछलियों की संख्या में बढ़ोतरी दर्ज की गई है।वहीं कार्यक्रम में उपायुक्त रामनिवास यादव एवं वन प्रमंडल पदाधिकारी मनीष तिवारी ने कहा की मछुआरों को उचित तकनीकों के उपयोग से ही मछलियों को पकड़ना चाहिए। वहीं मंत्री ने अनुसंधान केंद्र की ओर से दिए गए 10 जाल व 15 लाइफ जैकेट को मछुआ सोसाइटी अध्यक्ष अशोक चौधरी को सौंपा।इस मौके पर वन प्रमंडल पदाधिकारी मनीष तिवारी, जिला परिवहन पदाधिकारी सन्तोष गर्ग, मछुआ सोसाइटी उपाध्यक्ष छोटे लाल चौधरी, मंत्री राजीव चौधरी, भाजपा जिला अध्यक्ष रामदरश यादव, रामानंद साह,जय प्रकाश सिन्हा एवं अन्य लोग मौजूद थे।

Kelanchal Times, Sahibganj, 27.04.2023

हिबगंज / पाकुड़ पंच

ल की कनेक्टिविटी

ं को होगा फायदा

त्री ने प्रेस कांफ्रेंस कर दी जानकारी

मंत्री ने गंगा नदी में छोड़ी मछली

दी झारखंड ईस्टर्न गंगेटिक फिशर मैंस कॉपरेटिव सोसाइटी लिमिटेड के तत्वाधान में मत्स्य अनुसंधान केंद्र, बैरकपुर, कोलकाता ने नमामि गंगे अभियान के तहत रेन्चिंग कार्यक्रम का आयोजन किया। जिसमें मुख्य अतिथि के तौर पर केंद्रीय बंदरगाह जहाजरानी और जलमार्ग राज्य मंत्री शांतनु ठाकुर मुख्य अतिथि व उपायुक्त रामनिवास यादव विशिष्ट अतिथि के रूप में उपस्थित हुए। इस दौरान अतिथियों ने गंगा नदी में रेहू, कतला व मृगाल मछली छोड़ी। मंत्री ने कहा कि इस योजना से गंगा नदी में मछलियों की संख्या में इजाफा होगा। साथ ही नदी का इको सिस्टम भी बरकरार रहेगा। लोगों को रोजगार मिलेगा। अनुसंधान केंद्र के डायरेक्टर बसंत कुमार दास ने बताया कि इस वर्ष फरक्का से यूपी तक गंगा में 25 लाख मछली छोड़ने का लक्ष्य रखा गया है। रेन्चिंग कार्यक्रम से गंगा में मछलियों की संख्या में बढ़ोत्तरी दर्ज की गई है। मंत्री ने अनुसंधान केंद्र की ओर से दिए गए 10 जाल व 15 लाइफ जैकेट को मछुआ सोसाइटी अध्यक्ष अशोक चौधरी को सौंपा। मौके पर डीएफओ मनीष तिवारी, डीटीओ सन्तोष गर्ग, मछुआ सोसाइटी उपाध्यक्ष छोटे लाल चौधरी, मंत्री राजीव चौधरी, भाजपा जिला अध्यक्ष रामदरश यादव, रामानंद साह, जयप्रकाश सिन्हा व अन्य मौजूद थे।

Pakur Punch, 26.04.2023

Sixty thousand fish seeds ranched by ICAR-CIFRI at Sahibganj, Jharkhand

26th April 2023, Sahibganj

ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata released sixty thousand fish yearlings of Indian Major Carp (Rohu, Catla and Mrigal) at Ojha toli ghat, Sahibganj, Jharkhand under Namami Gange Program today.

The Chief Guest, Shri Shantanu Thakur, Union Minister of State, Ministry of Ports, Shipping and Waterways applauded the initiative of ICAR-CIFRI and Namami Gange and said that ranching will not only help the farmers but also help the river to restore its ecosystem. The Minister also urged the local fishers to not use zero mesh size net fishing.

ICAR-News portal, New Delhi, 27.04.2023

Khabar Update, 26.04.2023

Sari Katha, 26.4.2023

All India Radio (Ranchi), 26.04.2023

জাতীয় নদী পালন কর্মসূচির ধারাবাহিকতায়

বেলুড় মঠ সংলগ্ন গঙ্গায় মাছের চারা ছাড়লো সিফ্রি

৬ মে ঃ ICAR সেন্ট্রাল ইনল্যান্ড ফিশারিজ রিসার্চ ইনস্টিটিউট, ব্যারাকপুর নমামি গঙ্গে প্রোগ্রামের অধীনে ৬ মে ২০২৩ তারিখে পবিত্র বেলুর মঠ সংলগ্ন বরেন্দ্রপাড়া ঘাট, বালি, হাওড়া, পশ্চিমবঙ্গে একটি 'ন্যাশনাল রিভার রেঞ্চিং প্রোগ্রাম২০২৩' আয়োজন করে। জাতীয় নদী পালন কর্মসূচির ধারাবাহিকতায়। গত ৫ই এপ্রিল, ২০২৩ তারিখে জাতীয় মৎস্য সঞ্চার অনুষ্ঠানের সূচনা করা হয় পশ্চিমবঙ্গের নবদ্বীপের গঙ্গা নদীতে মাছ ছাড়ার মাধ্যমে এবং এই জাতীয় স্তরের অনুষ্ঠানের অঙ্গ হিসেবে এখনও অবধি ভারতবর্ষের তিনটি রাজ্যজুড়ে গঙ্গা নদীর গতিপথের বিভিন্নস্তরে প্রায় ৯ লক্ষ ভারতীয় মেজর কার্পের চারা ছাড়া হয়েছে এবং এই সমগ্র কর্মসূচির মাধ্যমে ২২ লক্ষ মাছের চারা ছাড়ার লক্ষ্যমাত্রা ধার্য করা হয়েছে। জাতীয় মৎস্য সঞ্চার কর্মসূচির দ্বিতীয় ধাপের অঙ্গ হিসেবে গঙ্গা নদীর নিম্ন গতিপথে প্রথমবারের জন্যে আজকে মাছ ছাড়া হলো।আজ নদী পালন কর্মসূচিতে, সিআইএফআরআই ২.৫ লক্ষ উন্নত ভারতীয় মেজর কার্পস ফিঙ্গারলিংস অর্থাৎ রুই,কাতলা ও মৃগেলের মাছের ছাড়া গঙ্গা নদীতে ছাড়া হয় (১৫০ মিমি) স্বামী রাসবিহারী মহারাজ জি ও ডঃ বসন্ত কুমার দাস এর সক্রিয় অংশ গ্রহণের মাধ্যমে। স্বামী রাশবিহারী মহারাজ জি (বেলুড় মঠ, রামকৃষ্ণ মিশন এবং রামকৃষ্ণ মঠ) আমাদের দৈনন্দিন জীবনে গঙ্গা নদীর গুরুত্ব তুলে ধরেন এবং জেলেদের গঙ্গা নদীতে প্লাস্টিক এবং অন্যান্য বর্জ্য না ফেলার আহ্বান জানান। তিনি মা গঙ্গাকেও প্রাচীন পুরাণের সাথে তুলনা করেন এবং স্থানীয় জেলেকে নির্বিচারে মাছ ধরা এড়াতে বলেন। এ ছাড়া বালি থানার উপপরিদর্শকও কর্মসূচিতে সক্রিয়ভাবে অংশগ্রহণ করেন। বিজ্ঞানভিত্তিক মৎস্য চাষ, ইলিশ ও ডলফিন সংরক্ষণের লক্ষ্যে ৫২ জন স্থানীয় মৎস্যজীবী ও মৎস্যজীবী মহিলাদেরকে স্থানীয় বাসিন্দাদের সাথে নিয়ে একটি গণসচেতনতামূলক প্রচার চালানো হয়। অনুষ্ঠানে এনএমসিজি প্রকল্পের সদস্যসহ সিআইএফআরআই-এর বিশিষ্ট বিজ্ঞানীরা উপস্থিত ছিলেন।

