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Socio-economic and livelihood analyses of hilsa (*Tenulosa ilisha*) fishers of lower stretch of Ganga River, India

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ABSTRACT

The present study was conducted to understand the socio-economic and livelihood features of the hilsa fishers in Hooghly-Bhagirathi river system and also to find out the reasons of decline in hilsa fishery as perceived by the fishers. Results of the analysis revealed that 60% of the hilsa fishers belonged to jele/malo community and the average experience in hilsa fishing was for about 20 years. Hilsa fishery contributed 38.84% in annual family income of fishers' households. Lower hilsa catch in Hooghly-Bhagirathi river system during the past ten years led to large scale forced migration among the fishers' community. The younger generation of fisherfolk had lost their interest from fishery particularly of hilsa fishery due to uncertain income. Six reasons behind decline of hilsa fishery as perceived by the fishers were documented and ranked. According to the fishers, 'use of destructive fishing gears' (mean score 66.06) was ranked as first among the reasons behind decline in hilsa fishery followed by 'erratic rainfall' (64.54); 'huge catch of hilsa fish in lower part of Hooghly/sea mouth' (60.3); 'industrial pollution in Hooghly River' (52.3) and 'freshwater discharge/influx' (35.07). Poor implementation of mesh size regulation, poor enforcement of closed season in rivers, ineffective extension services, and recurring climatic hazards made the hilsa fishery more vulnerable. The government, fishery cooperatives, NGOs and other related organisations need to join hands to support the hilsa fishers for sustainable hilsa fishery management.

Keywords: Ganga River, Hilsa fishery, Hooghly-Bhagirathi river system, Livelihood, Socio-economics

Introduction

The hilsa shad *Tenulosa ilisha* (Hamilton, 1822) is having a significant ecological, economic and cultural importance in South Asia and is presently in the focus of conservation efforts to preserve sustainability of its fishery (Mohammed, 2013). It is a fish of national importance to Bangladesh and very popular among the Bengalees. Hilsa fishery is a source of livelihood for many people in West Bengal. A large number of people of fishers' community in lower stretch of the river Ganga, also known as Hooghly-Bhagirathi river system are engaged in hilsa fishing for their livelihood. The lower most 523 km of river Ganga is comprised of 295 km stretch of Bhagirathi River from Farakka to Nabadwip and 228 km stretch of Hooghly Estuary from Nabadwip to Frezarganj. The Hooghly estuarine system on the Indian coast of Bay of Bengal is one of the largest and most productive estuaries in the country (Jhingran and Ghosh, 1978) covering about 8000 km^2 which sustain important multi-species commercial fisheries. Hilsa is an anadromous fish which ascends the freshwater stretch of rivers from inshore areas of sea mainly for breeding purpose (De and Saigal, 1989). It migrates from the Bay of Bengal to the inland freshwater rivers of Myanmar, Bangladesh and east coast of India like Hooghly-Bhagirathi Estuary to spawn (Naser, 2014). Maximum catches of the fish are observed from July to September and sometimes up to middle of October. Two spawning seasons during July - September and January - February have been identified by previous workers (Pillay, 1958). In Bangladesh, hilsa fishery employs approximately 447,000 fishers of which 32% are engaged permanently and 68% part time (DoF, 2006). In West Bengal also, a large number of fishers are engaged in exploitation of hilsa in the marine, estuarine and freshwater zones of Hooghly-Bhagirathi river system. Bhaumik and Shama (2012) reported that about 20,930 fishers are operating in lower stretch whereas about 5600 fishers in the freshwater zones in the upper stretch. Most of these fishers are from 'Malo' community and they are the backbone of hilsa fishery related activities (Azad and Haque, 2003). The hilsa fishers are one of the poorest groups belonging to the lower strata of the society. For the last few decades, the total fish catch from Hooghly river system has declined due to siltation, pollution, over-exploitation and use of destructive fishing gears. Moreover hilsa juveniles during their journey back to the sea are also caught indiscriminately by the fishers and sold in markets as *khoira* (*Gudusia chapra*) fish. Catching of hilsa juveniles significantly contribute to decline of adult hilsa production from Hooghly-Bharirathi river system and an extrapolated estimation revealed that 50% reduction in juvenile killing has the potential to

increase the adult production by 10% (Bhaumik, 2010). Due to the decline in hilsa catches, the livelihood of associated fishers is under threat. Several studies have been conducted on the status of hilsa catches and reproductive development of hilsa, but very few initiatives have been undertaken to investigate the socio-economic condition of the hilsa fishers of Hooghly-Bhagirathi river system. The present study was conducted during 2010-13 in Hooghly-Bhagirathi river system in order to understand the socio-economic and livelihood issues of the hilsa fishers and also to identify the perception of hilsa fishers regarding the reasons behind decline of hilsa fishery.

