Population Growth, Lifespan, Development and Conservation Methods of Labeo Rohita Fish in Gandhi Sagar Reservoir

Radha Anjana[1], Dr. Neetu Chouhan[2]

[1]Research Scholar, University Of Technology Jaipur (Raj.), Doctor of Philosophy in Zoology

ABSTRACT

Labeo rohita, also known as rohu, is an important type of fish found in India. It has become a major part of the fish population in the Gandhi Sagar Reservoir (GSR) because it was intentionally introduced as part of a planned stocking program. This man-made lake is located in Madhya Pradesh, on the Chambal River. Originally, the lake had only native fish species, but now rohu and Catla catla make up a large part of the fish caught there.Growth and Development: L. rohita in the reservoir grows steadily and consistently because the water environment is good and there is not too much competition for food and space. In ideal farming conditions, this fish can grow to 500–1,000 grams in one year. In natural river systems, the fastest growth happens in the first year, such as 34.6 cm in one study, and then slows down as the fish gets older. The species usually starts breeding in its second year. The relationship between the length and weight of L. rohita in similar environments often shows that weight increases a little slower than the cube of its length, called negative allometric growth. However, some studies in other areas have found that the growth is proportional, called isometric growth. Lifespan: Studies on L. Rohita in river systems have found that some fish can live up to 11 years. One study recorded a fish of this age. The maximum age generally recorded is close to 10 years.

Gandhisagar Dam is located at 22°04′N and 75°22′E, on the border between Madhya Pradesh and Rajasthan. The reservoir spans an area of 660 km². When the dam is full, the water level is 399.9 meters, with an average area of 402 km². The maximum length of the reservoir is 67.8 km, and the maximum width is 26.1 km. Construction of the dam started in 1954 and was completed in 1960. Over 228 villages were either completely or partially submerged due to the flooding caused by the dam. Full submergence happens when the water level reaches around 50 meters, but due to low rainfall in the last three years, the dam's capacity utilization has dropped by more than 40%. During the study period in December to January 2001–2002, the water level was 381.9 meters, which reduced the area of submergence by about 250 km². Many large islands became visible again in the reservoir, and the state government allocated large areas on both banks for farming. Conservation Methods: Managing L. rohita in the Gandhi Sagar Reservoir involves several strategies to make sure the fish population stays healthy and the fishery is sustainable. Stocking Support: Keeping up with stocking young fish and fingerlings is an important management activity, especially as the reservoir environment may affect natural reproduction. RegulatoryMeasures: Laws are important for managing the fishery. These include setting closed season when fishing is not allowed, creating protected areas, and controlling fishing nets to keep them from catching baby fish. Habitat Management: The physical features of the reservoir, such as shallow areas, pools, and gorges, offer necessary feeding and sheltering spots for the fish. Cooperative Management: Working with and organizing local fishermen into cooperatives helps manage fishing efforts and marketing, leading to a more organized and sustainable fishery. Because of improvements in multiple spawning of carps, there is a growing need for high-quality larval diets. Larval fish lack the right enzymes or enough digestive enzymes to process feed efficiently. This means that breaking down feed ingredients into simpler nutrients using bacterial enzymes may help these young fish. Five experimental diets (D1–D5), each with the same calorie and protein content, were made with 32% fish meal, 34% mustard oil cake, 30% rice bran, and 2% cod liver oil. These diets were fermented in a lab using Bacillus circulans bacteria (at a rate of 108 cells per gram) at 37°C for 1 to 5 days. The bacteria used came from the intestines of young rohu fish (Labeo rohita). A non-fermented diet (RD) was also tested. Rohu eggs (average weight 0.35 mg) were given these diets freely for 21 days, feeding them every half hour from 9 a.m. to 4 p.m.

Results fermenting the diets increased the amount of protein and free amino acids, while reducing crude fiber. Diets fermented for 4 and 5 days (D4 and D5) led to the best growth and survival (98% and 98.33%) of rohu eggs compared to other diets. A strong positive link was found between the RNA:DNA ratio and specific growth rate across 18 dietary groups (6 groups tested in triplicate).

Keywords: Labeo rohita, Fertilization, growth survival Labeo rohita eggs fish, intestinal microflora; fermentation; diets; growth; survival; Labeo rohita spawn ,conservation methods.

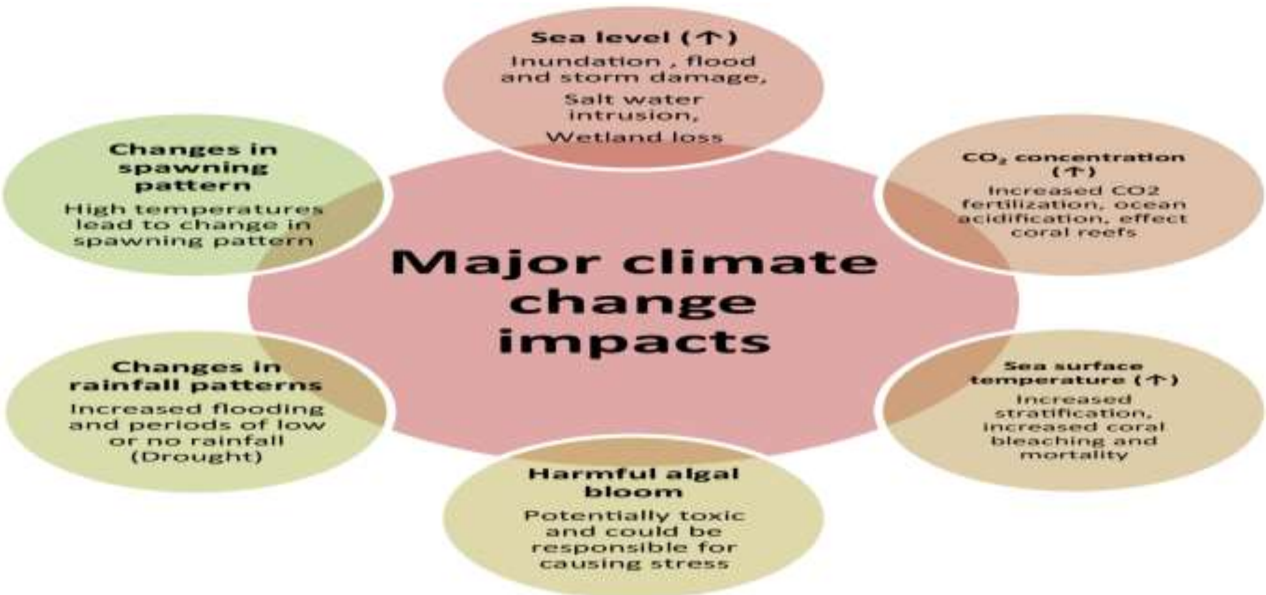
I. INTRODUCTION

Labeo rohita, also known as rohu, is an important type of major carp found in India. It plays a significant, though not always ideal, role in the fishery of the Gandhi Sagar Reservoir. The population, growth, and survival of this species in the reservoir are affected by the construction of the dam and the way it is managed, especially through stocking programs. Population Growth and Lifespan Population Status: L. rohita was not originally present in the Gandhi Sagar Reservoir but was introduced after the reservoir was created as part of a plan to develop a major carp fishery.Although stocking was successful and the fish established itself, it has never made up more than 2% of the total catch, which is much less than Catla catla. This shows L. rohita does not do as well in this environment. Rivers, L. rohita can live up to 11 years or longer, with some fish in the Ganga River even reaching that age.In other river systems, the maximum age is 8 years or more. Biodiversity Survey of Gandhisagar Reservoir, Madhya Pradesh. This paper discusses the results of a biodiversity survey carried out at Gandhisagar Dam, which is located on the border between Madhya Pradesh and Rajasthan.

Different methods were used to study the diversity of living things like fish, reptiles, birds, mammals, and plants. Eight types of plants were found, with Vallisneria spiralis being the most common. The survey found 21 fish species, eight reptile species, 139 bird species, and one mammal species. Gandhisagar Reservoir is in danger because of human activities which have led to a steady decline in the variety of life in the area. Gandhisagar Dam is part of a big project designed to provide irrigation and generate hydropower for both Madhya Pradesh and Rajasthan. The Chambal Valley Project was built in three phases. The first phase completed the Gandhisagar Dam and Kota Barrage in 1960. Later, the Rana Pratap Sagar Dam was built in 1970, and the Jawaharsagar Dam in 1973. The River Chambal starts in Indore District and flows for 1,056 km before joining the Yamuna at Pachnada in Uttar Pradesh. It passes through the Malwa and Hadoti plateau, crosses the boundary fault between the Vindhya and Aravalli mountain ranges, and finally flows into the Gangetic Plains.

