DOI: https://doi.org/10.36094/sc.v91.2025.Unraveling_the_Growth_and_Economic_Significance.Nandy.219

ARTICLE

Sci. and Cult. 91 (3–4) : 219-223 (2025)

UNRAVELING THE GROWTH AND ECONOMIC SIGNIFICANCE OF HILSA, A SEVEN YEAR STUDY AT GODAKHALI: A MAJOR HOTSPOT

SAURAV KUMAR NANDY[1], POONAM MAJUMDER[1], BASANTA KUMAR DAS[1*], HENA CHAKRABORTY[1], MALA KUMARI[1], SHREYA BHATTACHARYA[1], ARGHYA KUNUI[1] AND AMIYA K. SAHOO[1]

The study in Godakhali, West Bengal, from 2018 to 2024 focused on the growth and economy of hilsa. Monthly catch data revealed a total harvest of 89.846 tonnes. Interaction with approximately 225 fishermen, revealed that the monthly average income during the study period ranged from ₹1,304 to ₹ 9,630. The catch percentage showed an upward trend, peaking in 2021 after a decline due to COVID-19. The findings of the study establishes that Godakhali is one of the major landing centre in the Hooghly-Bhagirathi River system.

Keywords: *Catch percentage, COVID-19, Landing centre, Hooghly-Bhagirathi*

Introduction

Godakahli, situated in the South 24 Parganas district of West Bengal, is known as one of the most well-known hotspots for the highly valued Hilsa (*Tenualosa ilisha*) species. In the culinary traditions of West Bengal and the surrounding areas, hilsa has a unique place. Hilsa is frequently served as a delicacy at festivals and rites, signifying joy and prosperity. These cultural customs have been further enhanced by Godakahli's status as a hub for Hilsa[1]. The Hooghly River, which flows through South 24 Parganas, provides a suitable habitat for Hilsa due to a combination of salinity gradients, abundant nutrients, and seasonal monsoon flows[2]. Hilsa thrives in brackish water, and Godakahli offers a unique confluence of saline and freshwater zones. This gradient supports various stages of the Hilsa lifecycle, including spawning and juvenile development. The river system is enriched with sediments and organic matter, providing abundant plankton, the primary food source for Hilsa. This enhances the growth and reproductive capacity of the species[3]. Godakahli serves as a crucial transit point for Hilsa during their annual upstream migration for spawning. The region's strategic location makes it a hub for Hilsa breeding activities. However, anthropogenic pressures such as overfishing, pollution, and habitat destruction pose significant threats[4]. Conservation measures, including regulated fishing zones and closed seasons, are being implemented in Godakahli to ensure the sustainability of Hilsa stocks[5]. Hilsa fishing is a major source of livelihood for thousands of families in Godakahli. The entire value chain generates significant income from fishermen to traders and processors. The export of Hilsa also contributes to foreign exchange earnings, bolstering the national economy [6]. Despite its importance, Godakahli faces numerous challenges threatening its status as a Hilsa hotspot. Unregulated fishing practices, including the use of illegal nets, have led to a decline in Hilsa stocks. Altered monsoon patterns and rising water temperatures affect the migration and breeding cycles of Hilsa. Known for its rich biodiversity and vibrant fishing culture, Godakahli is critical

1 ICAR-Central Inland Fisheries Research Institute, Barrackpore, Kolkata, West Bengal - 700120
e-mail: sauravnandy291@gmail.com

