

A Study on the Environmental Status and Fish Diversity of Maguri-Motapung Beel of Tinsukia, Assam

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ABSTRACT

Wetlands are among the world's most productive environment. They provide tremendous economic benefits to mankind through the production of fish and other plants and animals. But these processes can be maintained if the ecology of wetlands is allowed to continue functioning. Many environmental factors directly or indirectly affect the productivity of wetlands. Knowing the environmental status of a wetland can provide us the status of the place itself and will help in planning conservation methods, mitigation techniques and promoting the conservation of the place. This project was done to determine the environmental status and fish diversity of Maguri Beel of Tinsukia so that the current needs could be addressed and recommendations could be given for promoting the conservation of the place.

Keywords: Wetlands, productivity, conservation, Maguri-Motapung Beel

Introduction

Wetlands are the lands transitional between terrestrial and aquatic system where the water table is usually at or near the surface or the land is covered by shallow water. The most popular

term used for wetlands in Assam is the "beels".

Beels are considered to be one of the most lucrative sources of fisheries and these versatile aquatic bodies comprise an integral component of the Brahmaputra and Barak river basins of Assam and serve as natural habitats, breeding,

feeding and spawning ground of large and small indigenous fishes of different food habits. People living in village around the beels harvest the fish almost round the year without investment except catching devices. A large portion of rural families are engaged in part time fishing.

According to the Ramsar convention on Wetlands of International Importance (1971), wetlands are vital for biodiversity and are among the most productive ecosystem on the planet, often referred to as the “kidneys of the landscape” due to their ability to filter pollutants. They are often referred to as “biological supermarkets” as they support all life forms through extensive food webs and biodiversity (Mitsch and Gosselink, 1986).

Assam is a truly riverine state drained mainly by two river systems, the Brahmaputra and Barak. In the floodplains of these rivers are found a large number of lake-like natural water bodies and swamps. These water bodies are locally known as ‘beel’, while the marshes and swamps are generally known as ‘jalah’, ‘dolono’ etc. However all these natural features may be included under the comprehensive term

‘wetland’ following current international usage. These wetlands may be broadly divided into two categories. The lake-like features with a clear water spread area in the middle are the beels, while those covered by weeds, grasses etc. are swamps or marshes. Both beels and swamps, are geo-morphologically and ecologically very important features. These comprise a major component of the hydrologic regime of the state, acting as storage basins during the floods, reducing their impact and minimizing the potential for erosion (Deka and Goswami, 1992).

The beels in Assam are generally considered as fish granary of the state. The physico-chemical characteristics of water and soil of these beels are very favourable for fish growth. So they possess enormous fish production potentiality. The flood water carries young and brood fish from the main river into the beels. They utilize the shallow, nutrient rich water, particularly profuse planktonic food of the beel. So they act as feeding and breeding ground for many riverine fish species including Indian Major Carp. But considering the very high potentiality, the present fish production from these beels is far below the expected yield. Further, these wetlands are under the continuous

threat of extinction due to different anthropogenic stresses and subsequent result of showing downward trend in fish yield and catch per unit effort of certain economically important fish species.

With these views in mind, the present study was undertaken to evaluate the ecological condition of Maguri Beel, which is located near Dibru Saikhowa National Park and Motapung village of Tinsukia District in Assam. It is a critical wetland as it is the habitat of a large variety of wildlife, and it hosts several migratory bird species. It has about 84 species of fish, including Golden Mahaseer. It falls within the eco-sensitive zone of the biosphere reserve. Maguri beel is important for the people in the surrounding villages who rely on it for their livelihood and sustenance, particularly for fishing.

Over the past decade, Maguri Beel has undergone significant changes due to a combination of ecological, environmental, and anthropogenic factors. One notable transformation has been the alteration in biodiversity, with shifts in fish and bird populations driven by overfishing, habitat loss,

and pollution, potentially leading to a decline in native species. Increased agricultural runoff and urban development have likely degraded water quality, resulting in eutrophication and harmful algal blooms that threaten aquatic life. Climate change has also impacted the hydrology of the beel, causing variability in rainfall patterns and seasonal water levels, which affects both the wetland's ecology and the livelihoods of local communities. Additionally, agricultural expansion and urbanization may have encroached on the wetland, leading to habitat fragmentation. However, in response to these challenges, there may have been concerted efforts toward conservation and restoration initiatives, promoting community involvement in protecting the wetland's ecological health. Sustainable fishing practices could have emerged as local communities recognize the importance of preserving their resources. Overall, the interplay of these factors underscores the need for ongoing monitoring and sustainable management to ensure the resilience of Maguri Beel.