Gandhisagar Reservoir covers an area of 660 km², making it one of the largest inland water bodies.Its drainage area is 23,025 km², collecting water from rivers like Kshipra, Shivana, Retam, Chhoti Kali Sindh, Ansar, Rupania, and Tilsoi. Freshwater wetlands are facing many threats, which have caused serious problems for the country's freshwater resources. Issues include careless river damming, deforestation in the catchment areas, improper disposal of waste by cities and industries, releasing untreated sewage, pollution with pesticide remains, eutrophication, and soil erosion leading to siltation. These factors are causing the loss or complete disappearance of freshwater resources. The aim of this study was to examine the large-scale diversity of major inland wetlands in Madhya Pradesh and Chhattisgarh. This paper is based on the biodiversity survey of Gandhisagar Reservoir . Growth: The fish grows fastest during its first year, but its growth slows down in later years. As it gets older, more of its energy is used for making eggs and sperm. The head is broad, and the eyes are located on the lower half. The bottom lip is thick with a continuous fold. There are no whisker-like structures. The dorsal fin is positioned before the pelvic fins. The fish has large, regular scales, and there are about 40–43 scales along the lateral line. The body color is grey on the back, silver on the sides and belly, and the fins are dark, sometimes almost black. The maximum length can be up to 1,800 mm.

Development L. rohita is a species that naturally lives in large rivers in northern and central India. Maturity: The fish usually reaches sexual maturity in its second year. Habitat Preference: It likes rivers with moderate currents and is often found in big rivers, lakes, and reservoirs. Rohu fish eggs were collected from induced spawning of a single group provided by a local fish seed dealer. Four-day-old eggs were taken to the lab and kept for two days, being fed on a mix of plankton. One hundred eggs of similar size (average length 5 mm; weight 0.35 mg) were randomly placed in plastic containers with 15 liters of non-chlorinated water from a deep tube well. Each container was aerated continuously using an air compressor. During the experiment, the dissolved oxygen level, water temperature, and pH were 5.2–7.8 mg per liter, 26.8–30.2°C, and 6.5–7.5, respectively.



It warm water temperatures between 25-30°C (77-86°F). It mainly eats algae, aquatic plants, and tiny floating plants in the water. Breeding: Building dams can change how water flows and affect the natural breeding of L. rohita. This change in the environment is why stocking programs are needed to help the fish breed properly.

Conservation Methods Managing L. rohita in the Gandhi Sagar Reservoir is part of a bigger effort to improve fisheries in reservoirs. This work is led by places like the ICAR-Central Inland Fisheries Research Institute

Important ways to manage the fish include: Stocking Support: Regularly adding young L. Rohita fish to the reservoir helps keep the population healthy. This is done to make up for any natural failures in how many fish grow up on their own because of changes in the river. Fishing Regulation: Rules such as a closed fishing season, creating protected areas, and setting limits on fishing nets help prevent overfishing. These measures allow young fish time to grow and have babies before they are caught. Habitat Management: Scientists study the physical features of the reservoir, such as water levels and how much life is in the water, to make sure the environment supports fish. However, things like too much silt in the water can make it hard for fish to thrive. Monitoring: Scientists keep track of how many fish are caught, what types are caught, and how the population is changing. This information helps them manage the fish stock in a way that is sustainable and makes changes as needed. 54 fish species in the Chambal River in this region. Now, the reservoir is mainly a Catla reservoir, as it is the most abundant fish species, along with Rohu and Mrigal.

Protected under Schedule I of the Indian Wildlife (Protection) Act, 1972 occur in GR . Smooth-coated Indian otter Lutra perspicillata was a common sight throughout the length of the Chambal River. It has almost vanished downstream of Ranapratapsagar Dam and reappears only near Dholpur after a gap of almost 400km. The anecdotal accounts available at Kota suggest that until about 40 years back, it was a common sight in Chambal. We were particularly keen on reestablishing its prevent status. During this survey, we could record it from Gandhisagar and Ranapratapsagar reservoirs. Two otter families were sighted right below the guest house of the forest department at Gandhisagar. It was fairly common in all the suitable habitats, i.e., small fingers of shallow water in the rocky banks of the reservoir. A fisherman’s housing colony with 100 homes, water and electricity was built at Rampura under the National Fisherman Welfare Plan, but these efforts are limited and don’t reach many people. Issues like health, sanitation, children’s education, women’s welfare, and training require urgent attention from the M.P.M.M.S. management. It’s important to create alternative jobs for fisherfolk during the times when they are not working, so they can earn more money and avoid getting involved in bad activities. The loss of wetlands could be because of direct or indirect human actions or natural causes.

The Gandhisagar Dam would last for 100 years, but they didn’t consider the rate of environmental damage and its effects. There was also no dam management policy, which would have helped in planning activities in the reservoir’s watershed area. As a result, the reservoir has reached close to its full capacity (over 396 million cubic meters) only during nine monsoon seasons in the 23 years from 1980 to

2002. Threats Direct and Indirect Human Action: Discharging pesticides and herbicides causes eutrophication and loss of living things. Discharging domestic sewage leads to eutrophication and changes in water pH. Agricultural runoff and sediment flows. The upper watershed through building dams or small water structures on feeder streams. Farming on large areas of dry reservoir beds during droughts. Biofloc Technology (BFT) is seen as a new "blue revolution" in aquaculture. This is because it allows nutrients to be reused over and over again in the water without needing much or any new water. BFT is a kind of eco-friendly aquaculture that uses microorganisms living in the water. Biofloc is made up of small particles in the pond or tank, including both living and dead organic material, phytoplankton, bacteria, and organisms that eat bacteria. It uses the natural processes of microorganisms in the water to supply food to the fish while also helping to clean the water. Because of this, it is also known as active suspension ponds, heterotrophic ponds, or green soup ponds. system is a way to treat wastewater that has become very important in aquaculture. The main idea is to keep a high carbon-to-nitrogen ratio by adding a source of carbohydrates.

fish to breed in a controlled way is called induced breeding. Labeo rohita are made to breed by injecting a special extract from the pituitary gland, a process known as Hypophysation. Hypophysation is a method used in induced breeding for Labeo rohita by giving them an injection of pituitary gland extract. In this method, the extract is injected into the muscle or pectoral fin area of the fish. This process makes the fish ready to breed. If the pituitary extract is taken from the same type of fish, the process is called homoplastic. Induced breeding is used for many different types of fish. Using Hypophysation, we can get a large number of pure fish eggs in any season. This technique also helps in producing hybrid types of fish. This method has a high rate of fertilization, which is between 70 and 80 percent, and a high hatching rate, which is between 75 and 85 percent. This study explains the process and results of the Hypophysation technique.

major and minor fish species found in the area include Labeo calbasu, L. gonius, L. bata, L. boggut, Ompok bimaculatus, Wallago attu and Cirrhinus reba. the game fish, Mahseer is still present but in smaller numbers and sizes. In 2000-2001, 147 Mahseer were caught and together weighed only 386.5 kg. In our current survey, we identified 21 fish species, one of which, Chels laubaca, had not been reported earlier. The decrease in fish diversity can be linked to the change in wetland type from riverine to reservoir and also to the development of commercial fisheries, where market-friendly fish species are introduced and stocked. throughout the reservoir and seems to be doing well. Gavial was not seen by us or reported by local fisherfolk, who know the area well. The Common Indian Monitor (Varanus bengalensis) was seen along the riverbanks. Five species of turtles and one land tortoise were found . reported seven turtle species from Chambal, but Kachuga dhongoka and Chitra indica were not found in Gandhisagar Reservoir. However, the land tortoise Geochelone elegans was found in abundance on some islands. It is reported that turtle eggs and meat are consumed by Bengali fisherfolk working in the area. Other turtle species recorded were Kachuga kachuga, Aspideretus gangeticus and Lissemys punctata. The National Chambal Gharial Sanctuary between Kota and Morena. 192 bird species, including wetland and terrestrial birds. Since this survey was conducted during summer, we could include some migratory waterfowls and waders from earlier lists prepared by Sharma and Rao. This biodiversity study of Gandhisagar Reservoir is the first attempt to record bird diversity in this area. We recorded 139 bird species from the surroundings of GR. It is clear that many marshland and sand bank birds like waders, plovers, curlews, godwits, snipes were found in large numbers. This is because by January each year, a large area comes out of water and offers good feeding conditions for these birds. The presence of some fish-eating birds like cormorants, darters and terns was very noticeable due to their numbers. Most of the common geese and ducks found in central India were present, with Bar-headed Goose, Greylag Goose, Wigeon, Spotbilled Duck and Gadwal being the most common. The absence of Comb Duck and Cotton Teal is notable. The sighting of Sarus Crane and Common Crane is important since these species are currently threatened.