* Corresponding author: basantakumard@gmail.com

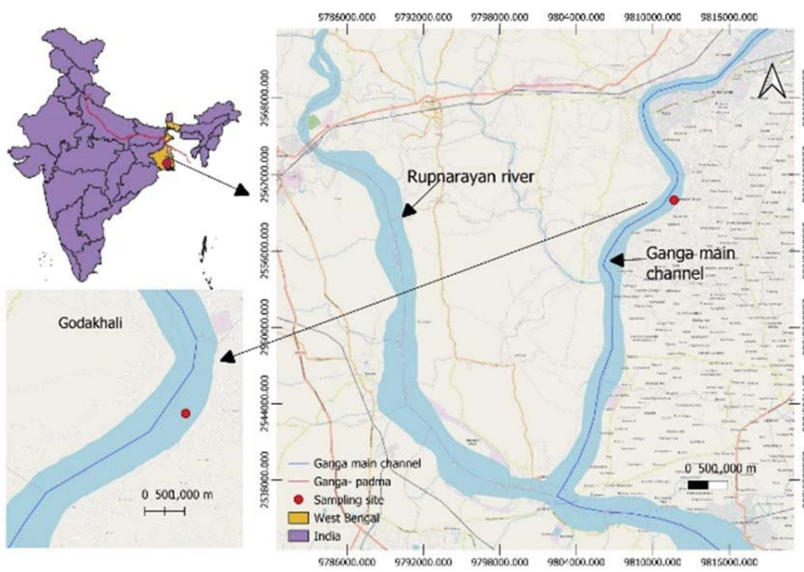

Fig. 1: Study area map of Godakhali

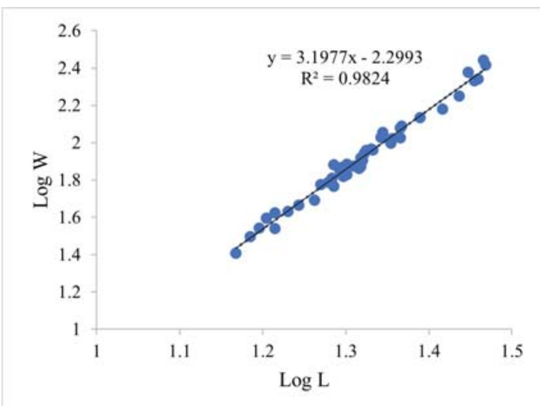

Fig. 2: Length- weight relationship of Hilsa

in sustaining the Hilsa fish population, a vital component of the local economy and ecological balance. This manuscript delves into the significance of Godakahli, the ecological factors contributing to its status as a Hilsa hotspot, and the socio-economic impact of Hilsa fishing

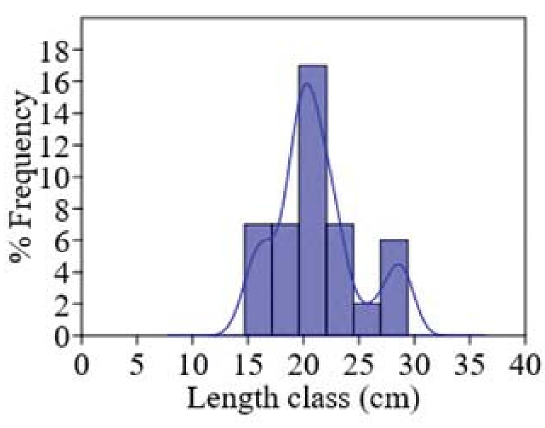

Fig. 3: Length- class relationship of Hilsa

in the region. Industrial discharge and agricultural runoffs contribute to water quality degradation, impacting Hilsa habitats.

Materials and Methods

Study Area: The study was conducted in Godakhali, West Bengal, India. Fresh specimens of *Tenualosa ilisha* were obtained monthly from the sampling site (22.403105º N & 88.139743 ºE) during 2018 to 2024 (Fig. 1).

Sample collection: Catch data of *Tenualosa ilisha* comprising mixed-size length groups were collected monthly during 2018 to 2024 from Godakhali, South-24 Parganas, West Bengal, India. The fish specimens were mainly caught by gill nets having mesh size (60-90 mm), length 8m, and height 4m. The mean total length (TL) and average body weight were measured. The data collected were grouped into different length classes (cm). The data were analyzed using SPSS software.

