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Fishing Practices in Sandha River: An Impact Assessment on Fisheries Resources

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Abstract

Sandha River is experienced with the use of different types of fishing gears to exploit its fisheries resources from time immoral. Therefore, the objectives of the present study were to explore fishing gears and identity their impact on fisheries resources from August 2015 to July 2016. During the study period, a total of 20 different types of fishing gears were observed under 7 major groups of gears of which gill net was the most productive and dominant gear followed by push net and fixed purse net. Higher mesh size (ranged from 0.4-11 cm) was observed for gill net with higher catch composition (0.5-7 kg/effort) and species specificity (52 fish species) while lower mesh size recorded for cast net (0.3-0.4 cm). In general, price of net and mesh size were found as a positive correlation with CPUE (Catch Per Unit Effort) (kg/effort) where r= 0.715 and 0.917, respectively. From the catch monitoring data, the total estimated catch from the Sandha River was 7801 kg. Further, according to Garretts Ranking Technique, fixed purse net was found as the most destructive gear followed by seine and gill net. Government as well as local authorities should pay more attention to keep up sustainable exploitation of Sandha River fisheries.

Keywords

Sandha River, Gears Impact, Mesh Size, CPUE, Sustainable Exploitation

1. Introduction

Bangladesh, on the northern coast of the Bay of Bengal, has the vast water resources in the name of river, floodplains, ponds, *beels*, *haors* and a long coastline. It is called a land of rivers as it has about 700 rivers [1] including tributaries with the total length is about 24,140 km [2]. In the life and living status of people especially for the fishermen of the country, water resources play an important role in terms of huge fisheries resources. A Bangla proverb says, "Mache Bhate Bangalee" which means, "A Bangalee thrives on fish and rice". This shows the importance of fish as a food and in eating habit of the Bangalee. So, fisheries sectors of Bangladesh have significant role in poverty alleviation, food security, nutrition supply, sources of income, employment opportunities, foreign exchange earnings and overall on the socio-economic development of Bangladesh [3]. This sector contributes 3.69% in GDP (Gross Domestic Product), 60% of the national animal protein intake and more than 11% people are associated in this sector for their livelihood [2]. So, fish and fisheries are marked as indispensable part in the life and livelihoods of the rural people of Bangladesh.

Among the 265 freshwater fish species [4], 54 indigenous fish become threatened within a very short period of time [5]. Overfishing, indiscriminate killing of fish larvae by different types of illegal fishing gears and damage eggs during PL collection, habitat loss and degradation, sedimentation, pollution and alterations to hydrology are some key factors for declining of inland riverine fisheries [6-16]. As a response, diversity of fish species is gradually decreasing with increasing excess fishing pressure over period.

Coastal rivers of Bangladesh are standing as valuable natural ecosystem [17] due to the presence of appropriate

natural feeding, spawning and nursery grounds for many commercially important fish species. Pirojpur, a coastal riverine district with huge fishery resources situated at the southern part of Bangladesh [18]. Among the several rivers of Pirojpur district, Sandha River is one of the important fish reserves that support diverse fishes compared to many other rivers in the coastal region [17]. Sandha River originates from the Meghna River near Muladi Upazilla with a total length of about 50 km and finally falls into the Bay of Bengal over through two coastal districts Barisal and Pirojpur. This river has great influence on the country's fisheries production and livelihood status of fishermen in the southern coastal region of Bangladesh. Different types of prohibited (banned by Govt.) fishing gears have been practiced by the fishermen in extreme level to catch fish in the Sandha River. Thus, production of fish as well as other fishery organisms in this river is now in fact at declining status as an alarming rate. There is no previous information regarding utilization of fishing gears and their impact on fisheries diversity in the Sandha River as well as most of the coastal rivers in Bangladesh. Further, measurement of fishing gears intensity towards declining of fisheries resources based on Garretts Ranking Technique is penurious. So, it is magnitude to record available fishing gears, catch composition by respective gears and their impacts assessment based on Garretts Ranking Technique on fish species of Sandha River, Bangladesh.