DurontoBarta, 08.05.2023

ICAR- CIFRI ranches Indian Major Carps at Bally, Howrah, West Bengal

Kolkata:ICAR - Central Inland Fisheries Research Institute, Barrackpore under NamamiGange programme organised a 'National River Ranching Programme-2023at Barendrapara Ghat, Bally, Howrah, West Bengal adjacent to Holy Belur Math on 6thMay 2023.In continuation of the National River Ranching Programme which was initiated from 5th of April 2023from Nabadwip, West Bengal. the pragramme was carried out at different stretchspanningacross3 different states. Till date more than 9.0 lakhs fish fingerlingswereranched during the period of April to May, 2023 with a target of 22 lakhs.In the present river ranching programme CIFRI released 2.5 lakhs of advanced Indian Major Carps fingerlings (> 150mm) which was released by ourDirector, Dr.Basanta Kumar Das. Theevent was graced by Swami Rashbehari Maharaj Ji (Belur Math, Ramakrishna Mission and Ramakrishna Math). Swami Jihighlight the importance of river Ganga in our daily lives and urged the fishermen not to litter plastics and other anthropological wastes in river Ganga. He also related mother Ganga with the ancient puranas and asked the local fisherman to avoid indiscriminate fishing. In addition to this, the Sub-Inspector of Bally police station also actively participated in the programme. A mass awareness campaign was carried out covering 52 local fisheries and fisherwomen along with local residence towards sustainable fisheries,Hilsa andDolphin conservation. The programme was attended by the eminent scientists of CIFRI along NMCGproject members.

Kalinga Chronicle, 08.05.2023

Samaja, 09.05.2023

पश्चिम बंगाल के महिला मछुआरों ने हुगली नदी में रैन्चिग कार्यक्रम में लिया भाग : सिफरी द्वारा की गई पहल

कोलकाता/संवाददाता । आईसीएआर- केंद्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान, बैरकपुर ने "नमामि गंगे" परियोजना के तहत 9 मई 2023 को हुगली, पश्चिम बंगाल के बालागढ़ और त्रिबेनी में "नैशनल रैन्चिग कार्यक्रम-2023" का आयोजन किया। 5 अप्रैल 2023 को नवद्वीप, पश्चिम बंगाल से इस कार्यक्रम की सूचना हुई। अप्रैल से मई, 2023 की अवधि के दौरान 11.5 लाख से अधिक अंगुलिमीनों को गंगा में छोड़ा गया। इस कार्यक्रम का लक्षय 22 लाख अंगुलिमीनों को गंगा में छोड़ना हैं ताकि मछली का स्टॉक बढ़ाया जा सके। सिफरी ने पश्चिम बंगाल के हुगली जिले के बालागढ़ (2.0 लाख) और त्रिबेनी (2.1 लाख) में कुल 4.1 लाख उन्नत भारतीय मेजर कार्प के अंगुलिमीनों को निषेचित किया। त्रिबेनी के कार्यक्रम में सहायक मत्स्य अधिकारी, श्री तन्मय दास और स्थानीय प्राधिकरण के सदस्यों ने भाग लिया। सिफरी के निदेशक डॉ. बि.के.दास ने गंगा नदी के महत्व पर प्रकाश डाला और नमामि गंगे कार्यक्रम के तहत सिफरी द्वारा की गई गतिविधियों के बारे में जानकारी दी। उन्होंने मछली पकड़ने की अंधाधुंध प्रथाओं से बचने और डॉल्फिन सहित गंगा की जैव विविधता के संरक्षण के लिए सभी को जागरूक किया। इसके साथ ही डॉ. दास ने मछुआरों और स्थानीय निवासियों से मां गंगा के संरक्षण के लिए परिश्रम करने का आग्रह किया। स्थायी मत्स्य पालन, हिल्सा और डॉल्फिन संरक्षण के प्रति स्थानीय निवासियों के साथ-साथ 100 से अधिक स्थानीय मछुआरों और महिला मछुआरों को शामिल करते हुए एक जन जागरूकता अभियान भी चलाया गया। इस कार्यक्रम में नमामि गंगे परियोजना के सदस्यों के साथ सिफरी के वैज्ञानिकों ने भाग लिया।

Indian Punch, 11.05.2023

हिन्दुस्तान www.livehindustan.com अपना पड़ोस

सुल्तानगंजः गंगा में छोड़ी गई रेहू-कतला प्रजाति की दो लाख मछलियां

संरक्षण

रैंचिंग कार्यक्रम की शुरुआत 2018 से

जलीय जीवों का संरक्षण व संवर्धन में लाभदायक

Hindustan, 24.05.2023

दैनिक भास्कर भागलपुर 24-05-2023

नमामि गंगे परियोजना के तहत सीआईएफआरआई की टीम ने गंगा में डाला मछली की जीरा

मछलियों की संख्या बढ़ाने के लिए कमरगंज में गंगा में डाला दो लाख जीरा

मछुआरों से छोटी मछली नहीं पकड़ने की अपील

गंगा के पानी में प्रदूषण की मात्रा पता लगाने के लिए टीम ने लिया सैंपल

गंगा में मछली की सिर्फ 190 प्रजातियां ही बची हैं

Dainik Bhaskar, 24.05.2023

गंगा नदी में छोड़े गए दो लाख जीरा

संसू, सुल्तानगंजः गंगा नदी की जैव विविधता को बनाये रखने एवं मछुआरों के बेहतर जीवीकोपार्जन को लेकर कई कारगर कदम उठाए जा रहे हैं। मंगलवार को कोलकाता के बैरकपुर स्थित केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान एवं नमामि गंगे की ओर से 'राष्ट्रीय रैन्चिंग कार्यक्रम-2023' के तहत विक्रमशिला डाल्फिन आश्रयणी एवं इको सेंसेटिव क्षेत्र से दूर कमरगंज घाट पर दो लाख से अधिक मछलियों के बच्चे छोड़े गए। इस मौके पर आइसीएआर-सिफरी के विभागाध्यक्ष डा. सामंता ने बताया कि संस्थान द्वारा नमामि गंगे परियोजना के तहत सन 2018 से ही रैन्चिंग कार्यक्रम की शुरुआत की गई है। इसके तहत लगभग 88 लाख से ज्यादा रेहू, कतला, कलबासु, मृगाल, नैनी मत्स्य प्रजातियों की अंगुलिकाओं को गंगा के नदीय मार्ग में आने वाले राज्यों उत्तराखंड, उत्तर प्रदेश, बिहार, झारखण्ड और पश्चिम बंगाल की विभिन्न नदियों व घाटों से छोड़ा जा चुका है।