Methods and Methodology

Maguri Beel is located at 27°34'36.2"N and 95°23'42.9"E. It is approx. 9 km away from

Tinsukia town and 50 km from Dibrugarh Airport. This lake is 3.8 km away from Guijan Ferry Ghat which is the gateway of the Dibru-Saikhowa National Park. Maguri Motapung Beel is located in the south bank of the Dibru River and it connects Dibru River through a small channel and finally meets Brahmaputra River. The study was conducted between February 2013 to January 2014.

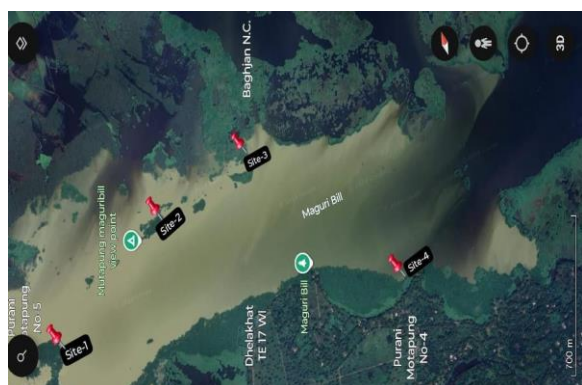


Fig 1: Google imagery showing the sites

Both live and dead species were collected from different wetlands of Dibrugarh and Tinsukia of Assam. The length-weight measurements were taken in the laboratory of the Department of Zoology, Tinsukia College. The maximum and minimum values of all the species were recorded. The species were measured to the

nearest length of 0.01 cm and weight of 0.01 g. The length-weight relationship of the fish was calculated using the regression equation: $\log W = \log a + b \log L$ with 95% confidence limits of the two constants 'a' and 'b'. To remove outliers log-log plot of length-weight was done (Froese, 2006). Condition factor measures the general well-being of the fish, which was calculated using the formula $K = 100W/L^3$ (Tesch, 1978), where K = condition factor; W = weight (g); L = length (cm).

Collection and Storage of Water Sample:

Analysis of water samples provides information on the nature and quantity of constituents present in the sample. The water samples were collected from four sites viz- site1, site-2, site-3 and site-4 using a boat. Plastic bottles were used for collecting the sample without the help of funnel and tubes. Proper labeling were done and carried to the laboratory.

Determination of Physico-Chemical Parameters

pH was determined immediately and dissolved oxygen was fixed on the site. In short period of storage, other parameters were also analyzed.

The physical parameters like water temperature, air temperature and turbidity were measured, while chemical parameters like pH, Dissolved O₂, alkalinity, hardness etc. were calculated following APHA (2005). The checklist of all the aquatic plants found in the wetland during the study was recorded.

Result

The physico-chemical characteristic of the wetland during the study period is presented in Table 1.

Parameters	Maguri Beel
Air temperature	18.9-34.3
Water temperature	17.89-28.9
pH	7.2±1.3
Dissolved oxygen	8.02±2.2
Hardness	55.34±9.01
Turbidity	15-20 cm
Alkalinity	35±5.34

Table 1: Physico-Chemical parameters of the wetland during the study period

A list of aquatic plants was prepared and presented in Table 2.

A total of 192 specimens from 6 different species, i.e., *Puntius ticto*, *Chanda nama*, *Rasbora daniconius*, *Mystus vittatus*,

Lepidocephalus guntea, and *Parambassis lala* were considered for study. In all the species studied, the maximum length didn't exceed 10 cm, and the highest length and weight were recorded in *M. vittatus* (9.54 cm and 9.58 g). The length range of the species studied was between 2.0 and 9.4 cm, and the weight ranged between 0.14 - 9.58 g. The regression coefficient was found to be higher in species like *C. nama* (0.96), *R. daniconius* (0.93), while it is found to be lower in other species. The condition factor (K) in all the studied species was found close to 1, with the least value in *P. ticto* (0.90 ± 0.21) and the highest in *L. guntea* (1.07 ± 0.21).

