

SUSTAINABLE MEASURES TOWARDS IMPROVING HILSA FISHERIES IN RIVER GANGA AND LESSONS FROM BANGLADESH: A REGIONAL APPROACH IS NEED OF THE HOUR

AMIYA KUMAR SAHOO^a, DHARMENDRA KUMAR MEENA^a, SANDEEP BEHERA^b
AND BASANTA KUMAR DAS^{a*}

The Ganga, is a home for 190 fish species at present, supports livelihood for millions of poor fishermen. Hilsa shad is commonly known for its nutritional, cultural and social importance and is known as state fish of West Bengal and national fish of Bangladesh. Realizing the importance of the species particularly towards fishermen livelihood, scientific evident sustainable measures have been proposed based on ICAR-CIFRI's experience over the decades and the successful sustainable measures adopted by Bangladesh towards improved hilsa production in the river Padma and Meghna. Therefore, a holistic regional approach is need of the hour to develop a joint management measures and policy towards sustainable hilsa fisheries in river Ganga.

Introduction

Hilsa shad (*Tenualosa ilisha*) is an anadromous fish that lives in the Bay of Bengal and migrate to the upstream rivers of Bangladesh, India and Myanmar for breeding and nursing of the offspring. It is the most important commercial transboundary species of which Bangladesh has the major share (86%), followed by India (8%), Myanmar (4%) and other countries within the Bay of Bengal region¹. Hilsa shad is commonly known for its nutritional, cultural and social importance and is known as state fish of West Bengal. A socio-economic estimation of fishermen showed that the lower stretch of the river Ganga viz. from Farakka to Frezarganj showed diversity of many commercial fish species like hilsa and contributes 38.84% share of the family income. However, the middle stretch particularly from Farakka to upstream Prayagraj, and Kanpur, the fishermen are deprived of this commercial

important migratory fishery majorly due to construction of Farakka barrage. The species is anadromous and migrates through riverine system for a large part of its life cycle. Therefore, large inland capture fisheries also exist for hilsa contributing about 45 percent of the catch (Table 1).

Table 1. Global Fishery Production in 2019 (Source: FAO. 2021²)

Country	Production (Tonnes)	Share (%)	Inland (%)
Bangladesh	5,32,795	95.42	45.51
India	20,678	3.70	28.68
Iran	1,505	0.27	0.00
Iraq	1,720	0.31	0.00
Kuwait	99	0.02	0.00
Pakistan	1,559	0.28	0.00
Total	5,58,356.5	100	44.49

Currently, In India major hilsa production comes from the marine sector. As per the CMFRI during 2019 and 2020 the hilsa production in the marine resources was 14,748 and 30,360 tonnes respectively. In river Ganga, i.e Hooghly

^a National Mission for Clean Ganga Laboratory, ICAR- Central Inland Fisheries Research Institute, Barrackpore, Kolkata - 700120.

^b National Mission for Clean Ganga, Ministry of JalShakti, India Gate, New Delhi-110001

* Corresponding author: basantakumard@gmail.com

Bhagirathi rivers represents a good hilsa catch. During, 2013 to 2016, our studies showed a catch of 16,318 t, 45,615 t 12,192 t and 48,922 t respectively³. While absence of hilsa was recorded above the Farakka barrage. Therefore, it is paramount to re-establish the hilsa fishery in river Ganga particularly in the stretch between Farakka to the Prayagaraj. ICAR-CIFRI has taken up a holistic approach including the hilsa aquaculture⁴ to improve the fish fisheries in river Ganga. The details are presented as below.



Fig. 1 Holistic Approach towards Hilsa Fisheries Improvement in River Ganga

Holistic Approach for Hilsa Re-establishment in River Ganga

Since 1975, the catch of hilsa has drastically declined in this stretch and currently has touched to nil. Realizing the importance of national priority towards biodiversity conservation, National Mission for Clean Ganga (NMCG) in collaboration with ICAR-CIFRI, Barrackpore took up a historic imitative towards re-establishment of Hilsa in river Ganga through scientific based holistic approach. The approach is based on four fundamental concepts (Fig.1).