2. Materials and Methods

2.1. Study Area and Duration

The present research work was carried out in the Sandha River situated in the Swarupkati upazilla under Pirojpur district in the central coastal region of Bangladesh (Figure 1). Ten sampling stations were selected for this research work for a period of 12 months between August 2015 and July 2016 located between latitude 22°05′ to 22°35′ north and longitude 90°08′ to 90°14′ east.

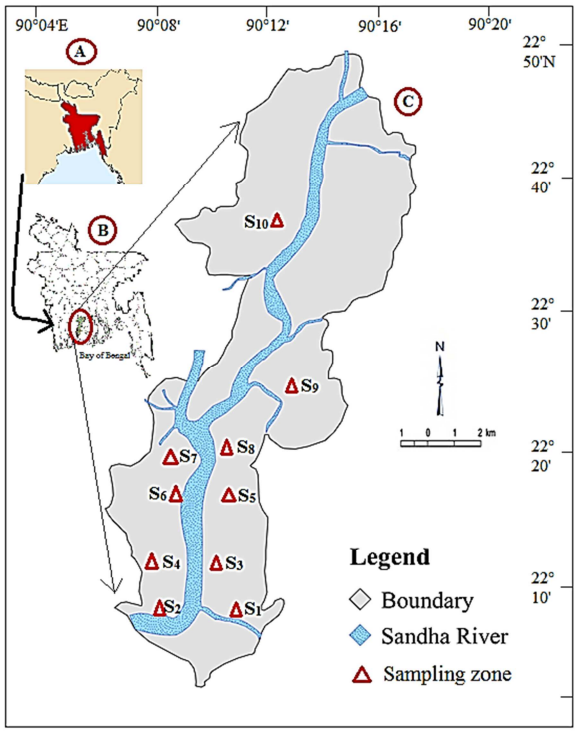

Figure 1. *Geographical location of study area; (A) Map of Bangladesh in the world, (B) Location of Pirojpur district in Bangladesh and (C) Map of Sandha River with ten sampling stations.*

2.2. Gears Survey

Surveys were undertaken on monthly basis using a gears survey form regarding types of fishing gears, gear operational system by the fishermen, catch composition, fish species caught by respective fishing gear etc. in the study area. Moreover, information on different types of gear, mesh size (Figure 2), price of net, total number of gears, fishing effort/day and CPUE (kg/effort) were collected during the study period. The available fishing gears were then categorized under different major groups according to Flowra (2011) [19].

Figure 2. *Measurement of mesh size of available fishing gears in the study area.*

2.3. Catch Monitoring Data

Catch monitoring data were collected on monthly basis from the fishermen during fishing time. Total daily catches by respective gears type were estimated from their average catch rates and then converted into monthly catch data using a model equation developed by de Graff and Chinh-

$$Yd = \sum_g \overline{CPUEg}.\overline{fg} \quad (1)$$

Where, *Yd*= Total daily catches for respective gear (g)

CPUEg= Daily mean catch per unit effort for respective gear

fg= Mean effort for respective gear day^{-1}

The daily catch per unit of effort (CPUE) was calculated as the total daily catch (Yg) divided by the sampled.

An open-ended interview schedule was applied to collect the data to measure the severity level of fishing gears. The ranks given by the respondents were then converted into percentage position with the help of following Garretts Ranking Technique.

$$\text{Percentage position} = \frac{100\times(Rij-0.5)}{Nj} \quad (2)$$

Where, Rij= Rank given to ith of gears by jth individual, Nj= Number of gears ranked by jth individual.

The percent position of each rank was then converted into scores referring to the table given by Garrett and Woodworth (1969) [20]. For each factor, the scores of individual respondents were added together and divided by the total number of the respondents for whom scores were added. These mean scores for all the gears were arranged in descending order and identified which gears were much destructive for fisheries community according to rank.

3. Results and Discussion

3.1. Fishing Gears

Fishermen of Bangladesh are familiar to use more than 100 different types of fishing gears belonging to nine categories [6]. Several types of net are designed to catch many species while some of these are used to catch specific species [21]. In the present study, a total of 20 different kinds of fishing gears were observed and these were categorized under 7 major groups of nets defined as gill net, push net, cast net, seine net, fixed purse net, traps and hook and line which mode of operation were detailed in literature [19, 22-25]. Among the 7 groups of net, gill net was the dominant gears followed by seine net and fixed purse net (Figure 3). Seine and gill net were also the dominant gears in Floodplain Rivers of Bangladesh [21]. Similar categorizes of fishing gears were also found from Andharmanik River [26], Jamuna River [27] and Paira River [28].