SL NO.	Common name	Scientific name
1.	Giant water lily	<i>Euryalea forex</i>
2.	Water lily	<i>Nymphaea albea</i>
3.	Water hyacinth	<i>Eichhornia crassipes</i>
4.	Tape grass	<i>Vallisneria spirallis</i>
5.	Hydrila	<i>Hydrilla verticillate</i>
6.	Water velvet	<i>Azolla pinnata</i>
7.	Water lettuce	<i>Pistia stratiotes</i>
8.	Coontail	<i>Ceratophyllum demersum</i>

Table 2: List of some plants species found in Maguri beel

During our study we recorded 43 species of fish species that belong to different families. The different families recorded during the study include Cyprinidae, Belonidae, Cobitidae,

Ambassidae, Abantidae, Channidae etc. Among the dominant family Cyprinidae dominant followed by Channidae.

SL No.	Local name	Scientific name	Family
1.	Kokila	<i>Xenentodon cancila</i>	Belonida
2.	Bahu	<i>Catla catla</i>	Cyprinidae
3.	Petgali	<i>Chagunius chagunio</i>	Cyprinidae
4.	Lachim	<i>Cirrhinus reba</i>	Cyprinidae
5.	Bhangona	<i>Labeo bata</i>	Cyprinidae
6.	Rohu	<i>Labeo rohita</i>	Cyprinidae
7.	Kuri	<i>Labeo gonius</i>	Cyprinidae
8.	Bhabo	<i>Osteobrama cotio</i>	Cyprinidae
9.	Puthi	<i>Puntius sophore</i>	Cyprinidae
10.	Tita puthi	<i>Puntius javanicus</i>	Cyprinidae
11.	Darikona	<i>Rasbora daniconius</i>	Cyprinidae
12.	Darikona	<i>Danio devario</i>	Cyprinidae
13.	Moa	<i>Amblypharygodon mola</i>	Cyprinidae
14.	Seni Puthi	<i>Puntius sarana</i>	Cyprinidae
15.	Mirika	<i>Cirrhius mrigala</i>	Cyprinidae
16.	Grass Carp	<i>Ctenopharyngodon idella</i>	Cyprinidae
17.	Silver carp	<i>Hypophthalmichthys molitrix</i>	Cyprinidae
18.	Common Carp	<i>Cyprinus carpio</i>	Cyprinidae
19.	Batia	<i>Lepidocephalichthys guntea</i>	Cobitidae
20.	Kukur batia	<i>Canthophrys gongota</i>	Cobitidae
22.	Chanda	<i>Chanda nama</i>	Ambassidae
23.	Kawoi	<i>Anabas testudineus</i>	Abantidae
24.	Goroi	<i>Chana punctata</i>	Channidae

25.	Cheng	<i>Channa gachua</i>	Channidae
26.	Sol	<i>Channa striata</i>	Channidae
27.	Sal	<i>Channa marulius</i>	Channidae
28.	Patimutura	<i>Glossogobius giuris</i>	Gobiidae
29.	Kholihona	<i>Trichogaster fasciata</i>	Osphronemidae
30.	Veseli	<i>Trichogaster lalius</i>	Osphronemidae
31.	Gulcha	<i>Mystus cavasius</i>	Bagridae
32.	Lal tengara	<i>Mystus tengara</i>	Bagridae
33.	Singora	<i>Mystus carcio</i>	Bagridae
34.	Ari	<i>Sperata seenghala</i>	Bagridae
35.	Magur	<i>Clarius magur</i>	Clariidae
36.	Singhi	<i>Heteropneustes fissilis</i>	Heteropneustidae
37.	Bordowa	<i>Pachypterus atherinoides</i>	Schibeidae
38.	Barali	<i>Wallago attu</i>	Siluridae
39.	Hil garua	<i>Hara hara</i>	Erethistidae
40.	Kuchia	<i>Monopterus cuchia</i>	Synbranchidae
41.	Bamil gosi	<i>Mastacembelus armatus</i>	Mastacembelidae
42.	Turi	<i>Macrognathus punctatus</i>	Mastacembelidae
43.	Kandhuli	<i>Notopterus notopterus</i>	Notopteridae
44.	Chital	<i>Chitala chitala</i>	Notopteridae

