# Status of Indian shad fishery in Dhubri district of Assam, India

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***Abstract***

The aim of the present study is to understand the people's dependency on Hilsa fishery as their livelihood and to suggest the appropriate measures for its conservation and economic sustainability. The anadromous Hilsa enjoys the highest attraction due to its unique taste, flavour, and culinary properties. About 15-20 per cent of global Hilsa catch is reported by India. Though, a report revealing the decline of Hilsa yield, bountiful harvest of samewas reported in Brahmaputra river of Dhubri district. The primary data of 30 Hilsa fishers have been selected randomly to study the economic status, constraints faced by them, exploitation level. About 40% of respondents involved in both fishing and agriculture and 30% are only engaged in fishing. About 63.33% of fishers owned motorised boats and the gear used for Hilsa fishing is monofilament Gill net with mesh size 7cm to 12 cm. About 63.66% of respondents are found to be perennial fishers. The average Hilsa landing is 6.25 tonnes in one landing centre during the Hilsa season. The economic analysis shows that motorised boat owners have highest B:C ratio (1.7) against traditional fishers (1.4) during Hilsa season. Overcrowding of fishers during Hilsa season, Price fluctuations, lack of weighing system, Small and unhygienic auctioning centre, etc. are some of the constraint faced by the Hilsa fishers. Implementation of Licence system onnumber of boats to be operated, measures for habitat restoration, check on mess size regulationshave to be given focus to make the Hilsa fishery economical and sustainable.

## I. INTRODUCTION

The Indian shad, *Tenualosa ilisha* (Hamilton) popularly known as Hilsa, the king of fishes is one of the most important commercial fishes of India. It is highly delicious, priced and has socio-cultural importance, especially in West Bengal and North-Eastern states of India. It distributed mostly in Bangladesh, Myanmar, and India with contributions of 50-60 per cent, 20-25 per cent and 15-20 per cent respectively to the global Hilsa catch [1]. It has a wide range of distribution hence occurs in marine, estuarine and river environments [2] and has the capacity to withstand a wide range of salinity. Being anadromous fish, it migrates from the Bay of Bengal to Assam through Dhubri district via Bangladesh and covers a distance of more than 890 Km for breeding purpose [3]. The Hilsa forms an important fishery in the lower stretches of river Brahmaputra with the contribution of about 9.75 per cent of the total catch [4]. Hilsa fishing occurs throughout the year with marked fluctuations in summer and winter months [5]. It has two breeding seasons, i.e. April to July which is the best season and October to December with October as peak season and usually breeds during full moon [6]. Some authors reported that the fish requires turbid water to migrate and may use less transparent water to breed.

According to [7] the Hilsa catch is declined in Hooghly-estuarine region whereas the same increased from 215 tonnes to 250 tonnes in Assam between the years 2013 to 2016 [8]. The supply is abundant in almost all fish markets of Guawahati, Assam during the breeding season [9] and [10]. Hilsa landing is rampant during the peak breeding season (i.e. October). Hence there is a necessity to study the demographic and economic status of Hilsa fishers in order to understand the economic status, constraints faced by fishers and to provide proper suggestions to mitigate over exploitation and promote conservation of Hilsa fishery in Brahmaputra River of Dhubri district, Assam, India.

## II. MATERIAL AND METHODS

***A. Data:*** A survey has been conducted in the month of October (peak breeding season), 2017 by using a pre-structured interview schedule. A sample size of 30 Hilsa fishers was randomly interviewed to achieve the objectives set for the study. The socio-demographic results were portrayed in percentages with the help of frequency tables.