The river enters the valley, about 6 km upstream from the dam and 1 km downstream, the number of vultures and other raptors increased significantly. Five species of vultures were seen, including the critically endangered White-backed Vulture and Long-billed Vulture. Fortunately, both of these vultures were breeding near the reservoir. Other noteworthy raptors recorded were Imperial Eagle, Crested Serpent-eagle, Osprey, Montagu's and Marsh Harrier, Kestrel and White-eyed Buzzard. The immediate area around the reservoir supports a variety of ecosystems that is reflected in the diversity of birds found there. The forest on the west bank of GR is home to parakeets, owls, drongos, malkohas, treepies, Asian Paradise Flycatcher, White-browed Fantail-flycatcher and babblers. The drying margins of the reservoir support various wagtails and pipits. Larks, wheatears, chats, quails, partridges, sparrows and munias have been recorded from grassland areas with scattered bushes.

It is clear that Gandhisagar Reservoir supports many threatened species of mammals, birds, reptiles and fish.

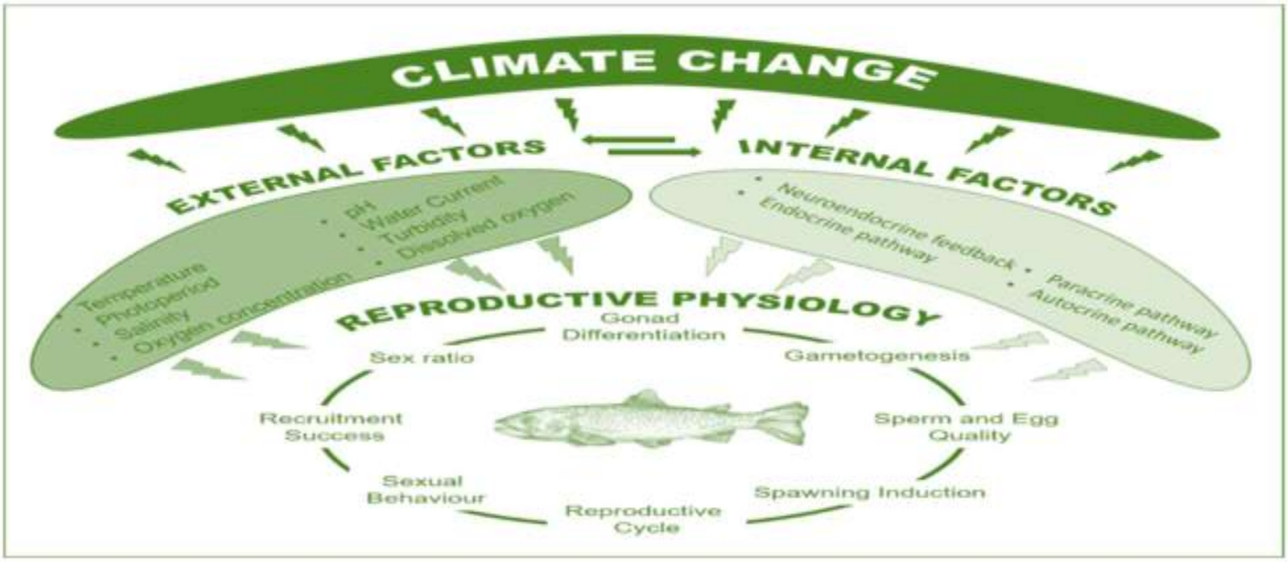
II: Review of Leturature

Labeo rohita, also known as Rohu, grows well in the Gandhi Sagar Reservoir, reaching maturity by the second year. However, there is a need for more focused research on the population, lifespan, and best ways to conserve this species in the reservoir. While general management practices for Indian Major Carp (IMC), such as stocking fish, using the right mesh size, and maintaining the habitat, are applicable, there is also potential for cage farming. Monitoring water quality and pressure is important for long-term sustainability, though there is not enough specific research on Rohu in this exact location. this habitat, whether from natural or human causes, could harm its biodiversity. It is also clear that humans are not unaffected by these changes, as our survival depends on the ecosystem and the water that Gandhisagar Reservoir provides.

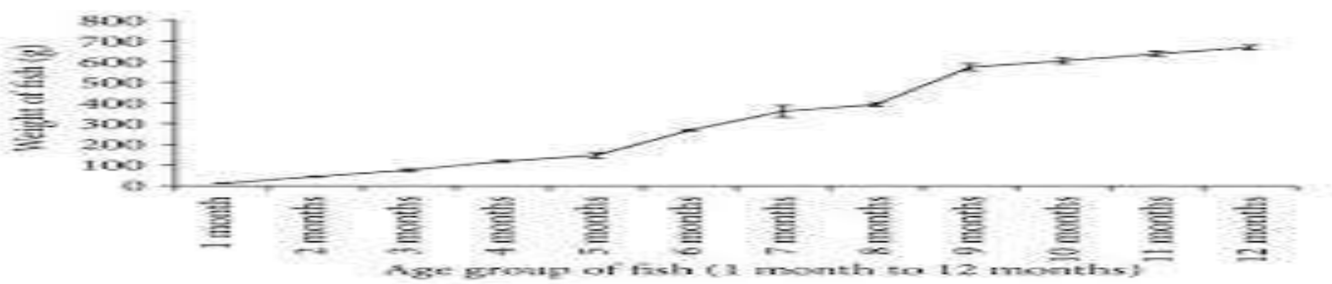
Socio-economic impact of fisheries Gandhisagar Reservoir not only irrigates 1.70 lakh hectares of farmland and produces 115 MW of electricity but is also a major producer of freshwater fish in the country.

The fisheries operations are managed through a fishermen's cooperative called the Madhya Pradesh Matsya Mahasangh Ltd. This Mahasangh is made up of 21 smaller societies with a total of 1,896 members. In the year 2000-2001, 1,489 fishermen were directly or indirectly involved in fisheries, including members from various communities like Bengalis, Bhois, Biharis, Kahars, Keers and Mallahs.

Population and Life History Age and Growth: Rohu grows quickly during the first few years and reaches maturity by the second year. Growth slows down as the fish gets older (for example, in the Ganga River, there is a lot of growth in the first year, but it slows by the 11th year). Habitat: Rohu prefers large rivers and reservoirs with moderate water flow. They thrive in water temperatures between 25 to 30 degrees Celsius, and they mainly eat algae and other microscopic plants, which help keep the ecosystem balanced. Reproduction: Rohu spawn in warm water, between 22 to 31 degrees Celsius.They produce a lot of eggs and have a polygamous breeding behavior. Gandhi Sagar Context Management: Data from CIFRI shows that scientific methods such as stocking fish and using the right mesh size greatly increased fish yields in reservoirs like Gandhi Sagar, raising output from 1 to 44 kilograms per hectare per year by the 1980s.



Research Gaps: While there are general studies on Indian Major Carp and reservoirs, more specific research on Rohu in Gandhi Sagar is needed. This includes understanding the fish's lifespan and current population structure, as general data from places like the Ganga River may not apply directly to the reservoir's unique ecosystem. Conservation Methods and Development Integrated Management: Use methods like stocking fish (especially in pens for raising young fish), control fishing effort (by using the correct mesh size and limiting the number of fishing boats and hours), and protect the habitat.
Cage Culture: Cage farming has the potential to increase fish production and make managing fish stocks easier. However, standard procedures need to be developed for this method. Research Needs: It is important to keep monitoring water conditions such as temperature, dissolved oxygen, and pH levels, and track fish populations using techniques like push netting, to help with adaptive management. Broader Approach: Focus should be on sustainabl practices, involving local communities and maintaining the health of the entire ecosystem, not just on increasing fish yields. Studies highlight the importance of Rohu, provide age and growth models based on data from the Ganga River, and describe general management strategies for reservoirs.