Table 3: List of fish species recorded during the time of study

Discussion

We all know that temperature plays a very important role in the production of fishes. The proper growth and development of fishes is directly and indirectly dependent on water temperature. The sunlight and the air

temperature influence the temperature of water of an aquatic system to a great extent. As ectothermic organisms, fish rely on external temperature to regulate their metabolic processes; optimal temperatures can enhance

growth and feed conversion efficiency, while extreme temperature can lead to stress and mortality. For instance, warmer waters may accelerate growth for certain species, but can also reduce oxygen level and promote algal bloom, which can negatively impact fish health.

Reproduction success is also closely tied to water temperature. Many fish species have specific thermal cues that trigger spawning behaviors. For instance, many temperate species spawn in the spring when water temperature begins to rise. If temperature is too low, spawning may be delayed or inhibited altogether, while excessively high temperature can lead to early or poorly-timed spawning, resulting in lower survival rates for eggs and larvae (Van Der Kraak and Pankhurst, 1997). This disruption can have long term implications for fish population.

Water temperature also affects the dissolved oxygen levels in aquatic environments. Warmer water holds less oxygen (Matthews and Berg 1997), which is critical for fish survival and growth. As temperature rises the metabolic demands of fish increase, further compounding

the challenge of maintaining adequate oxygen levels. Conversely, in cooler waters, oxygen levels tend to be more stable, supporting healthier fish stocks.

Climate change exacerbates the impact of water temperature on fish production. As global temperature rises, many freshwater and marine ecosystems are experiencing shifts in thermal regimes. Fish populations may migrate to cooler waters, impacting local fisheries and aquaculture. Species that cannot adapt to changing conditions may face decline or extinction, disrupting the balance of aquatic ecosystems and affecting the livelihood of those who depend on fishing and aquaculture.

The optimal temperature for fish growth is between 25°C- 31°C (Saha, 2010). The minimum and maximum water temperature recorded during winter and monsoon for Maguri beel water were 17.89°C to 28.9 °C supports this view. So, it may be concluded that water temperature of Maguri beel water is suitable for fish growth.

Temperature affects various water quality parameters such as pH, ammonia, nitrification rates, which are vital for maintaining a healthy aquatic environment, monitoring and managing temperature is essential for maximum productivity and sustainability.

The pH of water is a critical factor influencing fish production, as it directly affects the health, growth, and reproduction success of fish species (Parra and Baldisserotto, 2007). Most freshwater fish thrive within a pH range of 5 to 9 (Saha, 2021) with optimal conditions often hovering around 7 to 7.5. When the pH falls below or exceeds this range, it can lead to significant stress in fish population, impairing their physiological functions. Acidic water (low pH) can harm gill tissues (Boyd, 1990), leading to reduced oxygen uptake and increased vulnerability to disease. Similarly, high pH levels can precipitate the precipitation of harmful substances like ammonia, which becomes increasingly toxic as pH rises. Fish species exhibit varied tolerances to pH fluctuations; for example, salmonids prefer

slightly acidic to neutral conditions, while tilapia can tolerate more alkaline environments.

Moreover, the pH of water impacts not only the fish but also the entire aquatic ecosystem. Nutrients crucial for the growth of phytoplankton and other primary producers, can be altered by pH levels. For instance, at lower pH levels, certain essential nutrients like phosphorus can become less bioavailable, limiting the growth of primary producers and consequently, the food supply for fish. This disruption can lead to decreased fish populations.

The Maguri beel water was found slightly acidic during the period of investigation. Fish cannot live below pH 5 and above pH 9 and the value of pH found in Maguri beel is 7.2 ± 1.3 . So it may be concluded that the Maguri beel is suitable for fish.

Dissolved oxygen refers to the amount of oxygen that is present in water. It's crucial for survival of aquatic organisms, such as fish, invertebrates and microorganisms. Fish, like all aerobic organisms, rely on dissolved oxygen for

respiration; it is essential for metabolic processes that support growth, reproduction, and overall well-being. In natural water bodies and aquaculture systems, adequate levels of dissolved oxygen are crucial for sustaining fish populations. When DO levels are optimal, fish exhibit higher growth rates, improved feed conversion efficiency, and enhanced survival rates. Conversely, low levels of dissolved oxygen can lead to stress, reduced reproductive success, and increased susceptibility to diseases. Hypoxia, a condition characterized by low oxygen concentrations, can cause significant declines in fish populations, disrupt food webs, and even lead to fish kills, drastically impacting the biodiversity of aquatic environments.