***B. Economic analysis of Hilsa fishing***

In order to observe whether or not Hilsa fishing is profitable, the B:C ratio has been calculated. The B-C ratio for Hilsa fishing is estimated separately for normal fishing season and

Hilsa fishing season to compare their profitability. The comparison of B-C ratios has also been done between traditional and motorised boats. The B-C ratio is estimated using the following formula.

$$B - C\ Ratio = \frac{Gross\ Income}{Total\ Cost}$$

Where;
Gross Income (GI) = Average catch (Q)*Price (Rs/Kg)
Total Cost (TC): Sum of Total Fixed Cost (TFC) and Total Variable Cost (TVC)

***a) Fixed cost*:** is the cost that does not change with the level of output. The fixed costs in Hilsa fishing include; costs of the boat, gears, motor, Interest on fixed capital (@11.3 %), Depreciation value, Cost of repair and maintenance. The interest on fixed capital assumed to be the interest rate levied up on long term agricultural loans.

Rate of Depreciation on fixed assets was estimated using straight line method where;

$$Depreciation\ (per\ annum) = \frac{Original\ cost\ of\ asset - Junk\ value}{Useful\ life\ of\ the\ asst}$$

**Note**: The junk value of a fixed asset after its useful life is 10 per cent of the original cost.

Costs incurred on repair and maintenance of fixed assets is estimated based on the information provided by the sampled fishers.

***b) Variable cost*:** The cost which varies with the level of output. In this study, the daily expenses incurred by a fisher for fishing are considered as variable costs. These costs include; labour charges, marketing cost, fuel, lease, other miscellaneous costs, and interest on working capital (@8.1% per annum).

**Net Income:** The residual portion left with the fisher after deducting Total Cost (TC) from the Gross Income (GI).

**i.e. Net Income= GI-TC**

***C. Two sample t-test:*** In order to see the equality of two means (i.e. time spent on fishing and averages income obtained) during the normal season and Hilsa season.

**$H_0$:** 1) No difference between the incomes obtained from normal season and Hilsa season
2) No difference between the no. of hours spent on fishing during normal season and Hilsa season

**$H_1$:** 1) Incomes obtained in different seasons were vary

2) No. of hours spent on fishing varies between normal and peak seasons

$$\textbf{Test statistic: } t = \frac{\bar{x} - \bar{y}}{s\sqrt{\left(\frac{1}{n1} + \frac{1}{n2}\right)}}$$

Where,

$$s = \sqrt{\frac{\sum(x - \bar{x})^2 + \sum(y - \bar{y})^2}{n_1 + n_2 - 2}}$$

**Decision criteria:** If the test statistic value is greater than the table value at $n_1+n_2$-2 df, the null hypothesis is rejected (i.e., there is no significant difference between no. of hours spent on fishing during peak and normal seasons and also average income obtained from fishing during those seasons.

## III. RESULTS AND DISCUSSION

### *A. Demographic profile:*

The demographic profile of the fishers reveals that majority of Hilsa fishers (47%) were in the age group of 36- 45, followed by 33 per cent found under the age group 26-35. Only 10 per cent of fishers belonged to more than 45 years age group. Majority of the fishers (83.33%) have nuclear families. Out of total sampled fishers, about 53.33 per cent have a family size of 5-7 members, followed by 33.33 per cent with the family size of 2 to 4 members and the remaining fishers have a family size of more than 7. The literacy rate was found satisfactory as 73 per cent of fishers were educated at different levels. Majority of them (50%) have studied up to secondary level. The fishers with higher education, i.e. higher secondary and above are comprised of only 23 per cent. The social class of Hilsa fishers comprises only General (86.66%) and Other Backward Classes (13.33%). The religious status of fishers shows that 83.33 per cent were Muslims and the remaining 16.66 per cent were Hindus.

### *B. Hilsa fishing activity in Brahmaputra River of Dhubri district*

The Hilsa fishing starts immediately after the monsoon from the month October which is the peak season. Two types of boats (traditional and motorised boats) are being operated in Brahmaputra river of Dhubri district for Hilsa fishing where 63.33 per cent of respondents are using motorised boats and others are using only traditional boats. The gear which is used for Hilsa fishing is monofilament gill net of mesh size 7 to 12 cm. The average size of Hilsa available in the market is 36.03 cm long and 600 gm weight. The average price of Hilsa at landing cum auction centre is  180/Kg during peak season.