Ke findings show that scientific management, particularly stocking and mesh size, greatly improved fish yields in Gandhi Sagar. There is also potential for cage farming. However, specific details about Rohu's population dynamics in Gandhi Sagar are not well known, emphasizing the need for specialized research on lifespan, growth rates, and effective conservation strategies for the reservoir. Freshwater river fish can be raised in small water areas. They usually don't breed in ponds, but they can breed in reservoirs if certain steps are taken. Young fish and larvae from rivers can survive being moved over long distances. These fish reach sexual maturity after about one year. In northern India, they spawn from June to September. The eggs are about 1.5 mm in size and grow to 3-4 mm when they absorb water. The embryos hatch within 16-19 hours after they are fertilized. The yolk sac extends towards the back. The adult fish are fully grown after about 24 days. Fry that are around 25 mm in size mainly eat zooplankton, especially crustaceans and rotifers. They will only eat planktonic algae if there's no other food available. Adult fish mainly eat algae like Xanthophyceae and Chlorophyceae, diatoms, and bits of plants. These make up about half of their diet. The rest is made of decaying plant material, mud, and other things. They also eat small organisms like flagellates, rotifers, and tiny crustaceans but not very often. These fish are bottom feeders and are good to raise along with other fish that eat from the middle or top of the water. They are usually raised in ponds. After six months, they weigh about 340 grams and are around 24 cm long. By the end of the first year, they can be 1.1 to 1.8 kg and 45 to 61 cm in length. Under good conditions, they can grow up to 2.3 kg and 66 cm in one year. Ponds with lots of decaying material can produce more than 1100 kg per hectare per year.

In this case, a hatching cloth is fixed in the pond. Breeders are placed into the cloth after being injected with a special hormone solution. Spawning happens inside the cloth, and the spent breeders are removed. There can be up to six hatching ponds. They can be seasonal, meaning they might dry up during summer. This helps remove unwanted plants, fungi, bacteria, and other fish enemies, which in turn improves fish productivity. Fry that are 3 to 5 days old are moved from spawning ponds to nursery ponds, where they stay for about 30 days. The main purpose of these nurseries is to provide the right environment with enough food. There can be up to 4 of these ponds.

Rearing

Ponds:These

ponds can be either seasonal or year-round and are usually 90 feet long, 30 feet wide, and 4 feet deep.

They are used to raise more developed fry for a period of 2 to 3 months. These ponds are often long and narrow, with a gentle slope, which makes it easier to catch the fish using nets. They are normally placed close to the spawning and nursery ponds. The number of these ponds can vary depending on how the carp farming is planned, such as one-year, two-year, or three-year cycles. There can be up to 12 of these ponds.

Stocking fast-growing carps can improve production depending on the species chosen, their productivity, and how the stocks are managed.

These proper management, they need to be grouped based on their ecological and production characteristics. Scientists from CIFRI have already started working in this area and have developed classification criteria and management technologies to improve fish yields from the beels. However, there is an urgent need to protect these water bodies from damage caused by human activities. Reopening or digging up river connections where possible is a top priority. Building embankments and sluices around the beels can prevent people from using them for farming and urban development, and also stop too much silt and organic matter from entering the water from nearby areas.

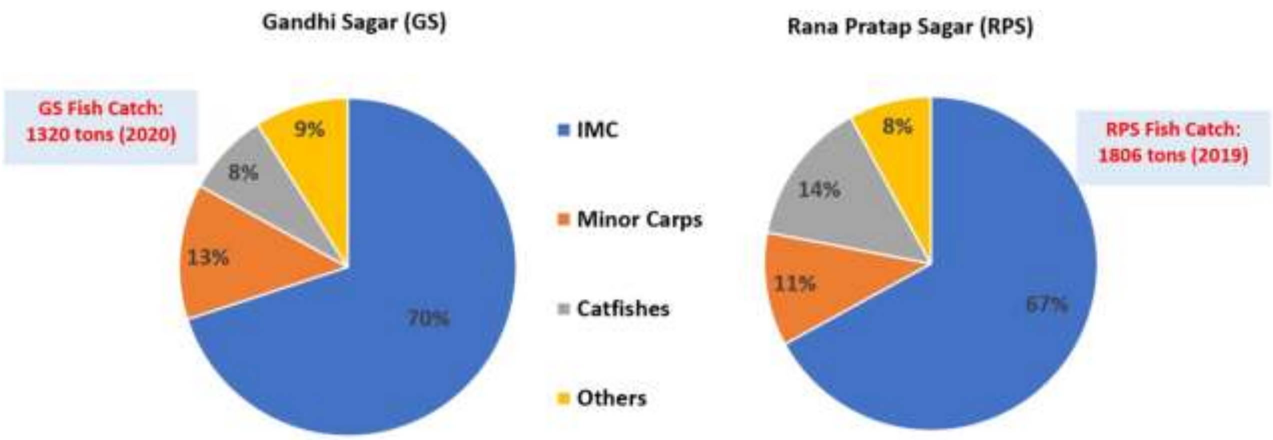
These plants causewater pollution and compete with plankton (tiny plants and animals in water) and fish for food and space. Methods for removing weeds include manual, mechanical, chemical, and biological ways. However, chemical methods are not safe for large water bodies as the harmful substances in weed killers can build up in the environment. Biological methods, like using certain herbivorous fish such as Ctenopharyngodon idella, are the best for controlling submerged weeds like Hydrilla, Najas, Zellingeria, Ceratophyllum, and Myriophyllum, as well as floating weeds like Lemna, Wolfia, Azolla, and Pistia.

III: Methodology

In the Gandhi Sagar Reservoir, the Labeo rohita (Rohu) fish population is well-established because of regular stocking and a good environment. The fish grows in a way that its weight increases in proportion to the cube of its length, which is called isometric growth. These fish can live more than 10 years. The main ways to protect and manage them include regular stocking of young fish, limits on fishing gear, and a time when fishing is not allowed. Population Growth and Lifespan Population Status: Labeo rohita was introduced into the Gandhi Sagar Reservoir after the dam was built and has become a common catch.The reservoir has high productivity and good habitat conditions, which help the fish, grow well. Lifespan: Studies in nearby rivers like the Ganga suggest that Labeo rohita can live up to 11 or more years.

Soil quality parameters	Expt. No.	Jan. 08	Feb. 08	Mar. 08	Apr. 08	May. 08	Jun. 08	Jul. 08	Aug. 08	Sep. 08	Oct. 08
pH	I	5.8	6.4	5.9	6.2	5.8	6.2	6.2	6.2	5.8	6.3
	II	6.0	5.9	5.5	6.4	6.0	5.5	6.4	6.0	6.0	5.8
	III	5.6	5.6	5.8	6.0	5.9	5.8	6.0	6.4	5.5	5.9
Nitrogen (%)	I	0.28	0.28	0.27	0.25	0.31	0.25	0.25	0.22	0.21	0.26
	II	0.22	0.27	0.27	0.31	0.28	0.32	0.20	0.20	0.25	0.22
	III	0.25	0.20	0.28	0.29	0.22	0.22	0.28	0.25	0.21	0.27
Organic carbon (%)	I	1.27	1.23	1.35	1.21	0.86	1.21	1.39	1.09	1.09	1.08
	II	1.01	1.04	1.00	1.31	0.88	0.90	0.59	0.71	1.11	1.16
	III	1.01	1.02	1.16	1.56	1.07	0.80	0.73	0.61	0.98	0.98
Phosphorous (mg L^{-1})	I	22	20	20	20	20	20	11	14	16	15
	II	18	12	18	22	16	18	22	18	14	13
	III	16	16	16	24	18	18	18	16	12	14
Potassium (mg L^{-1})	I	265	215	216	211	215	210	226	235	265	298
	II	246	200	223	198	190	221	236	210	266	290
	III	240	235	225	210	210	225	218	235	280	285
Sodium (mg L^{-1})	I	160	120	130	146	148	135	135	120	185	180
	II	150	135	146	126	135	140	146	135	186	185
	III	140	146	148	120	146	135	148	130	190	180

Growth Rate: The fish grows the most in its first year, and then its growth slows down as it uses more energy for reproduction. The way its length and weight relate shows that it grows in a balanced, isometric pattern. Development Labeo rohita is a fish that lives in flowing river systems in India and nearby countries. In the Gandhi Sagar Reservoir, there is evidence that the fish naturally breed, with large movements upriver during the monsoon season. The fish reaches sexual maturity in its second year of life. Conservation Methods Managing Labeo rohita in the Gandhi Sagar Reservoir is based on a plan created by the Central Inland Capture Fisheries Research Institute (ICAR-CIFRI) and other groups. It is suitable for growing in enclosed areas. It does not breed in ponds but might spawn occasionally in controlled environments like special reservoirs (bundhs). It reaches sexual maturity when it is about 55–56 cm long. In northern India, the spawning season is from June to September, and in southern India, it happens twice a year during the monsoon season. Eggs are laid in shallow,marginal river areas where they are incubated.The eggs are transparent spherical, about 2.0–2.2 mm in diameter, growing to 4.4–5.2 mm when swollen. The embryos hatch 10–18 hours after the eggs are fertilized. It takes about six weeks for the young to reach adult size. The larvae and fry are collected from rivers, transported over long distances, and used for stocking ponds and tanks. Larvae and young fry mainly feed on single-cell algae. Fry that are longer than20 mm mostly eat zooplankton, especially protozoans and crustaceans. Adult fish are surface and column feeders, eating decaying plant material, algae, protozoa, rotifers, crustaceans, and mollusks. The fish can grow up to 38–45 cm in length after one year and weigh about 900 grams. By the second year, the weight increases to 4–5 kg. Under good conditions, the fish can grow about 7.5–10 cm per month. A 2-year-old fish weighing 5 kg can lay around 80 eggs per gram of body weight. In fertile ponds, the total yield can be between 1,100 to 2,200 kg per hectare per year. It is widely farmed in India in ponds and tanks alongside other major carp species.Labeo rohita In India, this fish is called Rohu.