Materials and methods

The study was conducted all along the stretch of 523.59 km of the Hooghly-Bhagirathi river system after Farakka Barrage and ten important fish landing centres were selected as sampling sites, *viz*., Farakka, Lalbagh, Nabadwip, Kalna, Balagarh, Tribeni, Nawabganj, Diamond Harbour, Kakdwip and Frazergunj. From each site, 30 hilsa fishers were randomly selected. A total number of 300 fishers were interviewed personally. In selected sites, focus-group discussions and problem analysis (PRA) was conducted to collect general information. Semi-structured interview schedule was developed and used to collect data related to socio-personal and socio-economic variables and the data thus obtained were statistically analysed. Simple statistical techniques such as frequency, mean, percentages and correlation were used to analyse the data.

Open-ended interview schedule was also used to collect data about the reasons perceived by the fishers regarding decline in hilsa fishery. The ranks given by the respondents were then converted into percentage position with the help of Garretts Ranking Technique.

$$\text{Percent position} = \frac{100\,(R_{ij} - 0.5)}{N_j}$$

where, R_{ij} = Rank given to i^{th} constraint by j^{th} individual, N_j= Number of constraints ranked by j^{th} individual. The data obtained were statistically analysed employing tabular and percentage analyses.

Results and discussion

Socio-economic profile of hilsa fishers

Age and caste composition

It was found that (Table 1) most of the hilsa fishers (49.42%) belonged to middle age (32-54 years) group followed by old age group (40.33%) *i.e*., more than 55 years. The younger generation were not much interested in hilsa fishing as the income was uncertain. It was also perceived that people involved in hilsa fishing had experience of 6 to 40 years and on an average it was 20 years. The scheduled caste particularly the *Jele/Malo* community (60%) was found quite predominant in hilsa fishing followed by other backward communities (OBCs, 26%), general (8%) and scheduled tribes (6%).

Table 1. Age and caste composition of the hilsa fishers

Age composition	Respondents
Young age (<32)	31 (10.34%)
Middle age (33-54)	148 (49.42%)
Old age (>55)	121 (40.33%)
Caste composition	**Respondents**
Scheduled caste	180 (60%)
Scheduled tribe	18 (6%)
Other backward communities (OBC)	78 (26%)
General	24 (8%)

Distribution of households according to family size and family composition

In this study, family was defined as a group consisting of parents and their children living together as a unit with a common kitchen. In the study, it was found that most of the families were nuclear in nature. Average number of members of a family was five (Table 2) and the male female ratio was 1.14.

Table 2. Distribution of households according to family size and family composition

Family size				Average family size
<3	3-8	>8	Total	
42 (21%)	96 (43%)	62 (31%)	200	5

Educational status

Most of the hilsa fishers had education up to primary level (41.75%), followed by secondary level (24.36%). On an average 8.32% of the fishers had educational qualification above secondary level and 19.57% of the fishers were found illiterate. According to the census report of 2011, the average illiteracy rate in West Bengal was 22.9% and therefore the illiteracy level of fishers remains lower than the state average.

Family income and contribution of hilsa fishery to the income

It was found that the main occupation of the respondents was fishing. Some of the fishers or their family members were also working as daily wage labourers, agricultural labourers, handicraft workers (spinning), rickshaw pullers and vendors during off-season. The average annual family income of the fishers was ₹67385/- and on an average, fishers were

earning ₹25,385/- from hilsa fishery in a year. According to the fishers of the Hooghly-Bhagirathi river system, there are two seasons for hilsa fishing; during monsoon *i.e.,* middle June to middle September (*Ashar, Sravana, Bhadra* as per local calendar) and late winter *i.e.,* middle of January to middle of March (*Magh, Phalgun* as per local calendar). In upper stretch from Farakka to Dakkhineswar, hilsa fishers generally catch hilsa with small boat in a small group consisting of two to three members. In upper stretch, the average monthly income during hilsa fishing season was ₹7000/- and here the income sharing pattern among the fishers was very unique. The income from the boat is divided into two parts, boat and gear owner take one part *i.e.*, 50% and the rest 50% divided among the fishers in the boat with equal share.