There are more than 200 numbers of fishers in one landing centre during peak season and less than 100 numbers during the normal season. The average landing of Hilsa in one landing centre is about 6.25 tonnes.

The occupational status (Fig. 1) shows that about 30 per cent of fishers are engaged only with fishing and the about 40 per cent were engaged both in fishing as well as agricultural related works.

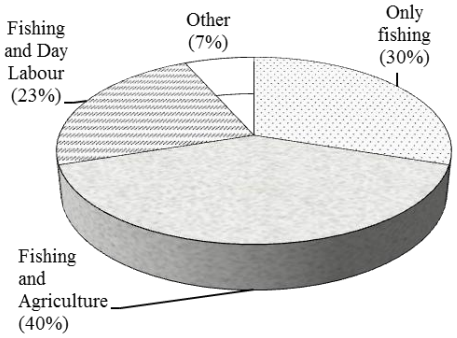


**Fig. 1: Occupational status**

### *C. Economics of Hilsa fishing using motorised and traditional boats during peak season*

A comparative Cost-Returns analysis of Hilsa fishing using motorised and traditional boats has been worked out for peak and normal seasons. The total fixed costs per member for Hilsa fishing during Hilsa season (almost 45 days) amounted to  1806.09 and  946.06 on motorised and traditional boats respectively. The fixed cost mainly consisted of annual depreciation on boat, gears and motor (depreciation value of motor is exempted for traditional boats). The depreciation value accounted for  1385.79 on motorised and  658.59 on a traditional boat. The rate of interest on fixed capital is calculated at 11.3 per cent. The total costs were  33,194.91 and  792.70 on motorised and traditional boats respectively. Among the variable costs, lease charge alone was accounting for 44 per cent on motorised boats whereas cost of labour (54.28%) was found more on traditional boats. The total variable cost was of the magnitude of  31,388.83 and  20,927.18 on motorised and traditional boats respectively. The other components of variable cost like marketing cost, cost of fuel etc. were lesser than 6 per cent on motorised boats. However, in the traditional boats the other variable cost was very meagre. On average, each member of motorised and traditional boat fishers has caught 311.42 kg and 168.09 kg respectively. The net return per member was estimated as  22,050.35 and  9,607.39 on motorised and traditional boats respectively. The B:C ratios of motorised (1.7) and traditional (1.4) fishers indicate that Hilsa fishing is a viable activity yielding a return of  1.7 and  1.4 for motorised and traditional fishers respectively for every one rupee investment.

**Table 1: Economics of Hilsa fishing during peak season ( /member)**

| Particulars | Motorised boat ( ) | Traditional boat ( ) |
|---|---|---|
| **Fixed Cost** | | |
| Capital cost (Boat+ Net + motor) | 12647.37 | 7121.21 |
| Interest on fixed capital (11.3 %) | 238.19 | 134.12 |
| Depreciation value | 1385.79 | 658.59 |
| Cost of repair and maintenance | 182.11 | 150.00 |
| Total Fixed Cost (A) | 1806.09 | 946.06 |
| **Variable Cost** | | |
| Labour cost | 11,531.58 (36.74) | 11,359.09 (54.28) |
| Marketing cost | 1,702.63 (5.42) | 0 |
| Cost of fuel | 1,226.32 (3.91) | 0 |
| Lease charge | 13,811.32 (44.00) | 7,831.82 (37.42) |
| Miscellaneous cost | 765 | 168.18 |

| | | |
|---|---|---|
| | (2.44) | (0.80) |
| Interest on working capital (8.1%) | 2,351.98 (7.54) | 1568.09 (7.55) |
| Total variable cost (B) | 31,388.83 (100) | 20,927.18 (100) |
| Total cost (A+B) | 33194.91 | 21,869.88 |
| Returns from sale of fish | 55,245.26 | 31,327.27 |
| Net returns (4-3) | 22,050.35 | 9,457.39 |
| B:C ratio | 1.7 | 1.4 |