Stocking Support: Regular stocking of young fish (fingerlings) helps keep the population strong and ensures fish are available for catching.
Regulatory Measures: Closed Season: There is a time of year when fishing is not allowed to protect fish that are breeding. Mesh Size Restrictions: Rules on the size of fishing nets make sure only bigger fish are caught, allowing younger fish to grow and breed.
Habitat Management: Even though dams can make it hard for fish to move freely, monitoring the water quality in the reservoir helps maintain a good environment for fish.

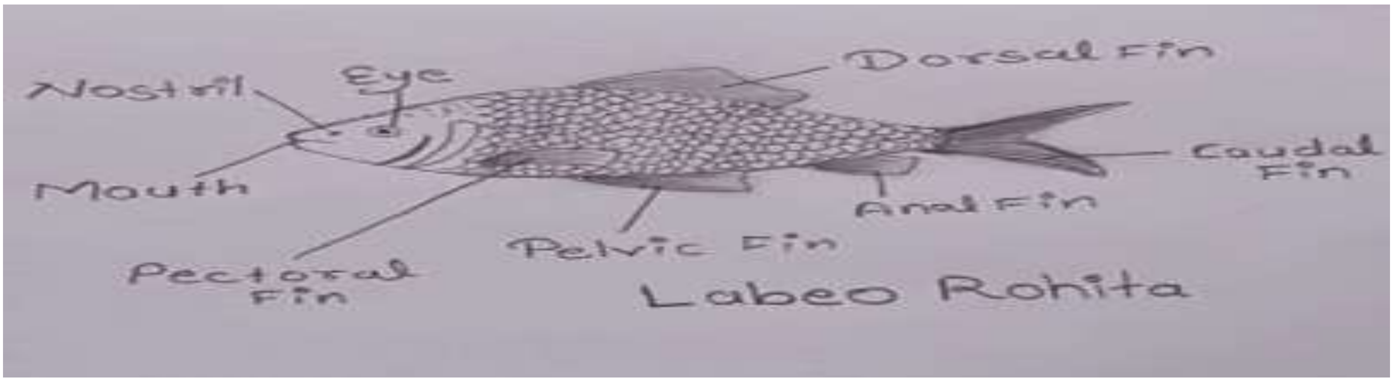


Fig.

Bio-conservation

Fish species that help in producing fish need to be preserved and brought back from other areas to restore lost or endangered species. how endangered fish reproduce. Species like Gadusia chapra and Amblypharyngodon mola are at risk of disappearing and need special care to save them.

Stock management the natural recycling of nutrients through the grazing chain of macrophytes, the plankton chain, and the detritus chain should be used to improve fish production.using these food chains properly can help maintain ecological balance in the system. The detritus food chain, which uses dead organic matter, is not being used enough. This energy source can be best used by stocking detritivores like C. mrigala, L. calbasu, L. rohita, etc. predatory fish. This is common in most open beels. In contrast, Beloon beel has a food chain based on macrophytes, with fish feeding mainly on the associated fauna or detritus. Management should aim to adjust the fish species present according to these food chains.

In India, there are more than 200,000 hectares of riverine wetlands, such as mauns, chaurs, beels, jheels, and pats, found along the Ganga and Brahmaputra rivers. However, due to flood control measures and irrigation projects, many of these wetlands have seen a decrease in fish production because of siltation, habitat loss, and heavy weed growth. Current fish yields from these wetlands are low, about 100 to 200 kg per hectare per year, but studies suggest they can produce up to 1,000 to 2,000 kg per hectare per year. These areas also provide good conditions for raising fish and prawns in pens.

Pen culture has gained much attention, especially in areas filled with weeds. This method allows use of all available water, helps in the best use of food sources for fish growth, and ensures that the entire stock can be harvested. The shape and size of the pen can vary. Since these enclosures need to remain undisturbed during the culture period, their protection from outside forces should be considered at the time of installation.

is

The right environment is important for the success and economic viability of the project. Before building the pen, an engineering survey should be done, focusing on the land type and surrounding drainage area. The shoreline should slope gently. For prawn farming, a sandy-loamy or sandy-clayey bottom is better than clayey soil. The pen should be in shallow water, at least 1 to 2 meters deep. A shallow depth keeps the area clean, productive, and easy to manage. However, if the depth is less than 1 meter, fish and prawns might suffer heat stress during summers. The site should be close to the bank, which lowers construction costs and makes management and harvesting easier. Water quality and the surrounding land should be good, and the water should be clean. Too many trees overhanging the pen can block light and cause leaves to fall into the water, which might release carbon dioxide as they decompose. Turbid water is not good for prawn culture.

Frame: Bamboo is widely available and affordable, especially in states like Assam, West Bengal, and Bihar. It's well suited for beels, mauns, and shallow ponds. The bamboo used should be 6 to 8 inches in diameter and at least 30 feet long. If bamboo isn't available, logs can be used. Galvanized iron pipes with a metal net can also be used for durability, but the cost must be considered before choosing these materials. Aquatic weeds use up nutrients from the water. Their overgrowth can cause problems like reducing oxygen levels, blocking light and movement, and making netting operations difficult. Weeds can be controlled by manual, mechanical, chemical, or biological means. Manual methods are often recommended in pens because they are inexpensive, simple, and effective.

Eradication of unwanted animals: It's important to remove unwanted organisms from the pen before stocking fish or prawns.

Weeds compete with the cultured species for food, space, and oxygen, while predators feed on young fish. Repeated netting is the best way to remove unwanted fish and other organisms like snails and insects that can interfere with pond management and reduce production. Using chemicals to kill unwanted organisms is not advised in pen culture. Supplementary feeding: Pen farming uses the natural resources of the water body mostly.

However, prawns need a high-protein diet for growth. They are fed 2 to 5% of their body weight in the evening, depending on the availability of natural food. This feeding can be done with commercial pellets or home-made mixtures of animal protein with carbohydrates and fats. Cockle flesh and fish meal are good sources of animal protein. Feeding in trays helps reduce waste and lowers the cost of production.

Precautions: Although pen farming boosts production and provides economic benefits, it can sometimes cause social and environmental problems. Rapid expansion without proper care can lead to serious consequences, as seen in Laguna de Bay in the Philippines. Rapid development of fish pens turned the lake into a series of enclosures, reducing the open water for fishing and leading to unemployment among traditional fishers. Excessive feeding in pens can quickly pollute the lake, leading to eutrophication. Therefore, pen farming should be done in a balanced way as part of a larger management plan for small water bodies.

Planning criteria: Before starting a large-scale pen farming project, it is important to survey the area and identify suitable sites, considering environmental, social, and economic factors.

It is also necessary to estimate the carrying capacity of each water body to determine the maximum pen area. This helps avoid issues like those experienced in Laguna de Bay. The social and economic effects of this change need to be carefully assessed. Converting open water fisheries to pen systems can change employment, income distribution, and other socio-economic factors, which should be considered carefully. Based on past issues in coastal aquaculture, environmental and socio-economic impact assessments are important.

reservoirs are very important for inland fisheries in India, it's still hard to get a clear idea of how much area they cover.

This lack of accurate information makes it difficult for research and development work. Different agencies have given different estimates, and they often don't match up. The National Commission on Agriculture estimated that there were about 3 million hectares of reservoirs in the mid-1960s and predicted that this would grow to 6 million hectares by 2000 (Anon., 1976). Bhukaswan (1980) said the area was 2 million hectares. listed 975 large and medium reservoirs covering about 1.7 million hectares. One problem with these estimates is that they don’t include small reservoirs, especially in states like Tamil Nadu, Karnataka, and Maharashtra.