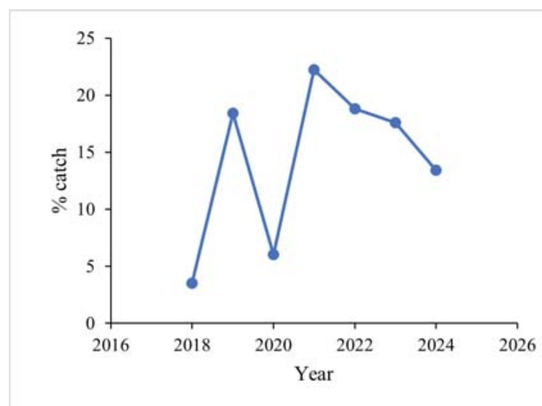

Fig. 4: Percentage catch data of Hilsa from 2018-2024

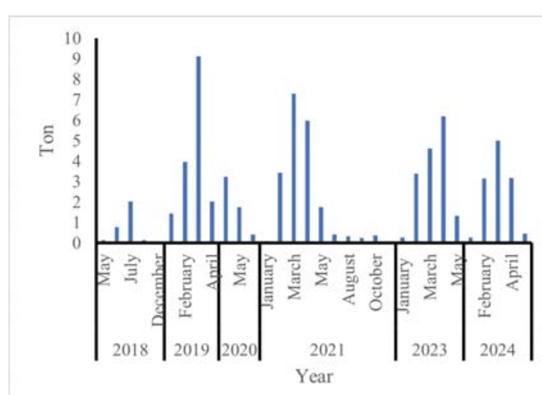

Fig. 5: Hilsa catch data at Godakhali from 2018-2024

A combination of primary and secondary sources was used to gather comprehensive data for this study. Primary data were collected from 160 fishermen in Godakhali, South 24 Parganas, between 2018 and 2024. The data collection involved semi-structured interviews, which included personal interviews, direct observations, and focus group discussions with various stakeholders such as fishermen and fish sellers. This approach allowed for the collection of empirical data that reflects the experiences and insights of those directly involved in the fishing community.

Results and Discussion

Length-weight Relationship: The non-linear length-weight relationship of pooled samples of *T. ilisha* caught from Godakhali is W= 0.00507 $L^{3.1977}$ and the logarithmic form of the same is Log W= -2.2993+ 3.1977 Log L (R^2= 0.9823). The length-weight relationship, the regression coefficient b=3, indicates symmetrical or isometric growth of fish. Allometric growth, whether positive or negative, is represented by b>3 or b<3, respectively. Fish with 'b' value of 3, maintain their body form over the course of their lives. At 1% and 5% levels, the value of 'b' was shown to be significant, indicating positive allometric growth in *T. ilisha*. The regression coefficient (R^2) was estimated to be 3.1977, indicating that the weight of the fish increases slightly more than the cube of its length, i.e., positive allometry (b>3). The R^2 value of the Hilsa population in Godakhali is 0.98 (Fig. 2 and 3)

***Catch Pattern of Hilsa in Godakhali* :** Godakhali is one of the tidal freshwater zones of the Hooghly estuary. From 2018 to 2024, a total of 89.846 tonnes of hilsa was harvested from Godakhali, West Bengal. Over this period, the percentage catch exhibited a notable upward trend, with the highest percentage recorded in 2021 and the lowest in 2018 (Fig. 4). The trend in catch percentage increased in 2019 but declined in 2020, likely due to restrictions on fishing activities during the COVID-19 pandemic. Following the relaxation of these restrictions in 2021, the catch percentage peaked, as extended fishing hours allowed for increased operations. However, from 2021 to 2024, a slight decline in the catch percentage was observed, potentially attributed to high fishing pressure, climate change, or alterations in migratory patterns driven by environmental changes.

Monthly Catch Pattern of Hilsa: Analysis of monthly catch data from 2018 to 2024 revealed that Hilsa catch was highest during March and April. The catch began to increase in January, peaked in March, and then declined steadily from April to July. Minimal catches were recorded between August and December (Fig. 5). There are two types of Hilsa migrants, one is the monsoon migrant and another is the spring migrant. The monsoon migrants move upstream to the river from June to October, whereas, the spring migrants move from January to February. After spawning, the monsoon migrants return to the sea from January onwards, and spring migrants return from July onwards, leaving behind the offspring in the river. The offspring remain in the river for the next few months and then migrate towards the estuary. Juvenile Hilsa of the spring migrants start downstream migration from November onward and inhabit the estuary during the post-monsoon season, instead of going into the sea[7,8]. The gut content of Hilsa revealed that they feed mainly on phytoplankton, mostly comprised of diatoms, green algae and blue-green algae[9]. The Phytoplankton community of the Hooghly-matlah estuary, including Godakhali, shows an abundance of blue-green algae during summer that further flourishes in monsoon, and green algae in the transition period between winter and summer, while the diatoms are dominated during the winter season[10]. Godakhali shows a rich diversity and abundance of phytoplankton during the winter and summer months. Therefore, the abundant catch of Hilsa from February to April in the region is due to the migration of the monsoon and spring population of Hilsa for the purpose of feeding. Also, the fishing ban imposed during May and June restricts the fishing activities in that region.