**Note:** Values in the parenthesis indicates percentages

***D. Economics of Hilsa fishing during normal fishing season***

The cost-returns of Hilsa fishing during normal season for motorised and traditional fishers have been worked out separately. It was observed that the total fixed cost amounted to  16,690.92 and  5242.02 per member on motorised and traditional boats respectively. The total fixed cost mainly consisted of depreciation on boat, net, and motor (depreciation value of motor is exempted for traditional boats). The depreciation values of motorised and traditional boats were accounted for  9143.636 and  2650 respectively. The Interest on fixed capital is calculated at 11.3 per cent. Among the variable costs, labour cost alone was accounting for 45.15 per cent and 61.41 per cent on motorised and traditional boats respectively. The other variable costs along with their contributions to the total variable costs have been depicted comparatively for the motorised and traditional boat fishers in the Table 2. The total variable cost incurred per member was  1,46,585.6 and  1,13,532 on motorised and traditional boats respectively. The variable costs such as marketing cost, cost of fuel, etc. were of less than 7 per cent for motorised boats however on traditional boats the same was very meagre. The total costs for motorised and traditional boats were estimated to  1,63,276.5 and  1,18,774.05 respectively. On average, each fisher of a motorised boat has caught 1,251.64 Kg and the same was 932 Kg for traditional fishers. The net returns were  24468.97 and  16,559.29 for motorised and traditional fishers respectively. The B:C ratios of motorised (1.1) and traditional (1.14) boats indicating that Hilsa fishing is a viable activity even in the normal season and yielding a return of 1.1 and 1.14 rupees respectively for every one rupee of investment.

**Table 2: Economics Hilsa fishing during normal season ( /member)**

| Particulars | Motorised boat ( ) | Traditional boat ( ) |
|---|---|---|
| **Fixed Cost** | | |
| Capital cost (Boat + Net+ motor) | 85,945.45 | 28,566.67 |
| Interest on fixed capital (11.3 %) | 6,474.56 | 2,152.022 |
| Depreciation value | 9,143.636 | 2,650 |
| Cost of repair and maintenance | 1,072.73 | 440 |
| Total fixed cost (A) | 16,690.92 | 5,242.02 |
| **Variable Cost** | | |
| Labour cost | 66,181.82 (45.15) | 69,720 (61.41) |
| Marketing cost | 9,883.64 (6.74) | 0 |
| Cost of fuel | 9,454.55 (6.45) | 0 |
| Lease charge | 46,936.36 (32.02) | 34,950 (30.78) |
| Miscellaneous cost | 3,145.45 (2.15) | 355 (0.31) |
| Interest on working capital (8.1%) | 11,070.64 (7.55) | 8,542.67 (7.52) |
| Total variable cost (B) | 14,6585.6 (100) | 11,3532 (100) |
| Total cost (A+B) | 1,63,276.5 | 1,18,774.05 |
| Returns from sale of fish | 1,87,745.5 | 1,35,333.3 |
| Net returns (4-3) | 24,468.97 | 16,559.29 |

| | | |
|---|---|---|
| B:C ratio | 1.1 | 1.14 |

**Note**: values in the parenthesis represent percentage

The results of t-test (Table 3) for equality of two means show that the null hypothesis are rejected. Hence time spent on fishing and income obtained from Hilsa fishing during peak and normal seasons were significantly different at $p < 0.001$ with $n_1+n_2-2$ degree of freedom.

**Table 3: t test for equality of two means**

| Season | N | Fishing hours | t- value | Significant | Average income (□) | t -value | Significant |
|---|---|---|---|---|---|---|---|
| Normal season | 19 | 1468 | 26.39 | <0.001 | 1,70,778.94 | 13.91 | <0.001 |
| Hilsa season | 30 | 237 | | | 46,475.37 | | |

***E. Constraints***

The constraints faced by the Hilsa fishers in the Dubri District of Assam have been shown in the Table 4. The maximum respondents (90%) were facing price fluctuation as constraint followed by lack of proper weighment system (83.33%) and overcrowding of fishers during Hilsa season (66.6 %).