Dainik Jagran (Bhagalpur Edition), 24.05.2023

नमामि गंगे परियोजना के तहत सीआईएफआरआई की टीम ने गंगा में डाला मछली की जीरा

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गंगा में मछली की सिर्फ 190 प्रजातियां ही बची हैं

Prabhat Khabar (Bhagalpur Edition), 24.05.2023

Hooghly TV news, 10.05.2023

News 18 Jharkhand, 23.05.2023


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ो : गंगा में छोड़ी गई रोहू-कतला प्रजाति की दो लाख
ालियां

Daily Hunt (e news), 23.05.2023

Publicvibe news, 24.05.2023


ইলিশ ও ডলফিন সংরক্ষণ কর্মশালা

সাকিল আহমেদ, ডায়মন্ড হারবার: ছোট ইলিশ ধরা এবং বিক্রি আইনত দণ্ডনীয় অপরাধ। প্রাকৃতিক ভারসাম্য বজায় রাখতে জলজ আর্যের উদ্যোগ এবং কাঁকুড়া মশাট সোশ্যাল ওয়েলফেয়ার সোসাইটিতে সচেতনতামূলক কর্মশালার আয়োজন করা হয়। ৩০ জন মৎস্যজীবী এই সচেতনতা শিবিরে যোগ দেন। সমুদ্র এবং গ্রামীণ জলজ পরিবেশে কীভাবে জাতীয় সম্পদ সুরক্ষা করা যায়, সেই বিষয়ে বিস্তারিত আলোচনায় যোগ দেন আয়োজক সংস্থা ইন্ডিয়ান কাউন্সিল ফর এগ্রিকালচার অ্যান্ড রিসার্চ উইংয়ের পক্ষে ডঃ বসন্ত কুমার দাস, এ কে সাহু প্রমুখ। কাঁকুড়া মশাট ওয়েলফেয়ার সোসাইটির পক্ষে সজল কান্তি কয়াল বলেন, 'গভীর সমুদ্রে ইলিশ শিকার করতে গিয়ে কারেন্ট জাল দিয়ে খোকা ইলিশ যাতে না ধরা পড়ে সে নিয়ে ইলিশ প্রজাতিকে বাঁচাতে ডায়মন্ড হারবার প্রেস ক্লাব উল্লেখযোগ্য ভূমিকা নিয়েছে।'

Puber Kolom Bengali, e-paper 6.06.2023


National River Ranching programme at Patna

Patna(KCN) :ICAR-Central Inland Fisheries Research Institute (ICAR-CIFRI), Barrackpore organized 'National Ranching Programme-2023' under Namami Gange Programme at Patna for fish conservation and restoration of river Ganga. Till date more than 88 lakhs of fishes have been ranched under the ICAR-CIFRI-NMCG project in different riverine stretch of river Ganga flowing through Indian states. In continuation of this, a ranching cum awareness programme was organized at Raja Ghat, Patna, Bihar in the presence of Dr. Rameshwar Singh Hon'ble Vice Chancellor BASU, Patna. Dr. Basanta Kumar Das, Director ICAR-CIFRI and Prinicipal Investigator, NMCG project highlighted the importance of ranching and conservation in river Ganga. A total of 2.0 Lakh artificially bred wild fish germplasm of Rohu, Catla, Mrigal and Calbasu seeds were released into the river at Raja Ghat. Above all the species Catla contributed the most(60%) with average size of 400 g. The event was also attended by Dr. Kamlesh Sharma ,HoD, ICAR-RCER Patna, Shri N. Jawahar,Principal cheif conservator of Forest (climate change and wetland Bihar) and dignitaries from Dept. Of Fisheries, Bihar and CRPF Patna. The efforts of ICAR-CIFRI will help in boosting the livelihood of then local fishers beside conservation of native fish germplasm.

Besides ranching program, a public awareness program was also organised ICAR-CIFRI, where more than 50 local fisher folks were present and promised to participate in govt. initiative for sustainable fisheries of river Ganga .

In this present program, active participation of fishers were observed. Besides this distribution of fishing nets were also provided to local fishers of Ganga.

Kalinga Chronicle, 02.07.2023


देवप्रयाग में महाशीर मछलियों का रैंचिंग सह जनजागरू...

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देवप्रयाग में महाशीर मछलियों का रैंचिंग सह जनजागरूकता कार्यक्रम का आयोजन

16 June 2023
उत्तराखंड, कारोबार / रोजगार, लाइफस्टाइल, विविध न्यूज़

Garhninad News, 16.06.2023


अलकनंदा नदी में छोड़ीं 10 हजार महासीर मछलियां

नमामि गंगे परियोजना के तहत जैव विविधता संतुलन की पहल

संवाद न्यूज एजेंसी

देवप्रयाग। नमामि गंगे परियोजना के तहत जैव विविधता संतुलन के लिए अलकनंदा नदी में 10 हजार महासीर मछलियां प्रवाहित की गईं।

इस मौके पर पतंजलि योगपीठ के सीईओ आचार्य बालकृष्ण ने कहा कि प्रकृति का संरक्षण वास्तव में मानव जीवन का संरक्षण हैं। कहा कि महासीर की लुप्त होती प्रजाति को संरक्षित किए जाने से गंगा व उसकी सहायक नदी में जलीय जीव तंत्र को मजबूती मिलेगी।

शुक्रवार को नमामि गंगे के तहत पतंजलि सेवाश्रम मूल्यागांव में आचार्य बालकृष्ण ने अलकनंदा नंदी में 10 हजार महासीर मछलियां प्रवाहित की। यह मछलियां केंद्रीय अंतस्थलीय मत्स्यिकी अनुसंधान सस्थान, प्रयागराज उत्तर प्रदेश की ओर से प्रदान की गई हैं। संस्थान ने