Fishing Crafts and Gear: The hilsa fishing in the Godakhali region is done mainly by mechanized and motorized vessels, where mechanized boats with inboard engines, as well as traditional motorized (with outboard engine) crafts, are operated. The traditional boats, which are plank-built, undecked or partly decked, are most commonly employed for hilsa fishing in that region. It is reported that presently, more than 5,957 small mechanized and 1,533 non-mechanized boats[7] mostly equipped with drift gill net containing 100 to 500 net pieces (total length comes to 0.5 km to 2 km), are actively engaged in the coastal areas of West Bengal. In the estuarine to freshwater zones, only small non-mechanised boats are operated for fishing of hilsa. Study showed that the non-selective gears and sustainability issues relevant to the Hooghly-matlah estuary and inferred that gears viz. Behundi Jal (stationary bag net) with a wide mouth of 27 m and small cod end of mesh size (about 2 mm), Char-pata Jal, a screen barrier having very small mesh operated for harvesting juveniles and Sitki Jal, a skimming net made up of polyethylene netting of mesh size of about 2 mm for collecting fry and fingerlings, are non-selective and highly hostile for sustaining the fisheries[11]. Similarly, the crafts engaged in fishing operations in the freshwater region of Godakhali are mostly non-mechanised or small mechanised boats and the most commonly used gear in the region is drift pocket gill net. Drift pocket gill nets are modified versions of gill nets specially designed for capturing hilsa.

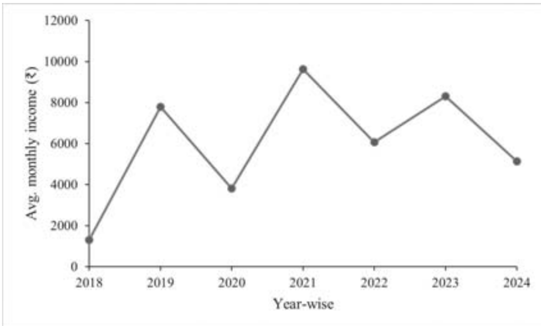

Fig. 6: Average monthly income of Hilsa fishers at Godakhali

Challenges

Overfishing: The highest contribution to the catch, based on length, was observed in the 20–30 cm length class, followed by the 10–20 cm class. However, in terms of numerical abundance, the 15–30 cm length class dominated. Juvenile catches in the Godakhali region were negligible, as primarily adolescent and adult *Tenualosa ilisha* migrate to marine environments for growth and sexual maturation. *T. ilisha* exhibits an extended breeding season, and small juveniles are often incidentally captured using non-selective fishing gears, such as small-meshed bag nets and scoop nets, during their seaward migration between November and May, occasionally extending to July. Fishing gear usage revealed that drift pocket gill nets accounted for the majority of hilsa catches. The market value of juvenile hilsa was significantly lower compared to that of adults, often resulting in their categorization as bycatch or '*Trash fish*'. The annual economic loss attributed to juvenile fishing was estimated at approximately USD 7.8 million. Allowing juvenile hilsa to grow for an additional year prior to harvesting could potentially increase production by 2,505 tons annually. Moreover, the conservation of juveniles could substantially benefit population recruitment, as these individuals would contribute to the next generation's spawning stock. A widely used fisheries management tool is Minimum Legal Size (MLS), designed to protect juvenile fish by regulating the size of fish caught, which has been set at 90 mm for gillnets, the primary gear targeting hilsa. Additionally, regulations established under the 2013 gazette notification prohibit the capture of *T. ilisha* smaller than 230 mm during the period from February to April each year in estuarine zones and bay mouths. A seasonal or complete prohibition of bag net fishing, particularly during the post-breeding season in the Hooghly-Bhagirathi riverine system, could significantly reduce the growth overfishing of *T. ilisha.* While the MLS regulations were implemented statewide in West Bengal under the 2013 notification, their effectiveness hinges on robust enforcement through monitoring and surveillance systems.