Concept I: Ranching of adult hilsa, Concept II: Captive breeding, Concept III: Awareness, Concept IV: Impact Assessment.

Concept I: This is extremely important to re-establish the hilsa fishery in the middle stretches of river Ganga through establishing their breeding ground and native habitat. Farakka barrage has been recorded as the major player toward blocking of hilsa migration to the upstream due to functional failure of Fish lock situated at Bay no 25 & 25A. Therefore, adult hilsa those get obstruction by

barrages are captured from the downstream of the barrage and released them to the upstream facilitating their upstream migration. This matured adult migrates upstream and release eggs and establishes their breeding and spawning grounds. This process involves series of scientific activities including transportation of adult hilsa, a challenging task, tracking their migration rout and monitoring their breeding and spawning ground. A total of 42375 adult hilsa has been ranched during 2020-22. Honable Union Minister of Jala Shakti, Shri Gajendra Singh Sekhawat Ji ranched Hilsa dult in the upstream of the Farakka Barrage.

Concept II: Captive breeding of Hilsa shad has been a difficult task for the researchers since more than five decades due to its complex life cycle. As the adult that remains in sea migrates upstream to river for the breeding and spawning. During this phase of migration, a series of biological and environmental changes occurred. Therefore, it is extremely important to develop a standard breeding protocol for the juvenile production. Once these juveniles are resistance predation, these will be released into the different sites of the river Ganga particularly in the middle stretch for hilsa fishery improvement.

Concept III: As overfishing, pollution, juvenile killing, and illegal fishing are the major factors responsible for the depleting the native fish species in the river Ganga. Therefore, awareness programme plays a critical role among the fishermen and public on biodiversity conservation of the depleted aquatic species. Awareness programme on Hilsa conservation and re-establishment in the river Ganga has brought significant attention among the fishermen in the middle stretches. Though there are several methods, we observed media, connecting though Ganga Prahari and one-to-one interaction created more effective ways. More than 7000 fishermen representing from the states of U.P., Bihar, Jharkhand and West Bengal during 2020-21.

Concept IV: Impact assessment plays a critical factor towards understanding of the planned activities those are implemented. Our initial assessment on ranching has shown that fishermen from Balia, U.P and fishermen from Bhagalpur, Bihar and Rajmahal, Jharkhand have reported hilsa in river Ganga. Though the number of record is few but this signifies the migration rout of Hilsa and confirms that hilsa could re-establish its native habitat and breeding ground, provided a holistic approach is adopted.

The activities have been described in the Figure 2.



Ranching of Hilsa



Artificial Fertilization and Breeding



Hilsa Awareness for Conservation in River Ganga



Survey Based Assessment on Hilsa Production

Fig.2 Ongoing Activities towards Hilsa Fisheries Improvement in River Ganga

Revival of Hilsa Fishery in Bangladesh: Lesson Learning

Owing to gradually decline of hilsa fishery, the government of Bangladesh started implementation of the HFMAP in 2005 and since then Hilsa production gradually reversed and increased @5%/year until 2014. To improve the annual incremental production further, Department of Fisheries and WorldFish jointly the ECOFISH activity, a USAID funded five-year initiative (2014-2019). The project supported Department of Fisheries (DoF) and local communities to establish a collaborative science-based management, called “co-management” that focuses on the reduction of overfishing, protection of juveniles, protection of brood in the peak spawning season through involving all stakeholders as well as improving community empowerment focusing on women and livelihood diversification to improve the resilience of the community to endure compliance during fishing ban periods.