The relationship between dissolved oxygen (DO) levels and fish production is a fundamental aspect of aquatic ecosystem health. Fish depend on dissolved oxygen for respiration, with different species exhibiting varying oxygen requirements; for instance, trout thrive in higher DO levels, while some catfish can tolerate lower concentrations. Adequate DO not only supports optimal growth and metabolism but also

influences reproductive success, as stress from low oxygen can lead to decreased spawning and higher mortality rates among eggs and larvae. Furthermore, the dynamics of dissolved oxygen are affected by various ecological processes, such as photosynthesis by aquatic plants and phytoplankton, which increases oxygen during the day, and the decomposition of organic matter, which consumes oxygen and can lead to hypoxic conditions.

According to Saha (2010), DO values from 5 – 10 mg/L is ideal for fish growth and the DO determined in Maguri beel is 8.02 ± 2.2 mg/L. . Therefore we can conclude that the beel is suitable for fish growth.

Environmental factors such as water temperature, salinity, and organic matter decomposition can influence dissolved oxygen levels in aquatic systems. Warmer water temperatures, for example, typically decrease the solubility of oxygen, making it harder for fish to thrive. Additionally, nutrient pollution can lead to algal blooms that, when decomposed, consume vast amounts of oxygen and create

hypoxic conditions, further stressing fish populations. Therefore, understanding and managing these environmental factors is crucial for optimizing fish production.

Water hardness refers to the concentration of dissolved minerals, primarily calcium and magnesium ions. It plays a significant role in fish production and overall aquatic ecosystem health. Hard water is often characterized by higher levels of these minerals, while soft water contains lower concentrations. The hardness of water can influence various physiological and ecological aspects essential for fish survival, growth, and reproduction. For many fish species, particularly those in freshwater environments, optimal hardness levels are crucial for maintaining health. Fish utilize calcium from the water for essential biological processes, such as osmoregulation, which helps them balance internal and external water concentrations. This process is particularly vital for freshwater species that need to retain salts and maintain fluid balance in a hypotonic environment.

Moreover, water hardness can impact the availability of essential nutrients and trace elements that fish need for growth and reproduction. Harder water typically has higher concentrations of calcium and carbonate, which can contribute to better growth rates in certain fish species. In addition to physiological effects, water hardness influences the overall aquatic environment, including the composition and abundance of algae and aquatic plants. Hard water often supports higher productivity levels because calcium is a key component in the growth of aquatic plants and phytoplankton. These primary producers form the base of the food web, providing essential nutrients for herbivorous fish and subsequently supporting higher trophic levels. However, if hardness levels become excessively high, it can lead to imbalances in the ecosystem, potentially fostering harmful algal blooms that disrupt the food web and negatively impact fish populations.

Based on the total ion concentration of the water, Khopkar S.M (1993), divided the hardness of water into five categories; mild (0-

40 mg/L), moderately hard (40-100 mg/L), hard (100-300 mg/L), very hard (300-500 mg/L), and extremely hard (500-1000 mg/L). As a result the water gathered from Maguri beel is determined to be 55.34 ± 9.01 mg/L which is classified as moderately hard. So the beel is suitable for fish growth.

Turbidity in water refers to the cloudiness and haziness caused by suspended particles. High turbidity reduces light penetration affecting photosynthesis in aquatic plants, which are vital for oxygen production and as a source of food for herbivores fish. Additionally, high turbidity can alter the behavior and physiology of fish species. Many fish rely on sight for feeding, and increased turbidity can hinder their ability to locate food, leading to decreased growth rate and overall health. Turbidity can negatively affect breeding and spawning behaviors. Many fish species require specific conditions, including clear water, to successfully reproduce. Turbid water may discourage spawning activities or result in lower fertilization rates due to the difficulty in detecting mates or suitable nesting sites. This

can lead to decreased recruitment of juvenile fish into populations, further exacerbating declines in fish numbers.