A lake-like ecosystem transitions into a river-like system in an impoundment. Studies show that Chlorophyceae and Bacillariophyceae are the main types of plankton in rivers. When a reservoir is formed and the flowing environment changes into a still water system, saprophobes (organisms that live in dead material) disappear and are replaced by saproxenes (organisms that depend on dead material). Microcystis, which thrives in the new environment, grows rapidly and becomes the most common type of plankton. In many reservoirs, the differences between lake-like and river-like plankton are clear, depending on the location—such as in lotic (flowing), lentic (still), and cove areas. The river-like area, even though having less plankton, often has more variety and balance compared to the still water areas,

which have more dominance of certain types and less evenness .
plains and the Malnad region have lots of plant growth, including littoral, submerged, and emergent types. In transitional areas with laterite and red soil, the tanks are fertile and have lots of plankton, but less weed growth. In black soil regions, weeds are mostly submerged or emergent like Hydrilla, Chara, and Nitella. In red soil areas, which are seasonal, vegetation is mainly found along the edges.

In the ecosystem of a reservoir, periphyton is the least studied group. Periphyton is an important part of the food that certain fish eat, and these fish help make up a large part of the total fish population in tropical reservoirs. Because of the frequent changes in water level, the growth of periphyton on natural surfaces is limited. However, when water levels are more stable, periphyton grows well. Reports show that rich periphyton is often found on things like boats and rafts that move with the receding water. Fixed surfaces either become exposed when water levels drop or get covered when they rise, making it hard for periphyton to survive. Experiments with artificial surfaces, like glass slides, have shown that periphyton can settle well.

It was affected as early as the mid-19th century when the Upper and Lower Anicuts were built on the Cauvery river. These barrages blocked the migration path of the hilsa, and the construction of the Mettur dam in 1935 completely stopped the hilsa run in the Cauvery. Many fish were affected by the Mettur dam, including Puntius species, which made up 28% of the catch in 1943–44 but disappeared by the mid-1970s. Although the native Cirrhinus cirrhosa had some initial success, it also declined. Low water levels during July for three consecutive years likely caused this decline. Similarly, Labeo kontius, which was second to Cirrhinus cirrhosa in the Cauvery, also disappeared from the reservoir. Introduced Gangetic carps also didn't establish themselves well in the reservoir. C. mrigala was stocked in 1950–51 and appeared in the catch from 1957–58, contributing up to 13.9% in 1966–67, but later disappeared. The same fate happened to Labeo rohita. Recruitment failure, changes in water levels, and predator pressure are the main reasons the Indian major carps failed in the Stanley reservoir. In 1993, the total catch in the reservoir was 115 tons, comprising L. rohita (19%), Wallago attu (15%), other catfishes (14%), Puntius species (14%), and C. catla (10%).

Bhavanisagar is the only reservoir in the Cauvery basin where many native fish species like Puntius spp., Tor putitora, T. tor, A. hexagonolepis, P. dubius, P. carnaticus, L. kontius, and C. cirrhosa are still doing well.

Their survivalis mainly due to uninterrupted breeding in Moolathurai and Nellithurai, especially when water flows from the Pilloor reservoir upstream. P. dubius moves up the Moyar river during the northeast monsoon and lays eggs in batches of 1,000 to 2,000 on gravel beds. Similar breeding success has been seen in Cirrhinus reba, Labeo fimbriatus, Labeo calbasu, L. kontius, and Puntius carnaticus.

Positive impact of reservoirs on fish fauna. Many fish species not only survive but also thrive in the reservoir ecosystem, which is why the biomass in reservoirs increases in the early stages of creation. However, most of the fish that multiply in these systems aren't particularly important commercially or ecologically. The small clupeid fish, Salmostoma phulo phulo and O. vigorsii, which support the dry fish trade in Nagarjunasagar and Tungabhadra, multiply more than they do in the river environment. The catfish P. pangasius, which was previously a catadromous migrant, has now adapted to become a resident in Nagarjunasagar and is now a crucial part of the fish population. Ramakrishniah described several instances where reservoirs served as sanctuaries, citing examples like Barilius bola. A realistic assessment of fish production from reservoirs in India is difficult. Even though there is a lot of data on water quality and the types of living things in these reservoirs, the information about how much fish is caught is very limited. Reliable data on fish catch and production is the weakest part of the information we have about reservoirs. Worse still, the figures we have for most reservoirs are often wrong or not trustworthy. This lack of accurate data is because of several reasons .

The methods that have been used in Indian reservoirs so far mainly involve putting in small fish, either of one type or a mix of types, without having a clear plan for how many to put in or what mix to use, based on how much the reservoir can support. The number of fish stocked and the mix of species are usually decided based on what is available, as shown in the case studies in later chapters. The basic productivity of a reservoir depends on how much sunlight it gets and how well the system can turn that sunlight into chemical energy.

Also the efficiency of turning energy into food at different levels of the food chain varies a lot from one reservoir to another, depending on the kinds and amounts of living things present. Any rate of energy conversion above 1% is considered good. In an ideal situation, the fish that are caught should use the available food in the best possible way so that the energy is used as efficiently as possible. At the same time, the fish should be part of a short food chain so that they can convert the primary food into fish that can be caught. But in most reservoirs, these ideal conditions are not usually found. Indian reservoirs usually have a wide variety of living things. The main group is phytoplankton, which includes types like Cyanophyceae, Chlorophyceae, Dinophyceae, and Bacillariophyceae. These are more common than zooplankton, which includes copepods, cladocerans, rotifers, and protozoans. Other living things in the reservoir include insect larvae and nymphs, worms, nematodes, and molluscs. There is a lot of growth on surfaces in the water, like the plants that grow on rocks and structures. However, the big changes in water levels make it hard for large plants to grow. Also, many of these niches, except for insects, Cyanophyceae, and molluscs, are shared by the main carps and other fish that are not wanted, which is why controlling these unwanted fish is important. An ecosystem-focused management plan focuses on the different levels of the food chain, which includes shared, unshared, and unused niches. Energy from the primary producers gets to fish .

Methodology studing Labeo rohita in a reservoir like Gandhi Sagar uses various scientific methods: Sample Collection: Fish samples are taken from different places using nets and other fishing tools. Age and Growth Studies: Scale Analysis: Fish scales, which have yearly growth rings, are used to figure out the age of the fish and how fast it grew in the past. Length-Weight Relationship: By measuring the length and weight of fish, scientists can understand how healthy the fish are and how well the environment supports them.

Population Dynamics: Stock Assessment Tools: Software like FiSAT II helps estimate things like how many fish die naturally, how many are caught, and the level of fishing. Yield-Per-Recruit Analysis: This helps find the best level of fishing to keep the fish population healthy and produce the most fish over time. Environmental Monitoring: Regular checks on water quality and living things like plankton help understand how well the ecosystem can support fish.