अलकनंदा नदी में महासीर मछलियों को प्रवाहित करते आचार्य बालकृष्ण।

आचार्य बालकृष्ण बोले प्रकृति का संरक्षण ही है मानव जीवन का संरक्षण

महासीर में पुनः बढ़ोतरी की पहल की है। कहा गंगोत्री से गंगा सागर तक गंगा की वनस्पति, मिट्टी, जलीय स्थिति पर योगपीठ द्वारा अनुसंधान किया जा रहा है।

सूखा, अनेक महामारियों का सामना करना पड़ रहा है।

मत्स्यकी अनुसंधान संस्थान प्रयागराज के निदेशक वीके दास ने कहा जल प्रदूषण से महासीर का जीवन संकट में है। भारत में इसकी 15 प्रजातियों में से कई विलुप्त हो चुकी हैं। मौके पर सहायक निदेशक गरिमा मिश्रा, प्रो. प्रकाश नौटियाल,

Samvad, 17.06.2023

गंगा में कम हो रही हैं मछली की प्रजातियां

सहारा न्यूज ब्यूरो
ऋषिकेश।

गंगा नदी में विलुप्त हो रहे मत्स्य प्रजातियों के संरक्षण व संवर्धन को ध्यान में रखते हुए भारतीय कृषि अनुसंधान परिषद,केन्द्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) प्रयागराज के द्वारा देवप्रयाग के अलकनंदा नदी पर पंतजलि सेवाश्रम के प्रांगण में महाशीर मछलियों का रैंचिंग सह जनजागरूकता कार्यक्रम आयोजित किया गया।

इस अवसर पर गंगा नदी में 10000 (दस हजार) महाशीर मछलियों के वीज को छोड़ा गया। राष्ट्रीय स्वच्छ गंगा मिशन (एनएमसीजी) के अन्तर्गत आयोजित इस कार्यक्रम में संस्थान के निदेशक डा.वीके दास ने गंगा नदी में मछली और रैंचिंग के महत्व को वताया। उन्होंने कहा पुरे गंगा नदी में कम हो रहे महत्वपूर्ण मत्स्य प्रजातियों के एक करोड़ से ज्यादा वीजों के रैंचिंग का लक्ष्य रखा गया है। डा. संदीप वेहेरा ने नमामि गंगे परियोजना के वारे में जानकारी दी।आचार्य वालकृष्ण ने मानव सभ्यता के लिए गंगा के महत्व को वताया और गंगा को स्वच्छ रखने और इसे वचाने के लिए आह्वान किया। इस अवसर पर कुछ जरूरतमन्द मछुआरों को मछली का जाल दिया गया।

गंगा नदी में 10000 महाशीर मछलियों के बीज को छोड़ा

Sahara News, 18.06.2023

Etv Bharat News Hindi, 17.06.2023

पटना के राजाघाट पर गंगा में दो लाख मछलियां छोड़ी

पटना, प्रधान संवाददाता। शुक्रवार को पटना के राजाघाट पर गंगा नदी में दो लाख से अधिक मछलियों को छोड़ा गया। इस कार्यक्रम का उद्देश्य गंगा नदी की जैव विविधता को बनाये रखना एवं मछुआरों को जीवीकोपार्जन उपलब्ध कराना है। केन्द्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान बैरकपुर कोलकाता एवं नमामि गंगे परियोजना द्वारा 'राष्ट्रीय रैन्चिंग कार्यक्रम-2023' के तहत गंगा में मछलियां छोड़ी जा रही हैं।

मछलियां गंगा में बढ़ते प्रदूषण को कम करने और नदी पारिस्थितिकी को बनाये रखने में सहायक है। मौके पर नमामि गंगे परियोजना के प्रधान अनुवेशक परियोजना डॉ. बसंत दास ने बताया कि संस्थान द्वारा नमामि गंगे परियोजना के तहत इस कार्यक्रम की शुरुआत 2018 में की गई थी। अब तक 95 लाख से ज्यादा रोहू, कतला, कलबासु और मृगल/नैनी की फिंगरलिंग को गंगा उत्तराखंड, उत्तरप्रदेश, बिहार, झारखंड व बंगाल के विभिन्न घाटों से छोड़ा जा चुका है। मुख्य अतिथि बिहार पशु विज्ञान, बिहार के कुलपति डॉ. रामेश्वर प्रसाद ने कहा कि छोड़ी गई मछलियां गंगा नदी के पारिस्थितिकी तंत्र को सुदृढ़ करेंगी। प्रधान मुख्य संरक्षक वन जवाहर प्रसाद मौजूद थे।

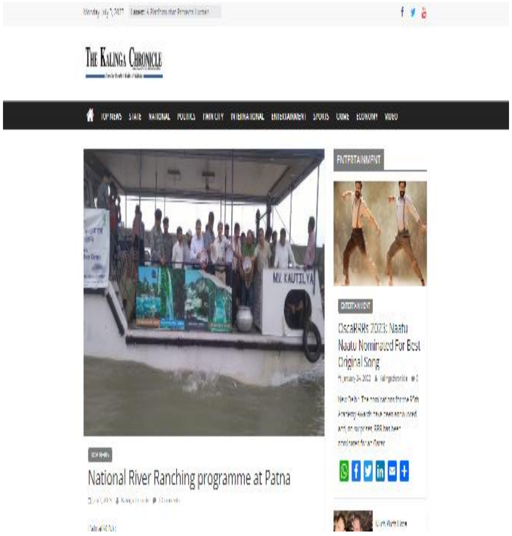
राजा घाट पर गंगा में शुक्रवार को मछलियां छोड़ते अधिकारी।

उद्यम | बड़े बाजार व छोटे कस्बों में भी होगा उपलब्ध, जूस और बर्फी की हुई सबसे ज्यादा बिक्री

सूबे में अब पंचायत स्तर पर खुलेंगे नीरा कैफे

बरसात में भी मिलेगा जूस

Dainik Bhaskar, 01.07.2023



Kalinga Chronicle, 01.07.2023

हिन्दुस्तान

गंगा नदी में छोड़े गए मछलियों के दो लाख बीज

पहल

- सिफरी की ओर से कोटवा नारायणपुर घाट पर हुआ कार्यक्रम
- विलुप्त हो रही मत्स्य प्रजातियों को बचाने की कवायद

बलिया, संवाददाता। गंगा नदी में विलुप्त हो रहे मत्स्य प्रजातियों के संरक्षण व संवर्धन के उद्देश्य से भारतीय कृषि अनुसंधान परिषद-केन्द्रीय अंतर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) की ओर से शनिवार को कोटवा-नारायणपुर घाट पर गंगा नदी में दो लाख भारतीय प्रमुख कार्प का बीज छोड़ा गया। राष्ट्रीय नदी रैंचिंग कार्यक्रम के तहत मुख्य अतिथि सांसद वीरेन्द्र सिंह मस्त की मौजूदगी में कतला, रोहू व मृगल मछलियों के बीज का संचय किया गया।