In lower stretch from Diamond Harbour to Frezarganj, fishers were getting more quantity of fish catch as it was nearer to the sea mouth. The average monthly income of the hilsa fishers during peak season was also higher than the fishers of upper stretch *i.e.,* ₹11000/- during hilsa catching months. In lower stretch, fishers exploit hilsa in groups by hiring mechanised boats locally known as trawlers (Bhaumik and Sharma, 2012). A group of 8-12 fishers go for fishing in deep sea for 8-10 days trip. The income sharing pattern of the fishers in lower stretch was also very typical. They paid 30% of sale to the boat owner, 30% was spent towards fuel and repairing of the vessel/net and for meeting food cost onboard. The rest 40% is divided among the co-fishers, where 2% more are given to boat and engine drivers (Bhaumik and Sharma, 2012).

In Hooghly-Bhagirathi river system, hilsa fishery contributes a significiant share to the income of the fishers. Contribution of hilsa fishey to the family income of a fishermen household was 38.84% per annum. The finding is also acquiescent to the finding that hilsa is the major component of fishery in the Hoogly-Bhagirathi river system accounting for about 20-25% of the total fish landing (Bhaumik and Sharma, 2012).

Expenditure pattern

Fishers spent considerable amount of money for hilsa fishing operation and the rest for family or household purposes. In the present study, it was found that fishers spent almost 40% for fishery operation and 60% for family. The boat hiring charges contributed maximum (76%) in the total expenditure of fishery operation followed by net and gear repairing charges and license fee (Fig. 1). Similar survey conducted on a sample of twenty fishermen of Konkan found that almost 80% of their gross expenditure was used for running their business activity

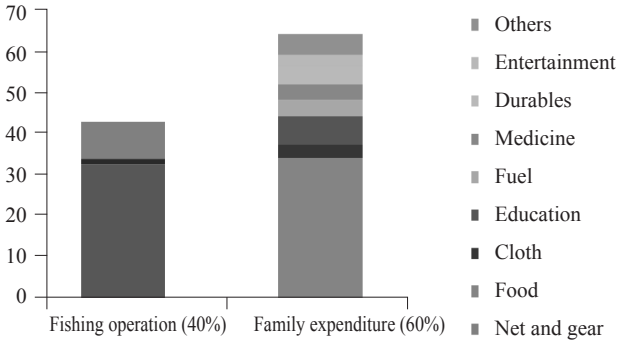

Fig. 1. Expenditure pattern of hilsa fishers

and remaining 20% for family expenditure (Ulman *et al.*, 2008). The household expenditure was maximum for food (53%) followed by education of children (11%). The finding is similar to the finding of Karthikeyan *et al*. (2013) where he reported majority of the fisher folk in southern coastal districts of Tamil Nadu spent maximum portion of their income for food. Sathiadhas *et al.* (1994) also reported that the expenditure on food items is maximum in family budget *i.e.*, 58 and 85% in Mallipattinam and Keechankuppam villages respectively among the traditional fishermen in Thanjavur coast of Tamil Nadu.

Correlation coefficient of family incomes of hilsa fishers with other socio-economic variables

Table 3 shows that family income of the hilsa fishers is significantly correlated with selected socio-economic variables like number of earning members in family, experience of the respondent in hilsa fishing (in years) and the income from hilsa fishery. All these variables are positive and highly correlated ($p<0.01$) with the family income of hilsa fishers. If the respondent has more number of earning members, more number of years of experience in hilsa fishing or income from hilsa fishery is good, his household income is higher. But, other socio-economic variables like age, education and social participation of the respondents do not have any significant correlation with the family income of the hilsa fishers.