**Table 4: Constraints face by Hilsa fisher**

| S. No. | Particulars | Frequency | Percentage |
|---|---|---|---|
| 1. | Price fluctuation | 27 | 90.00 |
| 2. | No weighing system | 25 | 83.33 |
| 3. | Overcrowding of fishers during Hilsa season | 20 | 66.67 |
| 4. | No storage facilities | 19 | 63.33 |
| 5. | No ice-plant nearby | 18 | 60.00 |
| 6. | No proper transportation facilities | 17 | 56.67 |
| 7. | Small and unhygienic auctioning centres | 15 | 50 |

***F. Fishing regulation in Assam with respect to Hilsa fishing***

As per [11] the regulation on Hilsa fishing includes restrictions on the use of Berjal/ Mahajal or fasijal or any type of net with the mesh size less than 7cm bar/14 cm mesh during breeding season w.e.f 1st April to 15 July. The use of net with the mesh size less than 1 cm bar/ 2 cm is prohibited in any fishery. Prohibition on catching brood fish of certain species in any proclaimed fishery is imposed w.e.f 1st May to 31st July. Catching and killing of fish by any method for any purpose including consumption and selling of undersized fish of certain species is prohibited between 1st August to 31st October to ensure natural breeding, propagation and growth of fish in all fisheries and natural water bodies. Though there are regulations on fishing with the intension to conserve however found ineffective to fulfil the objective as the regulation laid does not coincide with the Hilsa season (breeding of Hilsa takes place after completion of monsoon).

Restriction on mesh size during breeding season (i.e. 1st April to 15th July) usually does not coincide with the Hilsa breeding season. The average size of Hilsa usually caught in Brahmaputra River is 36.03 cm and the first maturity is reported at the size of 35-37 cm [12]. Therefore the catch comprises either brooder or spent hence the regulation on the use of net with mesh size less than 1 cm bar/ 2 cm throughout the year rather confined only to breeding season could be an appropriate method for conservation of Hilsa fishery.

According to [13], the Bangladesh has imposed numbers of fishing ban days especially for Hilsa during its breeding season. As Hilsa is a migratory fish, the ban season in Bangladesh may be the reasons for its bountiful harvest in Brahmaputra River. The monsoon flood which makes the water turbid and less transparent may also be another

reason contributing to migration and breeding of Hilsa in Brahmaputra River.

## IV. SUGGESTIONS

It is the right time for Assam state to form regulations for the conservation of Hilsa fishery resource. The licensing procedure for boat should be implemented to restrict the free entry and to prevent from overfishing. The licensing procedures shall ensure that the practices are directed towards conservation and habitat restoration along with the livelihood support of dependent fishers. Regulation on mesh size for the breeding season should also be implemented during Hilsa season. The first sexual maturity of Hilsa occurs at the size 32 cm to 36 cm hence the use of 110 mm mesh size gill net will be ideal as minimum size caught in this net is 36 cm TL and allows all under sized fishes to escape. As the fishing rights are allocated to co-operative societies by the State Government, establishment of proper linkage between stakeholders is necessary to implement the policies and regulations. The co-operatives should have a mandate to ensure the welfare of the fishers and conservation of fishery resources of the river as well. Since Hilsa is a migratory fish, a uniform period of ban season, the prohibition of destructive fishing practices and mesh size regulation in India and Bangladesh is necessary during its breeding season. It is important to integrate both GIS and Histological studies of Hilsa gonad to pinpoint breeding season of Hilsa and implement the management policies accordingly. There should be proper weighing system and mechanism to set the price of fish to avoid middlemen exploitation of fishers. The construction of large auctioning centres with modern facilities and maintenance of existing centre with hygiene are necessary in order to ensure the quality and shelf life of fishes. The provision of cold storage facilities is necessary in order to make the fish available for the consumer during lean season.

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