राष्ट्रीय स्वच्छ गंगा मिशन (एनएमसीजी) के बैनर तले आयोजित इस कार्यक्रम में संस्थान के निदेशक डॉ. बीके दास ने गंगा नदी में मछली व रैंचिंग के महत्व को बताया। कहा कि इस वर्ष गंगा नदी में कम हो रहे महत्वपूर्ण मत्स्य प्रजातियों के 25 लाख से ज्यादा बीज का रैंचिंग किया गया है। मुख्य अतिथि ने पतितपावनी गंगा को स्वच्छ रखने तथा जैव विविधता को बचाने का आह्वान किया। जिले के जलभराव वाले क्षेत्र सुरहताल, भागड़ नाला, मगही नदी, कोरहरा नाला आदि में भी मत्स्य उत्पादन के लिए प्रेरित किया। कहा कि इससे रोजगार के अवसर पैदा होंगे तथा जल क्षेत्रों के प्रदूषण को भी कम करने में मदद मिलेगी। सांसद ने मत्स्य पालन के साथ मिश्रित कृषि व मोटे अनाज की खेती को अपनाने की भी अपील की।

इस दौरान सांसद ने सक्रिय व जरूरतमंद मछुआरों को जाल भी वितरित किया। बीडीओ शिवांकित वर्मा, मत्स्य निदेशक संजय कुमार, जिला कृषि अधिकारी डीके सिंह आदि ने जैव विविधता व मछलियों के बारे में लोगों को जागरूक किया। केंद्र प्रभारी डॉ धर्मनाथ झा ने संचालन किया, जबकि संस्थान के वैज्ञानक डॉ राजू बैठा ने सबका आभार जताया। वैज्ञानिक डॉ मितेश रामटेक, डॉ विकास आदि की अहम भूमिका रही।

नरही क्षेत्र के कोटवा- नारायणपुर में शनिवार को मछली के बीजों को गंगा में छोड़ते सिफरी के सदस्य।

Hindustan, 02.07.2023

विलुप्त हो रहे मछलियों के दो लाख बीज को सिफरी द्वारा बलिया के गंगा नदी में छोड़ा गया

Univarta Hindi Dainik, 02.07.2023


रिवर रैंचिंग के तहत गंगा में छोड़ी गईं दो लाख मछलियां

कोटवा–नारायणपुर घाट पर गंगा में कार्यक्रम, किया जागरूक

Dainik Jagran 02.07.2023


विलुप्त हो रही मछलियों के दो लाख बीज गंगा में छोड़ा

Rashtriya Sahara, 02.07.2023


मछलियों के दो लाख बीज गंगा में छोड़े

Amar Ujala, 02.07.2023


गंगा नदी में छोड़े गये कार्प के बीज

Jansandesh Times, 2.7.2023


गंगामें छोड़ा गया दो लाख कार्पका बीज

Dainik Aaj, 02.07.2023


विलुप्त हो रहे मछलियों के दो लाख बीज को सिफरी द्वारा बलिया के गंगा नदी में छोड़ा गया

Dainik Aajad Patra,02.07.2023


विलुप्त हो रहे मछलियों के दो लाख बीज को सिफरी द्वारा बलिया के गंगा नदी में छोड़ा गया

Bharat ekta times, 02.07.2023

Kalinga chronicle, 02.07.2023

मछलियों के दो लाख बीज गंगा में छोड़ा गया

Jagruk Express, 02.07.2023

दैनिक भास्कर भागलपुर 24-07-2023

गंगा से बरसेगा अमृत

1000 करोड़ के 8 प्रोजेक्ट से उद्धार

दैनिक भास्कर भागलपुर 24-07-2023

चार लाख जीरा डाला, अब मछली की नहीं होगी कमी

Dainik Bhaskar, Bhagalpur, 24.07.2023

सिफरी द्वारा पश्चिम बंगाल के कालना में 'राष्ट्रीय रैंचिंग कार्यक्रम-2023' के तहत गंगा नदी में मछली अंगुलिमीन छोड़े गए

Fingerlings released at Kalna, West Bengal in river Ganga by CIFRI under National Ranching Programme

Kolkata,(KCN):A river ranching program under 'National River Ranching Programme-2023' was conducted by ICAR-Central Inland Fisheries Research Institute, Barrackpore at Mahismardini Ghat, Kalna (East Burdwan District), West Bengal on 23rd August, 2023. In continuation of the national river ranching programme which was initiated from 5th of April 2023 from Nabadwip, West Bengal the pragramme was carried out at different stretch spanning across 3 different states. Till date more than 27 lakhs of fish fingerlings were ranched during the period of April to August ,2023. During the event a total of 1.56 lakhs of advanced fingerlings (> 450g) of Indian Major Carps were released in the river by Dr. B. K. Das, Director, ICAR CIFRI along with CIFRI NMCG team members. The event was also marked by gathering of 58 number of local fisherwomen and fishermen from nearby areas belonging to SC/ ST community.A mass awareness on sustainable fisheries and dolphin conservation was also conducted at Mahismardini Ghat, Kalna among the gathered fishers.Director ICAR CIFRI highlighted the importance of river Ganga in our daily life.He urged the local community not to throw any plastics and other anthropogenic waste in to the river water. Further, he also addressed the local fishers to avoid indiscriminate catching juvenile and brood fishes. He also said about the present ranching initiatives taken up by ICAR CIFRI from last 5years.The importance of River Ganga and the initiative taken by National Mission for Clean Ganga programe was also exhibited among the local fisher community.

Jharkhand Darshan, 24.08.2023 | Kalinga Chronicle, 24.08.2023

চালু হল 'দুরন্ত বার্তা' অ্যাপ ডাউনলোড করুন প্লে-স্টোর থেকে

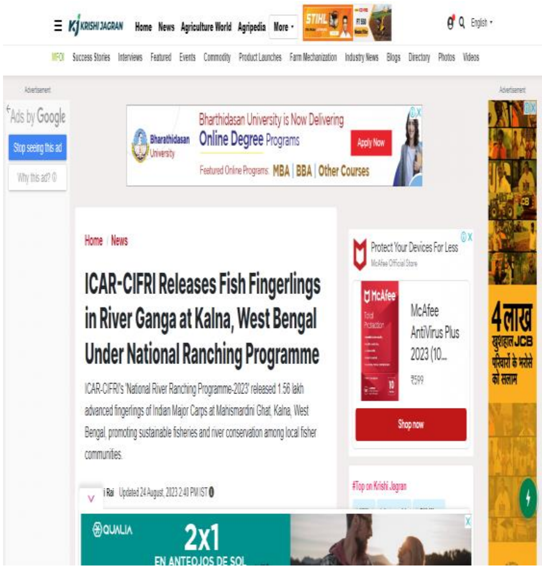
দুরন্ত বার্তা

সূচিকিৎসা

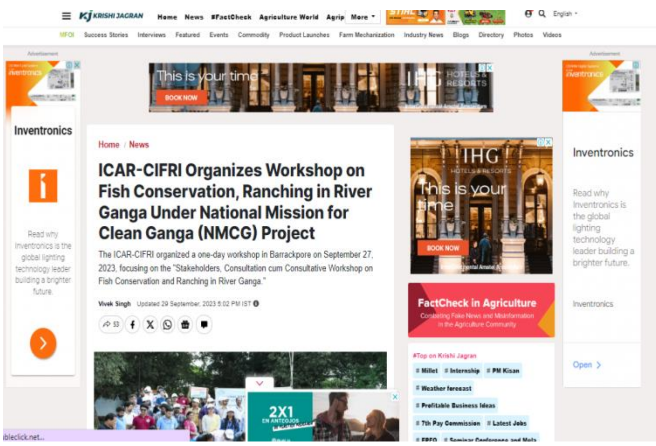
Volume No. 28, Issue No.: 254 Thursday, 24 August, 2023