Another significant concern associated with turbidity is its impact on water quality. Suspended particles can harbor pollutants, including heavy metals, nutrients, and pathogens. When turbidity is high these harmful substances can become more concentrated, posing risks to fish health. For instance, excess nutrients from agricultural runoff can lead to eutrophication, a process that creates hypoxic conditions detrimental to fish survival. Additionally pathogens and parasites can thrive in turbid environments, increasing the likelihood of disease outbreaks in fish populations.

Furthermore, turbidity can alter the physical characteristics of aquatic habitats (Robel, 1961). Increased sedimentation resulting from high turbidity can smother critical habitats such as spawning grounds, reefs, and the benthic environments that many fish species rely on for shelter and food. The value of turbidity of

Maguri beel recorded was, which is within the limit of tolerance for fishes.

Alkalinity in water, defined as its capacity to neutralize acids, plays a crucial role in maintaining the health and productivity of aquatic ecosystems, particularly in relation to fish production. It is primarily influenced by the presence of bicarbonate, carbonate, and hydroxide ions, which help buffer pH fluctuations in the water. For fish, stable pH levels are essential, as even minor changes can stress aquatic organisms, disrupt metabolic processes, and lead to reduced growth and reproductive success. Optimal alkalinity levels generally range from 30 to 300 mg/L as calcium carbonate, providing a conducive environment for various fish species. High alkalinity enhances water's ability to resist acidification, ensuring that pH levels remain stable, which is vital for fish survival. For example, many freshwater fish, such as tilapia and catfish, thrive in waters with moderate alkalinity, as this promotes better overall health, growth rates, and feed efficiency.

Furthermore, alkalinity directly affects the availability of essential nutrients, such as phosphorus and nitrogen, which are critical for the growth of phytoplankton and aquatic plants—the primary producers in aquatic food webs. Healthy populations of these organisms provide a vital food source for herbivorous fish, which in turn support higher trophic levels. In systems with low alkalinity, nutrient availability may be limited, hindering the productivity of primary producers and ultimately affecting the entire food web. This can lead to reduced fish populations and lower yields in aquaculture operations, emphasizing the importance of managing alkalinity to ensure a balanced ecosystem.

Moreover, alkalinity interacts with other water quality parameters, such as hardness and temperature, to influence fish production. For instance, in a well-buffered system with high alkalinity, changes in temperature may have less impact on pH, providing a more stable environment for fish. This stability is particularly important during critical life stages, such as spawning and early development, when

fish are more susceptible to environmental stressors. By maintaining appropriate alkalinity levels, fish producers can create conditions that support successful reproduction and growth, enhancing overall fish production.

The implications of alkalinity extend beyond individual fish health to broader ecosystem dynamics. In freshwater systems, low alkalinity can lead to acidification, which can harm fish populations and reduce biodiversity. On the other hand, high alkalinity can support productive ecosystems, enabling diverse fish populations to thrive. Thus, effective management of alkalinity is critical not only for optimizing fish production but also for maintaining healthy aquatic ecosystems.

The ideal range of total alkalinity for freshwater fish is 30-300mg/L. Total alkalinity recorded in the beel is 35 ± 5.34 mg/L, which is sufficient for the healthy fish growth.

Conclusion

The present study highlights the ecological status of Maguri beel in Tinsukia district. From this study it was found that all the water

parameters are suitable for the proper growth and development of fishes but still there is a decline in the production of fish. It may be because of the different gears and tools used by the fishermen in fishing practices. Over time, the adoption of technologies such as large trawlers, longlines and high capacity nets has increased fishing efficiency but also led to overfishing. These modern techniques enable fishers to catch large quantities of fish quickly, often surpassing sustainable levels and depleting fish stocks. In Fig. 8 we can see how small fishes get trapped in nets leading to the decrease in the overall quantity. The local who lives near the beel are totally dependent on fishing for their livelihood. So instead of these modern techniques they must use some traditional techniques, where the small fishes cannot be harmed. To enhance fish production while preserving ecological balance, it is essential to implement comprehensive management strategies that focus on pollution control, and community involvement in conservation efforts. This dual approach can ensure the long-term sustainability of both the aquatic ecosystem and their livelihood dependent.

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