Gill net and push net were found as the most frequently used gears in Sandha River. Higher mesh size (ranged from 0.4-11 cm) was observed for gill net with higher catch composition (kg/effort/day) and species specificity (52 fish species) while lower mesh size recorded for cast net (0.3-0.4 cm) (Table 1). Thus, mesh size had positive correlation with CPUE (kg/effort) and species specificity where r= 0.715 and 0.778, respectively (Table 2). After gill net, seine net and fixed purse net were the most dominant groups which got higher price as well as CPUE (kg/effort) with minimum fishing effort. Further, cast net showed higher fishing effort per day with lower mesh size and CPUE (kg/effort) (Table 1). During the operation of cast net, it was took very short time and also covered a few space, thus, the study recorded very low CPUE rate.

Gill net had higher priced (ranged from 400-90000 BDT) compare to other major groups of net followed by seine net and fixed purse net. Cast net was observed with maximum fishing effort/day (30-80 times) with lower CPUE rate. As the result, fishing effort/day showed insignificant negative relation with CPUE rate with r value -0.480. In terms of catch, gill net was the most productive and dominant gear followed by push net and fixed purse net (Table 1 and Figure 3). In general, price of net and mesh size had a significant positive correlation with CPUE (kg/effort) and species specificity (Table 2). Mia *et al.* (2015) [29] reported that selection of nets and mesh sizes were varied depending on choice, capital and abundance of fish. Recorded mesh size and price of respective gears from Meghna River estuary were much similar findings in comparison to the present study [23].

Table 1. *Different types of fishing gears with their mesh size, price and catch composition of respective gears recorded from Sandha River during study period.*

Group name of gears	Mesh size (Cm)	Price ranged (BDT)	Fishing effort/day	CPUE (kg/effort)	Catch/day (kg/day)	Species specificity
Gill net	0.4-11	400-90000	1-3	0.5-7	0.5-21	52
Push net	0.4-1.0	200-24000	20-50	0.02- 0.05	0.4-2.5	16
Cast net	0.3-0.4	2000-5000	30-80	0.00-0.03	0-2.4	10
Seine net	0.4	29000-49000	1-2	1-7	1-14	8
Fixed purse net	0.4	10000-25000	1-3	0.5-5	0.5-15	41
Traps	-	60-120	2-5	0-0.04	0-2	9
Hook and line	-	15-100	1-20	0-0.6	0-1.2	7