সিফরীর তত্ত্বাবধানে কালনায় ন্যাশনাল রেঞ্চিং প্রোগ্রাম এর মাধ্যমে গঙ্গা নদীতে ছাড়া হলো মাছের চারা

২৩ আগস্ট ঃ তারিখে পশ্চিমবঙ্গের কালনার (পূর্ব বর্ধমান জেলা), মহিস্মর্দিনী ঘাটে আইসীএআর সিফরী ব্যারাকপুর দ্বারা 'ন্যাশনাল রিভার রেঞ্চিং প্রোগ্রাম ২০২৩'-এর অধীনে একটি রেঞ্চিং কর্মসূচি পরিচালিত করা হয়।৫ ই এপ্রিল ২০২৩ এ পশ্চিমবঙ্গের নবদ্বীপ থেকে এই কর্মসূচিটি শুরু করা হয়। ৩টি ভিন্ন রাজ্যর আলাদা অঞ্চল জুড়ে বিস্তৃত হয়েছে এই কর্মসূচিটি। এখনও পর্যন্ত এপ্রিল থেকে আগস্ট, ২০২৩ এর মধ্যে ২৭ লাখেরও বেশি মাছের চারা নদীতে ছাড়া হয়েছে। সিফরী র অধিকর্তা ডাঃ বি কে দাস, এবং ওনার নামামী গঙ্গা টিম এর সদস্যরা ভারতীয় .মেজর কার্পের মোট ১.৫৬ লক্ষ উন্নত চারা (৪৫০ গ্রাম) নদীতে ছাড়েন। এই অনুষ্ঠানে স্থানীয় তফসিলি জাতি এবং উপজাতি সম্প্রদায়ের ৫৮ জন মৎস্যজীবী মহিলা এবং পুরুষ উপস্থিত ছিলেন। কালনার মহিষমর্দিনী ঘাটে উপস্থিত সবাই কে মাছ চাষ ও ডলফিন সংরক্ষণের ব্যাপারে সচেতন করা হয়। সিফরী র অধিকর্তা ডাঃ বি কে দাস আমাদের দৈনন্দিন জীবনে গঙ্গা নদীর গুরুত্ব তুলে ধরেন। তিনি নদীর জলে কোনো রকম প্লাস্টিক ও অন্যান্য বর্জ্য পদার্থ না ফেলার জন্য স্থানীয় মানুষদের প্রতি আহ্বান আহ্বান জানান।এছাড়াও, তিনি মৎস্যজীবীদের ছোট মাছের চারা ও ব্রুড মাছ ধরা বন্ধ করতে বলেন। তিনি গত ৫ বছর ধরে সিফরীর দ্বারা পরিচালিত রেঞ্চিং কর্মসূচী, ও অন্যান্য উদ্যোগ সম্পর্কেও বলেন। গঙ্গা নদীর গুরুত্ব এবং ন্যাশনাল মিশন ফর ক্লিন গঙ্গার (নামামী গঙ্গে) কর্মসূচি স্থানীয় মস্যজীবী সম্প্রদায়ের কাছে তুলে ধরা হয় এই অনুষ্ঠানে।



Duronto Barta, 24.08.2023 Krishi Jagran news portal, 24.08.2023



Krishijagran News (English and Bengali) dated 30.09.2023

One lakh fishes released in river Ganga by Sifri Prayagraj in Raebareli Dalmau

Prayagraj, Sanyam Bharat: On the occasion of National River Ranching Program 2023, keeping in mind the conservation and promotion of extinct fish species in the Ganga River, the Indian Council of Agricultural Research - Central Inland Fisheries Research Institute (CIFRI), Prayagraj, will organize the event in Dalmau, Rae Bareli, Uttar Pradesh on September 2023. 100000 (one lakh) seeds of Indian major carp - Katla, Rohu, Mrigal fishes were released in the river Ganga under the Ranching cum Public Awareness Programme, in this program organized under the National Mission for Clean Ganga (NMCG), Dr. Dharam, in-charge of the institute, Addressing the gathering, Nath Jha explained the importance of fish and ranching in the Ganga river. He said that this year, more than 30 lakh seeds of important fish species which are depleting in the entire Ganga river have been farmed. Chief Guest of the program Nirmala Paswan MLA (Member of Legislative Council), Uttar Pradesh, on this occasion called upon the people present to keep Ganga clean and save biodiversity. On this occasion, the special guest of the program, Dr. U K Sarkar, Director, ICAR-NBFGR, Lucknow, while addressing the fishermen present in the gathering, told about the importance of fish for the fishermen and river Ganga and acknowledged the importance of catching small fishes. Fisheries Inspector of Rae Bareli district, Shashank Naman, said that the contribution of fishermen in saving the fishes is important and told how they can help in increasing the fish diversity in the river Ganga. Rajesh Sharma, convener of Ganga Vichar Manch (Namami Gange National Clean Ganga Mission) said. Gave information about Namami Gange project and also made people pledge to keep Ganga clean, Dr. Avsar Alam scientist made them aware about biodiversity and fishes and asked to keep Ganga clean, Brijesh Dutt addressed the gathering. Gaur Chairman Municipal Council Dalmau and Vinod Nishad also addressed, fishermen from nearby villages and local people living on the banks of Ganga participated in the program. In the end, scientist of the institute, Dr. V.R. Thakur gave a vote of thanks. Assured that with the participation of the society we will be successful in achieving the objectives of this project, senior leader of BJP Uttar Pradesh Shyam Sundar Dubey and researchers and officials of the institute mainly participated in the program and addressed the gathering.