Habitat Degradation: The breeding and rearing habitats of *Tenualosa ilisha* in many river-estuarine systems face significant threats due to rapid degradation caused by river valley projects. Geo-morphological changes are among the key challenges affecting hilsa migration and fisheries. Reduced river discharge lowers the dilution capacity of the water, prolonging the retention of toxic substances. This not only impedes the migration of adult hilsa but also damages the fragile eggs and larvae. Industrial effluents further exacerbate the issue, as rivers like the Tapti and Narmada on the West Coast are heavily polluted with toxic contaminants, exposing hilsa and other aquatic life to hazardous conditions. The decline in juvenile hilsa catches in riverine systems has been linked to climate-induced disturbances such as siltation, closure of migratory pathways, and habitat degradation[12, 13]. Sedimentation in riverbeds and altered rainfall patterns are critical factors for hilsa breeding which further intensifies these challenges, adversely affecting various life stages of hilsa, including eggs, larvae, juveniles, and adults. Additionally, siltation at the mouths of estuaries increasingly hinders hilsa migration into these systems. Restoration efforts focus on enhancing river connectivity and reducing pollution to rehabilitate the natural habitats, which are essential for the successful completion of lifecycle of hilsa.

These factors collectively disrupt the species lifecycle mechanisms, prompting a gradual shift in the population towards marine environments. Consequently, marine catches of hilsa have increased, while inland catches have shown a decline. However, annual hilsa catches in these states have exhibited a declining trend over the past decade, largely attributable to overfishing[15,16]. These adults subsequently migrate further upstream to spawn, releasing eggs and establishing breeding and spawning grounds. Further, some population of Hilsa is seen to have established their spawning ground in the shallow areas of Godakhali region, where they spawn and complete their early life stages before returning to the sea.

Economic Valuation of Hilsa Fishers: The economic valuation of Hilsa fishers in Godakhali, West Bengal, reveals significant socio-economic dynamics and challenges. Since 2018 to 2024, no. of fishermen also varied between 110 to 225. Present study reveals that, the average monthly income of each fisherman of Godakhali ranges from ₹ 1,304 to ₹ 9,630 (Fig. 6) generated exclusively through Hilsa catch. Though the average monthly income of hilsa fishers have significantly improved over the years. Still, very low income was generated during 2020 probably due to restrictions imposed on fishing during COVID-19 pandemic. But as soon as pandemic regulations were relaxed in 2021, a peak in monthly income of ₹ 9,630 per fisher was observed (Fig. 6). Previous studies indicate that fishers in this region earn an average monthly income ranging from ₹ 25,000 to ₹ 30,000 (approximately USD 301–361) from all fish catch, which is notably higher than their counterparts in the upper stretches of the river Hooghly. Despite this, many fishers engage in non-fishery activities to supplement their income due to the declining catches of Hilsa[17]. The socio-economic importance of Hilsa extends beyond mere income; it plays a crucial role in cultural practices, particularly within the Bengali community during festivals and ceremonies[18]. However, the sustainability of Hilsa fisheries is threatened by overfishing, climate change, pollution, and habitat degradation. These challenges necessitate urgent conservation measures and sustainable fishing practices[19,20].

Investment in Hilsa fisheries is essential for enhancing livelihoods and ensuring the long-term viability of this economically important species. Addressing these issues through integrated management strategies will be vital for balancing ecological conservation with the socio-economic benefits derived from Hilsa fisheries.

Conclusion

This study highlights the ecological and economic importance of Hilsa (*Tenualosa ilisha*) in Godakhali, West Bengal, while addressing significant sustainability challenges. The findings confirm that Hilsa exhibits positive allometric growth, indicating its crucial role in local livelihoods and the regional economy. Godakhali's unique environmental conditions make it a key area for Hilsa migration and spawning. However, threats such as overfishing, climate change, pollution, and habitat degradation jeopardize Hilsa populations. Unsustainable fishing practices and infrastructure developments like dams disrupt migration routes and habitat quality. To combat these issues, enforcing fishing regulations, promoting sustainable practices, and restoring habitats are essential. Community involvement in mitigating climate change impacts and pollution is also critical. The study emphasizes the need for integrated management strategies that balance ecological conservation with socio-economic benefits. Protecting Hilsa fisheries in Godakhali is vital not only for biodiversity but also for supporting the livelihoods of millions who depend on this important species.