Table 3. Correlation coefficient between family incomes of hilsa fishers with other socio-economic variables

Variables	Correlation coefficient
Age	0.297
Education	0.242
Number of earning members in a family	0.730**
Number of years involved in hilsa fishing	0.513**
Social participation	0.278
Income from hilsa fishing	0.810**

** Correlation is significant at the 0.01 level (2-tailed)

Perception of hilsa fishers regarding reasons behind decline in hilsa fishery

Six reasons as perceived by the fishers were documented and were ranked with the help of Garretts Ranking Technique (Table 4) in order to identify the reasons behind decline in hilsa fishery in Hooghly-Bhagirathi river system over the decades. According to the fishers, 'use of destructive fishing gears' (mean score 66.06) was ranked first among the reasons behind decline in hilsa fishery. Fishers were also well known to the fact that the use of *meen jaal* (shooting net) for collection of prawn seed from Hooghly estuary led to huge destruction of other fish seeds. Use of *binti jaal* (bag net), *ber jaal* (siene net), *charpata jaal* (barrier net), *nauka vassal* (lift net), *ghono chhandi jaal* (small meshed gill net) were also causing massive loss of fish seed including hilsa juveniles. 'Erratic rainfall' or irregular rainfall pattern (mean score 64.54) was ranked as the second reason for decline in hilsa catch. 'Huge catch of hilsa fish in lower part of Hooghly River/ seamouth' (mean score 60.3) was ranked third. Most of the fishers particularly in upper stretch of Hooghly River (from Farakka to Dakhineswar) felt that, increase of mechanised boats in last one decade caused enormous exploitation of Hooghly River mouth during hilsa fishing season. Industrial pollution' (4th rank) was also reported as one of the major reasons for decline in hilsha fishery by the fishers. Study of Samanta (2013) showed that in Hooghly River, sewage and industrial wastewater were the primary source of pollution and metal as well as pesticide contaminations can have adverse effect on the health of aquatic organisms. 'Siltation in Hooghly River' was ranked 5th by the fishers. The siltation by sedimentation is also a very important phenomenon in Hooghly-Bhagirathi river system and the view is also supported by many researchers. Wasson (2003) reported that the combined catchment of Ganga-Brahmaputra rivers is 1.656x10^6 km^2 in area, that yields ~1000 x10^6 t per year of suspended sediment in Bay of Bengal which is ~8% of the total sediment load reaching the global oceans. 'Fresh water influx' (6th rank) due to construction of Farakka Barrage was another reason behind decline in hilsa fishery as perceived by the fishers. Due to increased freshwater influx, the spawning ground of the hilsa has been shifted downstream, and hence the upstream availability of hilsa has declined substantially.

Problem tree analysis

A problem tree analysis which is a bottom up approach that gives a diagrammatic presentation of the problem, its causes and effects, was employed to find the reasons for decline in hilsa catch and its effect on the living standard of fishers. A participatory rural appraisal (PRA) tool (problem tree) was used to analyse the problem of hilsa fishers of Hooghly-Bhagirathi River system (Fig. 2). The core problem was identified as 'decrease in hilsa catch'. The causes of the problem were identified through participants' brain storming where the participants identified the causes as well as effects. From the problem tree analysis, four major reasons were identified *viz*., destruction of hilsa juveniles, habitat degradation, indiscriminate catching of hilsa brood fishes and poor implementation of mesh size regulation act (GoW, 2013) which affect the hilsa fishery and ultimately the fishers fall into the vicious cycle of insecure livelihood and low standard of living.

Poor implementation of mesh size regulation, poor enforcement of closed season, ineffective extension services *viz.,* lack of mobility to cover all the fish landing centres to create awareness among the fishers; less importance to open water fisheries and overload of the fisheries extension personnel at block level and recurring climatic hazards made the hilsa fishery more vulnerable. There is an urgent need for taking essential measures towards conservation of the species for sustaining hilsa fishery in Hooghly-Bhagirathi river system. But, conservation efforts will be successful only if alternative income generating activity related programmes can be introduced as done in Bangladesh (Naser, 2014). Bridging the gaps of extension and research is also required. The government, fishery cooperatives, NGOs and other related

Table 4. Perception of the hilsa fishers regarding the reasons behind decline of hilsa fishery

Reasons behind decline of hilsa fishery	Rank given by respondents							Total no. of respondents	Total score	Mean score	Rank
	1	2	3	4	5	6	7				
Use of destructive fishing gears	39	77	56	75	32	14	7	300	19820	66.06	I
Erratic rainfall	111	68	65	26	19	4	7	300	19362	64.54	II
Huge catch of hilsa fish in lower part of Hooghly/sea mouth	89	70	67	34	20	10	10	300	18180	60.3	III
Industrial pollution in Hooghly River	47	41	34	78	50	18	32	300	15691	52.3	IV
Siltation in Hooghly River	9	23	32	47	51	75	63	300	12469	41.56	V
Freshwater discharge/influx	0	19	26	21	32	86	116	300	10522	35.07	VI