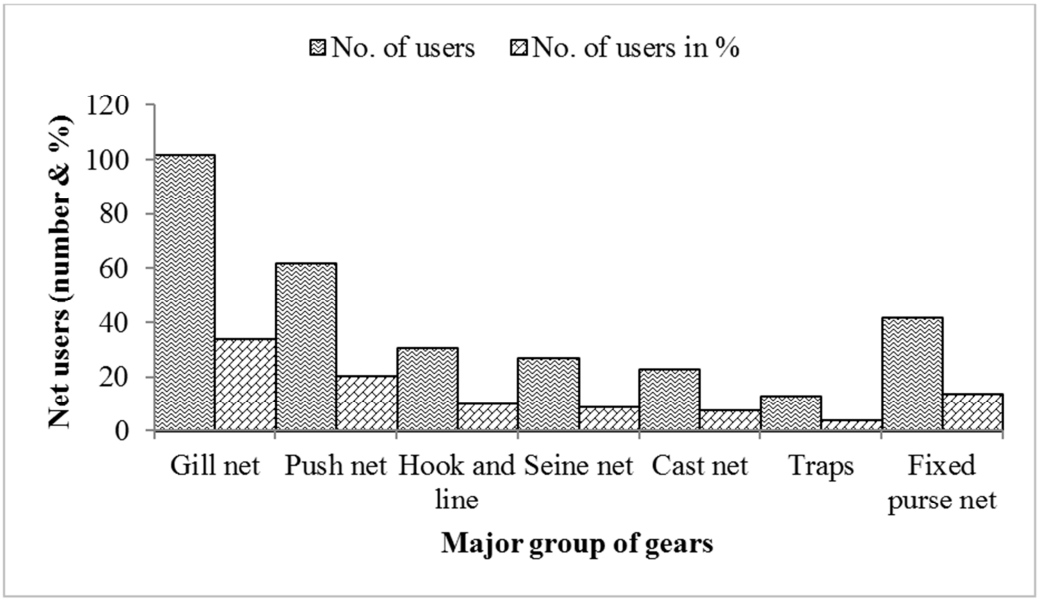

Figure 3. *Fishing gears used in the Sandha River.*

Table 2. *Pearson correlation co-efficient among mesh size, price, fishing effort, CPUE and species specificity of fishing gears.*

	Mesh size (Cm)	Price (BDT)	Fishing effort/day	CPUE (kg/effort)	Species specificity
Mesh size (Cm)	1	.813*	-.227	.715	.778*
Price (BDT)	.813*	1	-.423	.917**	.637
Fishing effort/day	-.227	-.423	1	-.480	-.291
CPUE (kg/effort)	.715	.917**	-.480	1	.808*
Species specificity	.778*	.637	-.291	.808*	1
*. Correlation is significant at the 0.05 level (2-tailed).					
**. Correlation is significant at the 0.01 level (2-tailed).					

3.2. Fishing Yield

Table 3 represents monthly estimated weight of fish in kg caught with different types of gears from the Sandha River during the study period. From the results, the total estimated catch from the Sandha River was 7801 kg recorded during the study period. Based on gears, total estimated weight of fish caught by gill net, push net, cast net, seine net, fixed purse net, traps and hook and line were 3693, 17, 1252, 786, 1540, 108 and 405kg, respectively. From all gears, the highest catch (1067 kg) was recorded in August 2015 and lowest (292 kg) was in May 2016. In terms of weight of harvested fish in kg, August 2015 was the most productive month followed by September, November and October (Table 3).

Table 3. *Monthly estimated weight (kg) of fish caught with different types of gears from the Sandha River during the study period.*

Group name of gears	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Total
Gill net	543	432	354	434	205	322	206	270	543	102	204	78	3693
Push net	5	0.7	1	1.2	0.6	0.5	2	0	0	1	2	3	17
Cast net	122	210	119	229	189	48	67	69	102	23	54	20	1252
Seine net	66	109	128	98	77	24	31	18	54	31	83	67	786
Fixed purse net	298	186	211	76	65	110	98	77	218	93	19	89	1540
Traps	6	13	17	15	19	9	0	13	7	3	6	0	108
Hook and line	19	67	65	52	42	13	11	24	33	34	5	40	405
Total	1067	1026.7	905	916.2	609.6	526.5	417	474	961	292	379	304	7801

3.3. Seasonal Catch Composition of Fish Species in Sandha River

During the study period, year was divided into three seasons: Summer season (March-June), monsoon season (July-October) and winter season (November-February). The highest number of fishes (48 species) was recorded in monsoon season followed by 41 species in winter season. The lowest number of fishes (36 species) was recorded in summer season from the study area (Table 4).

Table 4. *Seasonal catch composition of fish species recorded from the Sandha River.*

Season	Summer	Monsoon	Winter
Month	Mar to Jun	Jul to Oct	Nov to Feb
No. of species caught	36	48	41

3.4. Severity of Fishing Gears

Garretts Ranking Technique was applied to measure the severity of gears towards the declining of fisheries resources of Sandha River during the study period (Table 5). Fixed purse net especially *Badha* and *Char jal* caused massive destruction of small indigenous fish as well as larger size species of Sandha River and thus the gear group got first ranked with mean score 55.65 according to participants. Following fixed purse net, seine net (*ber jal*) was also responsible for indiscriminating killing of all size fish including fry and brood fish. As a result, the net received second position with mean value 54.39. Gill net especially *current jal* with third ranked (mean score 52.71) was responsible for large scale fishery caught ranged from small to large size fish. Push net was accountable for a significant reduction of PL of several species and thus, it was acknowledged as fourth position with mean value 51.80. Other major group of nets named as cast net, traps and hook and line had the mean score 48.10, 46.12 and 34.41 with ranked V, VI and VII, respectively.