In order to implement the science-based adaptive co-management, the production target was set at the maximum sustainable yield (MSY = 0.526 million tons) level that was estimated through stock assessment of the project and

then the building blocks of the co-management were established, livelihood supports in addition to Govt.’s rice support (@ 40 kg/ID card holder fisher/month for 7 months) provided, women empowered through better engagement, community savings and AIGA. To improve compliance through supporting law enforcing agencies, 400 trained community Fish Guards (CFGs) were engaged. Created a revolving Hilsa Conservation and Development Fund (HCDF) amounting BDT 350 million (US\$ 0.43) as seed money to support the co-management committees for the conservation of hilsa juveniles and brood stock as well as support the community fish guards during the fishing ban periods. Finally, Ecosystem Approach to Fisheries Management (EAFM) initiated involving all stakeholders to sustain the improvement.

As a synergistic impact of the general management activities as well as science-based co-management through combined efforts of DoF, WorldFish and other law enforcing and administrative officials, annual incremental total Hilsa catch increased from 5% to 11%, resulting a total catch of 0.517 million tons in 2018, which is almost the estimated MSY level. In addition, Hilsa size has also improved from an average 510 g in 2014 to 915 g in 2019.

Now, the government has taken up the best practices and hilsa production has further increased to 5.5 lac tons in 2020 through application of improved management practices and ensuring the compliance of the fishing bans, mesh size regulations, reducing the illegal harvesting of juveniles and brood stock, and providing the compensation to vast majority fishing households to endure the hardship during fishing bans. As a result of the increased production and improved size, the fishers' household income has also increased by 65% during this four-year period.

In addition, the Department of Fisheries (DOF) Bangladesh implements 22-day Brood Hilsa Ban period every year to improve the spawning success and hence to increase Hilsa production. The spawning success is the major indicator of the future Hilsa production. This study provides some insights in setting the effective brood ban period to improve the spawning success, effectiveness of the ban period through measuring the spawning success in consecutive three years (2017-2019) and impacts of the spawning success on Hilsa production, size and fishers' income. To set the effective brood ban period, the peak spawning month and then precisely the peak spawning week were determined. Then aligning with the lunar periodicity focusing on a full-moon and a new-moon spring tides, the most effective 22-day Brood Hilsa Ban period is suggested by a panel of experts and Govt. implemented that through gazette notification and engaging all stakeholders. The spawning success (%spent Hilsa) and brood abundance were estimated through comprehensive surveys conducted during the pre-ban and post-ban periods through dissection as well as external examination in major Hilsa habitats. Then the possible present and future production was predicted considering the survival and growth and compared with estimated maximum sustainable yield (MSY), carrying capacity and actual production. In 2017, the estimated spawning successes were found to be varied from 30% in the Padma to 70% in the Meghna with an average of 48% of the total Hilsa caught during the three consecutive days just after the ban period. In 2018 the estimated spawning success improved to 56% with variations from 13% in the Padma to 59% in the Meghna. In 2019, the estimated spawning success was found to be reduced to 33% with variations from 18% in the Padma to 48% in the Meghna.

As a result of the improved spawning success and subsequent Jatka (juvenile) conservation, Hilsa production increased from 387k tons in 2015 to 517k tons in 2019. The annual incremental growth of the production increased from 5% to 9.2% per annum due to the increased spawning success and Jatka conservation. Average legally tradable

Hilsa size also improved from 535 g in 2015 to 915 g in 2019. Finally, due to the increased production and improved size as well as getting supports for the alternative income generating activities (AIGAs), fishers' HHs income improved by 65% that led to improve their livelihoods.