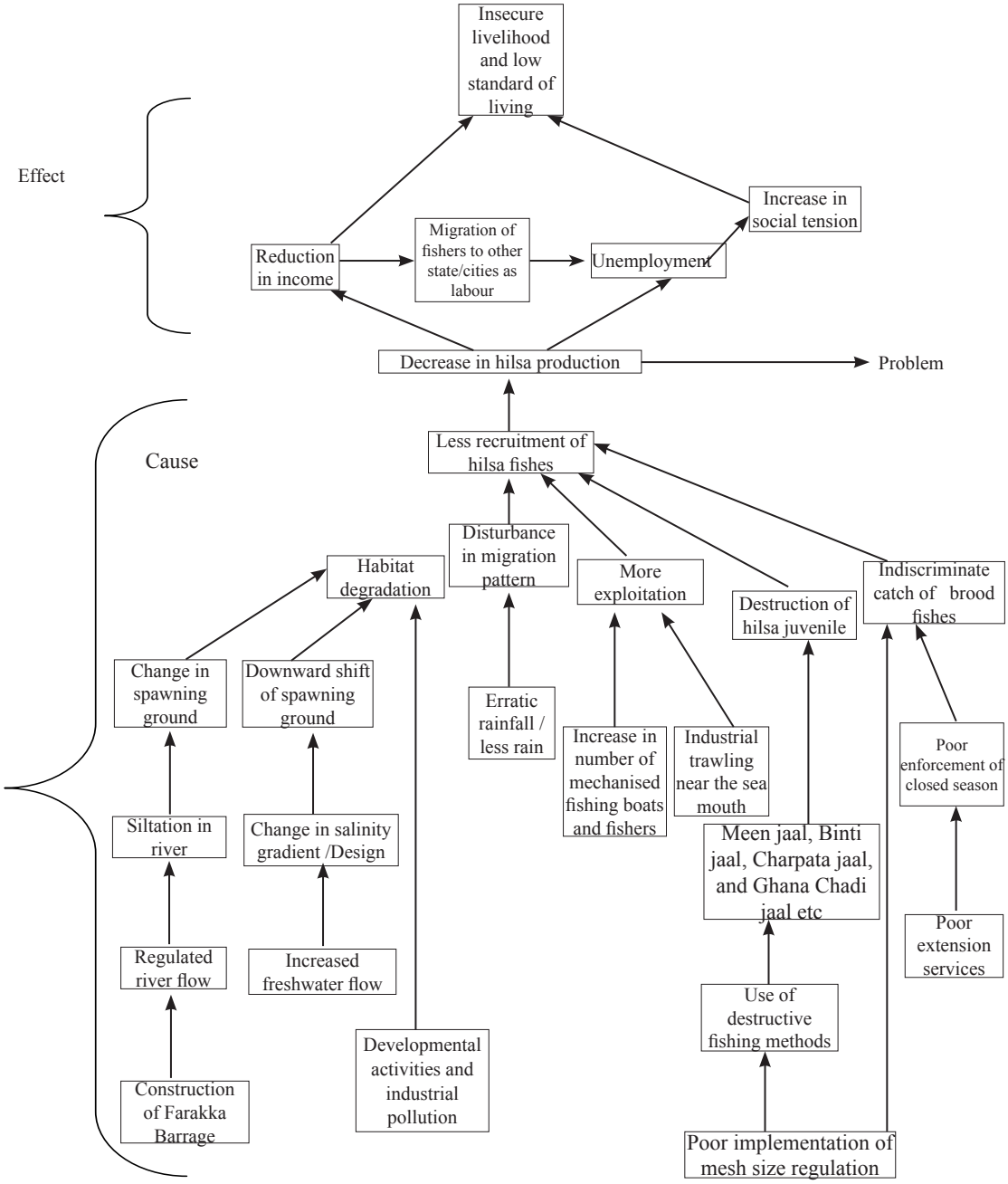

Fig. 2. Problem tree analysis

organisations need to join hands to support the hilsa fishers for sustainable hilsa fishery management through a win-win situation both for conservational as well as for sustainable fisheries.

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