Table 5. *Severity of fishing gears towards the declining of fish species abundance of Sandha River.*

Severity of fishing gears towards the declining of fish species	Rank given by respondents							Total no. of respondents	Total score	Mean score	Rank
	1st	2nd	3rd	4th	5th	6th	7th				
Fixed purse net	58	53	49	50	34	33	23	300	16695	55.65	I
Seine net	61	47	48	38	30	36	40	300	16318	54.39	II
Gill net	53	50	39	42	43	35	38	300	15813	52.71	III
Push net	64	56	29	74	37	23	17	300	15539	51.80	IV
Cast net	40	34	43	61	32	23	67	300	14431	48.10	V
Traps	0	13	0	38	57	80	112	300	13837	46.12	VI
Hook and line	44	31	36	62	12	17	98	300	10323	34.41	VII

Based on month, the highest estimated weight of fish in kg caught with different types of gears was found in August which followed by September 2015. Further, May, June and July was observed with low fishing yield compare to other fishing months. Ahmed (2008) [21], Sayeed *et al.* (2014) [30] and Sultana and Islam (2016) [31] estimated weight (kg) of fish caught with different types of gears which were much higher than the present study. Siddiq *et al.* (2013) [32] also observed 85 species of fishes in the monsoon period which much higher than present findings. In comparison of secondary data, present findings showed lower fish species both in number and CPUE rate. The lower CPUE for all fishing gears varied widely because the CPUE was not affected by environmental factors [17], but due to excess fishing pressure by prohibited fishing gears. Lower estimation of CPUE and species could be described on the basis of Garretts Ranking Technique. According to Garretts Ranking Technique, fixed purse net (*Badha* and *Char jal*) with very small mesh size was placed in river side or narrow channels (originated from the same river) during neap tide and after high tide, the net pulled out with bulk catches ranging from small to large size fish. Thus, the net group, therefore, was marked as the most detrimental for aquatic resources especially for larvae and brood fish. Followed by fixed purse net, another destructive gear was *Ber jal* under the seine net group. Due to lower selectivity of mesh size, the net had significant function to capture all types of fish species including larvae and brood fish. Further, gill net especially *current jal* was a threatened gear to the aquatic biota which observed during the present study period. In line with fisher's community, 'Gill net, a monofilament small mesh size net designed in such a way which facilitated to detain all fish species including spawn fish to a great extent'. Thus, the net could significantly reduce fish species in the Sandha River. Similar observation was also reported from Kajal River of Southern Bangladesh [15]. Push net especially *Moia jal* was mostly used to collect fry, fingerlings and PL of several species but mostly shrimp. Mia *et al.* (2015) [29] reported that the push net was found to be quite effective in catching fish of small to medium size of different species. During PL collection of shrimp, several larvae of other fish species were also caught which left as trash fish in death status. In addition, the net was hauling on the river bed which causes siltation problems and reduces water quality as well as disturbing bottom preferring fish species. Thus, the net had significant contribution towards the reduction of SIS species of Sandha River. Hook and line, cast net and traps had lower intensity towards the declining of fish stock of Sandha River. So, they were not destructive and could be allowed to operate throughout the year. In general, fixed purse net, seine net, gill net and push net were found as dominant fishing gears which cause much destruction of fish species to a large extent. But, other fishing gears (hook and line, cast net and traps) were not destructive for fisheries community. The findings were supported by Rahman *et al.* (2016) [15] and Rahman *et al.* (1999) [33].

4. Conclusion

The preliminary study was identified lower fish species and CPUE rate due to excess fishing practices by illegal fishing gears. Without maintaining government rules and

fishing ban period, fishing had been practices in Sandha River to harvest aquatic biota. But, uses of restricted fishing gears especially gill net were found as detrimental to fisheries community. If the present trend of fishing practices continued without proper management and control measures, then the valuable aquatic resources of Sandha River would be empty soon. Government as well as local authorities should pay more attention to maintain sustainable exploitation of Sandha River fisheries.

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