IV: Discussion

In the Gandhi Sagar Reservoir, the Labeo rohita, also known as rohu, has become a major fish species because people intentionally introduced and stocked it there. These fish grow quickly in their first few years, reaching up to about 34.6 cm in length. They can live over 10 years and have the potential to grow more than 1 meter long and weigh over 20 kg. The population of Labeo rohita grew rapidly after being introduced as part of a plan to create a profitable fishery. This plan was very successful, and now rohu, along with another fish called Catla catla, makes up a big part of the fish caught in the reservoir. These fish reach sexual maturity around two years old. However, in the reservoir, which is a still water environment, they don't naturally breed like they do in flowing rivers. So, most breeding happens through special programs where people help them reproduce and then release the young fish back into the water. The population of rohu has been well managed over time, leading to a big increase in the amount of fish caught. Fish yields have gone up from 1 to 44 kg per hectare per year because of proper management. Some of the key ways they manage the fish include adding more young fish to the reservoir regularly, controlling how big the fishing nets are, setting times when fishing is not allowed to protect breeding fish, creating safe zones for fish to live, and keeping the water environment healthy by managing things like silt build-up. The aquatic flora Of the Gandhisagar Reservoir is dominated by riverine macrophytes. During the study period, eight plant species from five genera were collected from the reservoir. The Gandhisagar Reservoir is a large area of deep and open water with a massive growth of Vallisneria spiralis from a depth of about 4 meters. The other plants were found in shallower, marginal waters in dense clusters and mixed together. The female flowers of Vallisneria, hanging on their long pedicels, were most common in January. Fortunately, the GR and its upstream feeder streams are free of Eichhornia, which is common after the Jawaharsagar Dam and has become a problem for the canal system at Kota and downstream of the Kota Barrage. Main ways: through the grazing food chain and the detritus food chain. To pick the best mix of fish for the ecosystem, it's important to know how much energy each of these ways contributes. Many Indian reservoirs rely more on the detritus chain. Before India developed method to breed carp in captivity, fish eggs were collected from rivers and put into reservoirs. So, eggs from Puntius, Cirrhinus, and Labeo species collected from the Cauvery River were often put into reservoirs in Tamil Nadu along with other fish that can live in salt and fresh water, such as Chanos chanos, Etroplus suratensis, and Megalops cyprinoides. In Kerala, the common fish stocked in the early years were Labeo fimbriatus, Cirrhinus cirrhosa, tilapia, and Etroplus suratensis. With the development of breeding techniques, most states were able to produce a lot of carp eggs by the 1970s, which led to a change in the mix of fish, favoring catla, rohu, and mrigal. Now, most reservoir fisheries in India focus on developing carp fisheries. Their important role has been seen in both the Gangetic and peninsular reservoirs. These major carps are important in reservoir management because of their feeding habits and fast growth. However, these carps are not very good at using phytoplankton, which is the most common type of plankton in the water. The ability of silver carp to turn phytoplankton into fish meat has been shown in some reservoirs like Kulagarhi and Getalsud, even though there are some doubts about how well they can digest certain types of plankton like Microcystis. Still, the introduction of foreign fish into open waters is a topic of debate because of the possible negative effects on local fish.

Developing native fish species for stocking hasn’t made much progress in the country, even though some have been proven to be effective in boosting energy transformation. For example, P. pangasius, which mainly eats mollusks, is a good choice for reservoirs rich in mollusks. Puntius pulchellus, a species found in the southern part of the country, eats a lot of aquatic plants, and Thynnichthys sandkhol mainly eats Microcystis, which is a common type of algae in Indian waters. Adding a variety of fish species is important to create a diverse fish population that uses all the food sources in the ecosystem. In reservoirs where the water level doesn’t change much each year and the changes are not too big, plant life and vegetation can grow to varying degrees. The grass carp, Ctenopharyngodon idella, is a good option for such reservoirs. The common carp is also stocked in many reservoirs, but it doesn't usually survive well in warm, deep reservoirs in the south, especially when there are predators. However, this fish, which eats a lot of food, might work well in reservoirs in the northeast, Gobindsagar, and some peninsular reservoirs like

This is because these fish failed to breed. In Malampuzha, although there was a big increase in stocking density from the 1970s, the yield remained low at 5.0 kg per hectare. Even though catla grow to a large size, their share in the catch never went above 20%. In Peechi, 90% of the fingerlings stocked are Indian major carps, especially L. rohita, but they do not appear in the catch, and the yield remains at a low level of 4.5 kg per hectare.

None of the stocked fish could breed and contribute to the population. The same is true for Tungabhadra and Krishnarajasagar reservoirs. In Tungabhadra, the stocking rate varied from 1 to 11 per hectare over 17 years. In Krishnarajasagar, it varied from 0.15 to 67 per hectare. In both cases, the fish stocked failed to breed.

Gandhisagar in Madhya Pradesh is an example of successful stocking. Regular stocking of catla (2 million), rohu (1.3 million), and mrigal (1.1 million) between the 1950s and 1970s caused the fish yield to increase from 0.51 kg per hectare to 20.33 kg per hectare. Catla make up 60 to 70% of the catch, while mrigal and rohu contribute only up to 20%. Mrigal, which is native, is declining. In Ravishankarsagar, which is in the same state, an average of 1.77 million fingerlings was stocked each year, but the yield remained below 8.3 kg per hectare, mainly because the carps did not establish a breeding population. The amount spent on stocking was much higher than the value of the fish caught. In Rihand reservoir in Uttar Pradesh, a breeding population was established from the initial stocking. Although the yield rate is low at 0.58 kg per hectare, about 73 to 99% of the catch is C. catla.

The success of stocked Indian major carps in the Ukai reservoir in Gujarat is also because they breed in the reservoir. Apart from helping increase the fish in the reservoir, the young fish of Indian major carps are also reported to escape through the dam's outlet and help stock fish in downstream areas. In all the DVC reservoirs, like Konar, Tilaiya, Maithon, and Panchet, stocking didn't make much difference. Some breeding of catla and mrigal has been seen, but because the eggs don't survive well and breeding often fails due to unpredictable monsoons, proper fish population hasn't been built up.

the Indian experience with stocking in medium and large reservoirs shows that stocking works well only when the fish can breed themselves. the stocked fish than on building up a breeding population. Small water bodies offer the advantage of easier monitoring and control. Hence, the smaller the reservoir, the better the chances of success in stocking and catching fish. In fact, an imaginative plan for stocking and harvesting is the key to fisheries management in small, shallow reservoirs. Successfully catching the stocked fish makes stocking more profitable in small reservoirs.

Success in stocking has been reported from many small reservoirs in India. In Markonahalli, Karnataka, because of stocking, the percentage of major carps increased to 61%, and the yield increased to 63 kg per hectare. In Meenkera and Chulliar reservoirs in Kerala, yields increased from 9.96 to 107.7 kg per hectare and from 32.3 to 275.4 kg per hectare, respectively, through continuous stocking. In Uttar Pradesh, Bachhra, Baghla, and Gulariya reservoirs saw sharp increases in yield through better management, especially through stocking. In Gulariya, allowing the fish to grow as much as possible between the time of stocking and final harvesting, before the water level drops below a critical level, was important. The possible loss from smaller fish at harvest was made up for by having more fish. In Bundh Beratha in Rajasthan, stocking 100,000 fingerlings a year (164 per hectare) led to a fish yield of 94 kg per hectare, 80% of which was catla, rohu, and mrigal .

Instances where heavy stocking of Indian major carps failed in small reservoirs are very rare. In Govindgarh, even after stocking 19 to 390 fingerlings per hectare, the fish yield stayed at 15.92 kg per hectare during the 1960s and 1970s. The main reason for this low yield is the large number of fish escaping through an open weir. In Badua reservoir, Bihar, about 1.1 million fingerlings of catla, rohu, and mrigal were stocked between 1975 and 1979. However, the fish yield stayed between 4 to 7 kg per hectare during that time. Other management efforts in the reservoir are not known. Sreenivasan (1984) noted poor recapture of major carps in Manjalar reservoir, Tamil Nadu, after heavy stocking. The main reason is the rapid growth of tilapia, O. mossambicus, which competes with major carps for food, preventing them from thriving.

Removal of predators and weed fishes th presence of predatory and weed fishes hinders the survival and growth of economically important species in many Indian reservoirs .

Controlling these unwanted fish is a tough management challenge, especially in large reservoirs. A small number of predators can help control trash fish that compete with economic species. For example, a small predator population in Gobindsagar keeps minnows in check.

However, there are no scientifically proven methods to control predator populations effectively. Using gill nets of suitable mesh size, long lines, traps, etc.,are suggested to manage these unwanted populations. Changing the reservoir water level to control breeding and reduce young predator and minnow numbers has been tried in several countries. But this is not practical in many Indian reservoirs since water release is managed for irrigation and power needs. Poisoning specific areas, like sheltered spots, is used in other countries but is limited in India because of the diverse use of water and opposition from other users. David and Rajagopal (1969) said that using shore seines helped reduce catfish numbers in Tungabhadra reservoir by 76 to 81%. The large shore seine, Alivi, also removes trash fish in large numbers. Using this gear wisely, with the rule to return young fish of economic species back to the water, can help control trash fish populations. that trawling can be effective in controlling predators and trash fish. Bottom trawling in Gandhisagar caught 64 to 91% of unwanted fish and is recommended for controlling predators and minnows. However, it is only practical where the bottom is clear of obstructions. Natarajan suggested using two euryhaline species, Megalops cyprinoides and Lates calcarifier, for biological control of trash fish. These predatory fish do not breed in freshwater, so they don't get out of control

V. Summary and Recommendations

Labeo rohita (Rohu) in Gandhi Sagar Reservoir grows quickly at first, reaches maturity by the second year, but its growth slows as it gets older. These fish can live up to 11 years or more, and their maximum size is around 97cm. To manage them properly, it's important to do things like stocking more fish, using the right fishing tools, giving extra food, improving their living space (like using pens or cages for young fish), controlling diseases (such as fungal, bacterial, and parasitic infections), and stopping overfishing by setting rules on the size of fishing nets. These actions help keep the fish population healthy and support the ecosystem.Population Dynamics & Development Growth: Rohu grows very fast in the early years, like reaching 34.6cm in one year, but grows much slower later, sometimes less than 1cm in the 11th year, as the fish uses more energy for breeding.