Acknowledgments

The authors are grateful to National Mission for Clean Ganga for providing us the platform to perform the experiments and carry out the research activities and also to ICAR- Central Inland Fisheries Research Institute for providing us with all the research support and facilities. ❒

References

1. N. Naskar and S. Munshi, *SAARC Culture Journal*, 106 (2023).
2. G.K. Das, Coastal Environments of India. *Springer International Publishing,* (2022).
3. M. Moniruzzaman, M.A. Alam, M.H. Rahman, K.R. Hasan, R.A. Lima, and Y Mahmud, *American Journal of Bioscience and Bioinformatics,* **2**(1), 1-13 (2023).
4. P. Kumar, M. Kailasam, J.K. Sundaray, and T.K. Ghoshal, *Ecological Significance of River Ecosystems,* 455-480 (2022).
5. U. Bhaumik and R.K. Manna, *Souvenir and Abstract, Seminar on Caring Wetlands and Conservation of Riverine Fisheries*, Barrackpore: Organised by CIFRI, State Fisheries Department, West Bengal and IFSI, 59-67 (2010).
6. A. Ray, T.N. Chanu, N.K. Tiwari and B.K. Das, *Science and Culture,* **88**(9-10), 310-316 (2022).
7. U. Bhaumik, A.P. Sharma, *CIFRI Bulletin*, No. 179: 42 (2012).
8. U. Bhaumik, *Aquatic Ecosystem Health & Management*, **20**(1-2), 130-139 (2017).
9. K.M.M. Hasan, Z.F. Ahmed, M.A. Wahab, and E.Y. Mohammed, Food and Feeding Ecology of Hilsa (*Tenualosa ilisha*) in Bangladesh's Meghna River Basin (IIED, 2016).
10. A. Mariya, C. Kumar, M. Masood, and N. Kumar, *Environmental Monitoring and Assessment*, ***191***(9), 542 (2019).
11. U. Bhaumik and R.K. Manna, *Souvenir and Abstract, Seminar on Caring Wetlands and Conservation of Riverine Fisheries*, 59-67 (2010).
12. D. Fernandez-Jover, K. Toledo-Guedes, J.M. Valero-Rodriguez, V. Fernandez-Gonzalez, and P. Sanchez-Jerez, *Estuarine, Coastal and Shelf Science*, **181,** 144-152 (2016).
13. M.A. Hossain, I. Das, L. Genevier, S. Hazra, M. Rahman, M. Barange, and J.A. Fernandes, *Science of the Total Environment,* **651**, 1720-1734 (2019).
14. A. Bladon, M.A. Syed, S.T. Hassan, A.T. Raihan, M.N. Uddin, M.L. Ali and P. Steele Finding evidence for the impact of hilsa fishery management in Bangladesh (*IIED*, London, 2016) 1-47.
15. S. Dutta, S. Maity, A. Chanda, and S. Hazra, *World Journal of Fish and Marine Sciences,* **4**(1), 54-59 (2012).
16. I. Das, S. Hazra, S. Das, S. Giri, S. Maity, and S. Ghosh, *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences,* **89**, 525-532 (2019).
17. H. Chakraborty, P. DebRoy, A. Kunui, S.K. Nandy, C. Jana, A.K. Sahoo, and B.K. Das, *Frontiers in Sustainable Food Systems,* **8,** 1310077 (2024).
18. N. Majumder, Food Habits in Bengali Households: A Study of the Urban Middle Class and the Urban Poor (Jadavpur University, Kolkata, West Bengal 2016).
19. M.M.H. Mozumder, A. Pyhälä, M.A. Wahab, S. Sarkki, P. Schneider, and M.M. Islam, *International Journal of Environmental Research and Public Health,* **16**(23), 4814 (2019).
20. M.M. Islam, N. Islam, A. Habib, and M.M.H. Mozumder, *Sustainability, **12***(19), 7970 (2020).