A Regional Approach: Challenges and Way Forward

Regional cooperation is a challenge as it needs balancing national autonomy, priorities with responsibility. Hilsa fisheries have a unique position in this aspect. While it is the largest fishery in case of Bangladesh (43% of marine fish production and 12% of total fish production), it is a minor fishery in India (0.41% of marine fish production). Further, in India, management of coastal fisheries is the purview of State Government while policy making comes under the Union Government. Therefore, decision making for the whole water body is difficult. For example, various forums have suggested harmonizing the fishing ban period in Bangladesh and India. The Government of West Bengal has taken various complimentary measures in this regard. However, the fishing ban in India was decided based on inputs from the whole country, taking the median way and other factors like weather condition. Therefore, agreeing on a common period remains elusive. Even within a country, fisheries management needs cooperation from multiple agencies/ departments at various levels. However, there is no clear mandate of the secondary agencies on their role, responsibility and reporting procedure concerning fisheries. These factors are defined in a fisheries management plan, which is unfortunately absent. Hilsa is a regional species distributing in the Ganga-Brahmaptra-Meghna basin. Hence, a single-country management measures may not become a successful management. Furthermore, only coastal management measures cannot ensure sustainability of the fisheries unless riverine systems are improved. On the positive side, lower trophic level, and high fecundity of hilsa can ensure that with appropriate management measures, the fishery can be sustained, and optimum benefits can be obtained. Therefore, a regional approach for developing the management measures would definitely help in the restoration of this transboundary fish species.

Conclusion

Among the rich aquatic biodiversity, hilsa's position as a food is paramount and it is thus referred to as Machher Raja ("the king of fish"). It is culturally and religiously important fish, due to its unique taste, flavor

and richness in omega 3 and micro-nutrients, and considered as state fish of West Bengal and national fish of Bangladesh. Due to several anthropogenic factors this species has lost its presence in the middle stretch of the river Ganga. Realizing the importance, the Govt. of India under the National Mission for Clean Ganga (NMCG), ICAR-CIFRI has taken up a holistic approach towards re-establishing the hilsa fishery in river Ganga through ranching of adults/juveniles ii) artificial propagation and ranching of hilsa seeds iii) creating mass awareness on hilsa conservation and iv) impact assessment through field based survey. The results are very interesting. Now juvenile hilsa are available in the middle stretch of river Ganga, which was not available since last 40 years. In addition to our efforts, we have seen that the Bangladesh has adopted co-management policy and additional fishing ban period for the brooder. These two management measures have improved the hilsa production significantly. Therefore, a regional management approach is required, in spite of several constraints to re-established a sustainable hilsa fishery in river Ganga .

Acknowledgments

The authors are grateful to National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, Govt. of India for

the financial support. The scientific knowledge on Hilsa management towards sustainable production provided by Prof. Abdul Wahab from Bangladesh Agricultural University and World fish, Bangladesh is highly acknowledged and the authors are indebted to him. The authors thank all the project staffs, research scholars and technical involved under the NMCG programme. □

Reference

1. Rahman, M. J., Wahab, M. A., Amin, S. N., Nahiduzzaman, M., & Romano, N. Catch trend and stock assessment of Hilsa *Tenualosa ilisha* using digital image measured length frequency data. *Mar. Coast. Fish.* **10**(4), 386-401 (2018).
2. Fishery and Aquaculture Statistics. Global capture production 1950-2019 (Fish stat J). In: *FAO Fisheries Division* [online]. Rome. Updated (2021). www.fao.org/fishery/statistics/software/fishstatj/en
3. A. M. Sajina, V. R. Suresh, K. M. Sandhya, J. Mukherjee, R. K., Manna. B. K. Behera, S. K Banik. Status of hilsa fishery in hooghly-bhagirathi river system and associated coastal waters of northern Bay of Bengal. *Proc. Natl. Acad. Sci., India, Sect. B Biol. Sci.* **90**(3), 647-656 (2020).<https://doi.org/10.1007/s40011-019-01140-7>.
4. A. K. Sahoo, M. A. Wahab, M. Phillips, A. Rahman, A. Padiyar, V. Puvanendran, C. V. Mohan. Breeding and culture status of Hilsa (*Tenualosa ilisha*, Ham. 1822) in South Asia: A review. *Rev. Aquac.*, **10**(1), 96-110 (2018).