Maturity: They become mature by the second year, and older fish produce a lot of eggs, which can make individual growth slower.

Lifespan: These fish can live up to 11 years, close to the maximum natural lifespan of about 10 years in the wild. Population: The population is healthy and shows good growth potential.they can compete with other fish species but do well when food is plenty and the environment is good. Exotic fishes and their role in the reservoir fisheries of India

Despite having a rich and diverse fish genetic pool, India has introduced over 300 exotic fish species . Most are ornamental and stay in aquariums. Some have been introduced into aquaculture and open water systems with varying success. Three larvicidal fish Lebistes reticulatus, Nothobranchus sp., and Gambusia affinis—were introduced to control insect larvae in enclosed water. Silver carp and common carp were brought in to expand the species in aquaculture and improve productivity. Recently, the bighead carp and O. niloticus have been found in culture systems in eastern India. After unauthorized introduction, these species are becoming popular among farmers. Some introduced species have helped increase yields in ponds, but the accidental or deliberate introduction of some exotic fish into open waters has sparked debate. There is growing concern in India about how these exotic species might negatively impact native fish diversity in Indian rivers. Artificial eutrophication

Fertilizing reservoirsto increase productivity by promoting plankton growth has not been widely used in India. the main reasons for this are the multiple uses of water bodies and the competition among different water users. Surprisingly, even in reservoirs not used for drinking water or other purposes, fertilization has not been attempted. There is not much information on fertilization of reservoirs in India. Sreenivasan and Pillai (1979) tried to improve plankton levels in Vidur reservoir by applying super phosphate. When the canal sluice was closed, 500 kg of super phosphate with 16 to 20% P_2O_5 content was added to the reservoir, which covered an area of 50 hectares and had an average depth of 1.67 meters. Immediately after fertilization, phosphate levels in the water increased from zero to 1.8 mg per liter, and in the soil from 0.242 to 0.328%. Similar improvements were seen in organic carbon and Kjeldahl nitrogen in both water and soil. Experiments with urea were also conducted in the same reservoir.

Lime was also used in some upland lakes to reduce excessive carbon dioxide and acidity at the bottom .

This, along with the use of super phosphate in Yercaud Lake, raised the water pH from 6.2 to 7.3 and lowered the CO_2 level in the bottom water from 38 to 6.5 mg per liter. This led to an increase in the number and biomass of plankton. the main goal of using fertilizers is to boost the number of plankton and increase the rate at which plants in the water make their own food. In Vidur reservoir, applying fertilizers led to a big rise in both the bottom and floating life and doubled the amount of food production in the water. After using fertilizers twice, there were noticeable changes in the water, like the presence of free carbon dioxide, a drop in the water's acidity and less oxygen at the bottom. The measure of alkalinity, called methylorange alkalinity, went up from 44 to 108 mg per liter from top to bottom of the water, showing a lot of plant growth. Using phosphate helped break down organic material and produced carbon dioxide. As a result, fish production went up by half, and the size of fish like catla, rohu, mrigal, L. fimbriatus, and L. calbasu increased three times on average.

Experiments on fertilizing are happening in the 90 hectare Naktra reservoir in Madhya Pradesh, part of a research project by the Central Inland Capture Fisheries Research Institute.both organic and inorganic fertilizers are being used to improve the water and soil quality. Artificial eutrophication, a method to make the water more productive, was first tested in India at Kyrdemkulai (80 hectares) and Nongmahir (70 hectares) reservoirs in the northeast. They used poultry manure, urea, and superphosphate to boost productivity.

Fertilization can be very helpful in many small reservoirs in India, especially those with low productivity. Reservoirs in Madhya Pradesh, the northeast, and the Western Ghats that get water from poor areas often have low productivity and need artificial fertilization. China has had good results with fertilizing small reservoirs to increase productivity. In Shishantou reservoir, using both organic and inorganic manures along with feeding boosted fish production from 1,500 kg per hectare to 6,000 to 7,000 kg per hectare between 1985 and 1989. Before fertilization, the plankton levels were low, but after adding organic fertilizers, they increased, leading to higher fish production.
Pollution is causing more damage to reservoirs because of fast industrial growth, poor management of the land around the reservoirs, and other issues. Besides direct waste from industries, cities, and power plants, pollution from rivers that flow into the reservoirs also adds to the problem. The main causes of environmental damage in reservoirs are waste from industries, cities, farms
Conservation Methods & Management Stocking & Culture: Help by adding more fish to the reservoir and using the correct net sizes. Use pens or cages to raise young fish, which helps increase production. Feeding: Provide extra food like bran and cake mix, especially for young fish, which can help them grow faster.
Habitat: Improve water quality and increase nutrients by using manure, like cattle dung, which helps grow plankton, a natural food source for fish.
Disease Control: Treat bacterial infections (like ulcers), fungal infections (like Saprolegnia), and parasitic infections (like Ichthyophthirius) using disinfectants such as potassium permanganate and lime, medicated feed, and the right chemicals. Effort Control: Control how much people fish by setting rules on net sizes to stop overfishing. Rohu in Gandhi Sagar grows well and can be resilient if managed properly. However, it ongoing efforts to balance taking fish with keeping the population sustainable, controlling diseases, and improving natural food sources.
Recommendations: Implement Integrated Management: Use an Effort Control: Control how much people fish by setting rules on net sizes to stop overfishing. Monitor & Regulate: Control how much people fish by setting rules on net sizes and keep an eye on fish health to catch disease outbreaks early. Enhance Nutrition: Use manure to boost natural food sources and possibly add extra feeds to help fish grow better. Research: Do specific studies on Gandhi Sagar to learn more about local growth rates, how many fish die, and how the population changes. This can help create better management plans.

VI. CONCLUSIONS

In the Gandhi Sagar Reservoir, the Labeo rohita, also called rohu, has become a common fish species. However, managing its population is becoming more difficult. These fish can live up to 10 years and grow quickly at first, but their growth slows down as they get older. To protect them and make sure their numbers don't drop too low, a variety of management methods are needed to help with the decline in fish catches and worries about overfishing. Population Growth and Lifespan L. rohita is a key fish species in the Gandhi Sagar Reservoir, often caught along with Catla catla. While the fish has taken root in the ecosystem, the overall amount of fish caught has gone up and down over the years, which may show that the population is not being managed well. The longest a rohu can live in the wild is about 10 years. These fish grow quickly, reaching a length of around 35 to 45 centimeters and a weight of 700 to 800 grams within a year under normal conditions. Their growth is fastest in the first few years, and then it slows down as they become older. Development Rohu usually reach sexual maturity between the ages of two and five. They naturally spawn during the southwest monsoon season in flooded river areas. In reservoirs and ponds, people often use special methods to encourage spawning. In the early life stages, rohu go through several distinct phases, such as forming a blastodisc, becoming a morula, developing into a blastula, and then a gastrula. After that, the head and tail start to form, followed by the development of body segments. The fish hatches after 18 to 24 hours, depending on the temperature of the water. Over the next 30 days, they turn from yolk-sac larvae into juveniles, changing their shape and growing in a way that their body parts grow at different rates. Feeding Habits Rohu are omnivores. They mainly eat zooplankton when they are young, but as they grow older, they switch to eating more phytoplankton and plants that grow underwater. Conservation Methods Protecting and managing the rohu population is important because the total amount of fish caught is going down. Stocking Programs Raising rohu in the reservoir has been done since the late 1950s. These programs have helped keep the population stable, even if they are not always enough.

Fermenting feed ingredients can be a good method to develop better starter diets for rohu eggs, helping them grow and survive better. The Bacillus circulans strain can be used to ferment diets for 4 to 5 days to make nutrients more available.Fishing Regulation some experts think overfishing is a problem. To help the fish populations recover, it may be necessary to use fishing tools that are more selective and to stop catching fish that are too young to breed. This would allow the fish to have at least two breeding seasons before being caught. Habitat Management The reservoir needs a better conservation plan to deal with the effects of human activities and natural changes that are harming the ecosystem and reducing biodiversity. Research and Monitoring To manage the rohu population effectively, scientists should keep studying their age.

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