Sanyam Bharat Newspaper, 09-09-2023

SHREE 7NEWS

9 September 2023 वाराणसी (उत्तर प्रदेश)

सिफरी द्वारा डलमऊ में एक लाख मछली को गंगा नदी में छोड़ा गया

SHREE 7NEWS राष्ट्रीय नदी रैंचिंग कार्यक्रम 2023 के अवसर पर गंगा नदी में विलुप्त हो रहे मत्स्य प्रजातियों के संरक्षण एवम् संवर्धन को ध्यान में रखते हुए,भारतीय कृषि अनुसंधान परिषद् - केन्द्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान (सिफरी) प्रयागराज के द्वारा आज दिनांक 08 सितम्बर 2023 को डलमऊ रायबरेली उत्तर प्रदेश में गंगा नदी में 100000 (एक लाख) भारतीय प्रमुख कार्प - कतला,रोहू,मृगल मछलियों के बीज को रैंचिंग सह जन जागरूकता कार्यक्रम के तहत छोड़ा गया,राष्ट्रीय स्वच्छ गंगा मिशन (एनएमसीजी) के अन्तर्गत आयोजित इस कार्यक्रम में संस्थान के प्रभारी डॉ॰ धर्म नाथ झा ने उपस्थित लोगों को सम्बोधित करते हुए गंगा नदी में मछली और रैंचिंग के महत्व को बताया,उन्होंने कहा कि इस वर्ष पुरे गंगा नदी में कम हो रहे महत्वपूर्ण मत्स्य प्रजातियो के 30 लाख से ज्यादा बीज का रैंचिंग हुआ है,कार्यक्रम के मुख्य अतिथि श्रीमती निर्मला पासवान माननीया विधायक (विधान परिषद सदस्य), उत्तर प्रदेश ने इस अवसर पर गंगा को स्वच्छ रखने एवम जैव विविधता को बचाने के लिए उपस्थित लोगों से आह्वान किया, इस अवसर पर कार्यक्रम के विशिष्ट अतिथि डॉ यू के सरकार, निदेशक, ICAR-NBFGR, लखनऊ ने सभा में उपस्थित मछुआरों को संबोधित करते हुए मछुआरों और गंगा नदी के लिए मछलियों के महत्व को बताया तथा छोटे मछलियों को पकड़ने से माना किया,कार्यक्रम में रायबरेली जनपद के मत्स्य निरीक्षक श्री शशांक नमन ने कहा कि मछलियों को बचाने में मछुआरों का योगदान महत्वपूर्ण है और गंगा नदी में मत्स्य विविधता बढ़ाने में वे कैसे सहयोग दे सकते हैं बताया,श्री राजेश शर्मा संयोजक गंगा विचार मंच (नमामि गंगे राष्ट्रीय स्वच्छ गंगा मिशन) ने नमामि गंगे परियोजना के बारे में जानकारी दी साथ ही लोगो को गंगा को स्वच्छ रखने का संकल्प दिलाया,डॉ॰ अवसार आलम वैज्ञानिका ने जैव विविधता और मछलियों के बारे में जागरूक किया तथा गंगा को साफ रखने के लिए के लिए कहा,सभा को श्री ब्रिजेश दत्त गौड़ अध्यक्ष नगर परिषद डलमऊ और श्री विनोद निषाद ने भी संबोधित किया, कार्यक्रम में आस-पास गाव के मत्स्य पालक मत्स्य व्यवसायी तथा गंगा तट पर रहने वाले स्थानीय लागों ने भाग लिया,अन्त में संस्थान के वैज्ञानिका डा॰ वी आर ठाकुर ने धन्यवाद ज्ञापन करते हुए आस्वस्त किया कि समाज के भगीदारी से हम इस परियोजना के उद्देष्यों को पाने में सफलता प्राप्त करेंगे,कार्यक्रम में प्रमुख रूप से भाजपा उत्तर प्रदेश के वरिष्ठ नेता श्याम सुंदर दुबे एवं संस्थान के शोधकर्ताओं और अधिकारियों ने भाग लिया और सभा को सम्बोधित किया।

Shree 7 News, 09-09-2023

ICAR-CIFRI, Barrackpore organizes Concluding Workshop on "Stakeholders consultation cum consultative workshop on fish conservation and ranching in River Ganga" under National Mission for Clean Ganga (NMCG) project

Tata Steel Foundation honours two Odia mountaineers for conquering Kilimanjaro

Kalinga Chronicle, 27-09-2023

Rani Rasmoni's 231st "Abirbhav Diwas" observed by Dakshineshwar Kali Mandir in Kolkata

Ranching in river Ganga at Barrackpore under 'National Ranching Programme-2023'

ICAR-CIFRI organized workshop on "Stakeholders consultation cum consultative workshop on Hilsa fisheries improvement for sustainable fisheries and conservation in river Ganga"

Kalinga Chronicle, 28-09-2023

भारतीय कृषि अनुसंधान परिषद
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"STAKEHOLDERS CONSULTATION-CUM-CONSULTATIVE WORKSHOP ON FISH CONSERVATION AND RANCHING IN RIVER GANGA"

Home / "Stakeholders consultation-cum-Consultative Workshop on Fish Conservation and Ranching in river Ganga"

"Stakeholders consultation-cum-Consultative Workshop on Fish Conservation and Ranching in river Ganga"

26th September 2023, Barrackpore

ICAR-Central Inland Fisheries Research Institute, Barrackpore organized one-day workshop on "Stakeholders, Consultation cum Consultative Workshop on Fish Conservation and Ranching in River Ganga" today to address the accomplishment of the three-year project of NMCG, under the Ministry of Jal Shakti, Government of India.

Dr. Basanta Kumar Das, Director, ICAR-CIFRI and Principal Investigators, NMCG, briefed about the mission mode ranching, which released more than 65 lakhs of fish fingerlings during the period 2020-23 covering five states namely Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal. He

NMCG Workshop in ICAR website 28.09.2023

ପ୍ରମେୟ
THE PRAMEYA

ମତ୍ସ୍ୟ ସଂରକ୍ଷଣ, ପଶୁପାଳନ ନେଇ କର୍ମଶାଳା

ଗଙ୍ଗାରେ ମତ୍ସ୍ୟ ଉତ୍ପାଦନ ପାଇଁ ଆହ୍ୱାନ

The Premaya,29-09-2023

भा.कृ.अनु.प. - केंद्रीय अन्तर्स्थलीय मात्स्यिकी अनुसंधान संस्थान
AN ISO 9001 : 2015 Certified Organization
ICAR - CENTRAL INLAND FISHERIES RESEARCH INSTITUTE

NMCG Workshop in ICAR-CIFRI website, 27.09.2023

13. SUMMARY

During the project period 2021-23, objective-based achievements were summarized given as below:

1. A total of 57 different river ranching programs were carried out in five states and 64.15 lakh fingerlings of Indian major carps (IMCs) and Mahseer were released.
2. A significant impact of river ranching was observed when compared with the time series data of ICAR-CIFRI records showing that the landing of IMC increased by 28%, and 49% at Prayagraj, and Buxar comapared to 2020.
3. 181 fish species (172 native and 9 exotics) were recorded from river Ganga. The richest fish species were found in Bijnor (103), Narora (89), Prayagraj (84), Farakka (83), and so on with lowest at the site Harsil (4).
4. 9 different exotic fishes were recorded from entire river Ganga. Common carp (*Cyprinus carpio*) had the greatest distribution of 54%, spanning the entire middle section of the river.
5. ICAR-CIFRI has also assessed the current stock status of 11 fish species of river Ganga, including medium carps, catfishes, and small indigenous fishes
6. The results of the CPUE showed that the West Bengal has highest CPUE followed by Uttar Pradesh, Jharkhand, Uttarakhand and Bihar.
7. Shifting of few warm water fish species has been noticed in the upper stretches of the river primarily for climate change.
8. A total number of 205 awareness programmes at different states was conducted where 10,496 local fishermen and entrepreneurs were sensitized about the sustainable fishing in river Ganga.
9. 227 lakhs of IMC seeds were produced (2020-2023) through induced breeding of riverine wild fish germplasm.
10. 27,000 fingerlings and 127 live brooders of Mahseer are maintained and raised by ICAR-CIFRI in Koteswar, Uttarakhand.
11. Bijnor in Uttar Pradesh can be designated to be the ‘fish protection site’ or ‘fish sanctuary’ based on congregation of juveniles
12. 93 genera of plankton were recorded across all stretches with maximum abundance at site Bhagalpur (Bihar) and minimum at Fraserganj (West Bengal). The study also listed 20 different pollution indicating algal genera.
13. A total of 75 genera of phytoplankton belonging to 8 groups were recorded across the sampling stations.
14. 38 different families of benthic fauna were observed throughout the study in River Ganga while a 11 species were recorded in the lower and estuarine stretch of river Ganga.
15. 46 wetlands (from North to South) close to the main channel (River Hooghly) have been identified and analyzed according to their seasonal spread of water.
16. A total of 91,588 Hilsa brood fish were released in upstream of the Farakka barrage during the period.
17. Artifical breeding of Hilsa has been carried out at two places viz. Farakka and Godakhali of West Bengal and fertilization rate of 56% and 87.9% was achieved respectively.
18. A total no. of 22,47,000-23,57,000 eggs and 16,900 spawn of Hilsa were ranched at upstream of Farakka barrage for improvement of natural Hilsa population
19. Standardization of rearing of Hilsa seeds in grow-out system viz. FRP, earthen pond and raceway was done.
20. A total 243 numbers of Hilsa brood were stocks at Circular cages installed by ICAR-CIFRI in river Ganga at Farakka

21. A total of 3,065 numbers of Hilsa were tagged to assess their upstream migration starting from October, 2020 up to September 2023
22. Among the total tagged adult Hilsa more than 7.8% adult Hilsa recovered from different location from their released point with maximum recovery from middle stretch.
23. A total number of 493 awareness programmes at different sites of Farakka was conducted where 14317 local fishermen and entrepreneurs were sensitized about the conservation of Hilsa and Dolphin

14. Quarterly targets have been achieved

Indicators	Target	Quarter-wise Target				Quarterly Target Achieved			
		Q1	Q2	Q3	Q4	Q1 (April-June 2022)	Q2 (July-September 2022)	Q3 (October-December 2022)	Q4
No. of Carp fingerlings ranched in selected stretches of Ganga River in UP, Bihar and West Bengal.	8,00,000	5,00,000	50,000	1,00,000	1,50,000	A total of 14.3 lakh fish (IMC 14 lakh & Chital 30 thousand) were ranched covering states Uttar Pradesh (2 lakh), Bihar (4 lakh) and West Bengal (8.3 lakh).	A total of 4 lakh carp fingerlings (IMC 4 lakh) were ranched covering states of Uttar Pradesh (2 lakh) and Jharkhand (2 lakh).	Yet to achieved	Yet to achieved
No. of Mahseer (keystone species) brooders developed.	50	30	5	10	5	A total of 500 mahseer fingerlings are collected for brood stock development.	A total of 5000 mahseer fingerlings are collected for brood stock development.	Yet to achieved	Yet to achieved
No. of adult Hilsa ranched in Farakka stream.	7000	2000	50	100	4850	A total of 2005 Hilsa were ranched in Farakka upstream including 22 tagged Hilsa.Along with this, more than 5.4 lakh seeds were also ranched for which	A total of 265 Hilsa were ranched in Farakka upstream	Yet to achieved	Yet to achieved

						juvenile Hilsa are available in upstream upto Sahibgunj.			
No. of site-specific awareness cum trainings conducted for the fishers.	50	20	5	10	15	12 awareness programme were organized regarding sustainable fisheries and more than 308 local people were sensitized	A total of 78 awareness programme and a webinar have been conducted. A total of 994 beneficiaries have been sensitized regarding conservation of Gangetic Dolphin, Hilsa, and purpose of ranching of fishes in River Ganga during this period through 23 awareness programme.	Yet to achieved	Yet to achieved
Increased availability of Hilsa upstream of Farraka upto Allahabad (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
No. of fishermen trained	1,500	500	200	250	550	106 Hilsa and Dolphin awareness programswere organized covering Bihar, Jharkhand and	A total of 22 Hilsa and Dolphin awareness programs were organized covering Bihar, Jharkhand and	Yet to achieved	Yet to achieved

						West Bengal states. Active participation of 2035 people were noticed in awareness programme.	West Bengal states. Active participation of 2035 people were noticed in awareness programme.		

15. Publications (2021-2023)

15.1. Book/booklet

1. Das, B. K., Bayen, S., Johnson, C. (2022). *Socio-Economic Status of Fishers of River Ganga*, ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata and National Mission for Clean Ganga, New Delhi. 31p. ISBN: 0970-616X
2. Photo Album (2023): *River Ranching-A Glimpse*, ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata and National Mission for Clean Ganga, New Delhi. 95p. ISBN: 81-85482-51-9

15.2. Research Articles (Published)

1. B. K. Das, Ray, A, Chanu, T.N., Baitha, R., & Bayen, S. (2022). Fisheries of river Ganga: Present vs Past. Science & Culture. 88 (9-10):306-309
2. Bayen, S., Das, B.K., Sarkar, U.K.,Roy, S. & Ramteke, H.M (2022). Assessment and Evaluation of Small Indigenous Fishes (SIF) of river Ganga for conservation and livelihood security. Science & Culture. 88 (9-10):317-322
3. Bayen, S., Mohanty, T. R., Chanu, T. N., Johnson, C., Tiwari, N. K., Manna, R. K., Swain, H, K., & Das, B. K. (2021). Influence of riverine connectivity on phytoplankton abundance and diversity of associated wetlands of River Ganga: A comparative study of an open and a closed wetland. Aquatic Ecosystem Health & Management, 24(4), 34-45.
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16. ACKNOWLEDGEMENT

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