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Analysis of 'Kums' depth: Impacts on the natural carp spawning habitat of the Halda River of Bangladesh

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Abstract

The Halda River, one of the major natural spawning areas for Indian Major Carps (IMCs), is in danger due to some infrastructure development. This research identified 22 biologically important deeper areas or Kums (locally called) of the river that harbours more fish than other areas. The study was initially started in 2019, and with the follow-up study in 2022 and 2023, the reduction in 17 and 18 Kum's depth was determined respectively. The study also found a significant reduction in fish numbers at a 5% level of significance, stating that, if the depth of Kum decreases by 1 meter, about 3 fish will be lost per 10000 m^2. The reduction of Kum's depth most affects fish between 85 and 100 cm long. The study identified 8 significant reasons for the destruction of Kums, among which geobags and cemented blocks were the deadliest ones.

Keywords: Halda River, Kum, Fish, Depth, Chittagong, Bangladesh.

Introduction

Halda, the Bangabandhu Fisheries Heritage is the only national fishery heritage of Bangladesh and the only tidal river from which fertilized eggs of IMCs, viz., *Labeo rohita*, *Catla catla*, *Cirrhinus cirrhosus* and, *Labeo calbasu* are collected[10, 11, 14, 16]. Before merging with the Karnaphuli River, this 98-kilometre-long river originates from the hill springs of Chittagong and flows in a spiral through Manikchari, Fatikchari, Raozan, and Hathajari upazilas[4, 7, 9]. This meandering river has created some important oxbow bends along its journey[1, 16]. Those bends in the tidal river have created some deeper points as a result of the circulation of water. There are deeper pits around these bands and at some other places, which are known as Kums in the local language, which are more biologically diverse than other parts of the river.

About 53 species of finfish are found in Halda[4]. It is also home to the globally endangered dolphin, *Platanista gangetica*[12]. Besides being rich in biodiversity, the Halda River also offers a unique variation - a collection of fertilized eggs of IMCs directly from the river. By producing fry from these eggs, the natural fry demands of carp are met across the country to a great extent. Approximately 60% of the nation's pond carp are cultured from the fish fry that naturally occurs in the river[8]. Fishing, fish fry, irrigation, drinking water, water transportation, and sand extraction from this river generate 5.9, 0.42, 1332.6, 112.3, 10.1, and 211.96 million BDT annually, respectively[8]. Halda River contributes 29.50 million BDT if the indirect value of this river is calculated, and 31.46 million BDT in case of non-use value[8].

As a result, the preservation of the natural infrastructure of this river is very important. But various unplanned infrastructural developments such as sluice gates, rubber dams, and cutting of oxbow band, and also due to some illegal activities such as immense sand quarrying, have destroyed the river significantly[6]. Several recent developments have increased sedimentation on the river bed, such as riverbank protection using cement concrete (CC) blocks and geobags without considering the environmental impact. As a result, biologically important 'Kums' (deeper areas) of this river have been remarkably destroyed in recent years.

This study aimed to identify the Kums (deeper area of the river) with location, determine the biological importance of Kums, identify what types of artificial intervention are responsible for Kum's depth change, find out the damage those places have suffered as a result of unplanned development, and evaluate the effects of that artificial intervention on the fish population. At the same time, some recommendations have been made to preserve these important areas and to address those problems. This research will make an important guideline for the future infrastructure development of the river Halda.

Materials and Method

Study Area

The study area of this research was that stretch of the River Halda where most fish populations are found. At the beginning of this research in February 2019, data were collected regarding the identification of biologically important deeper areas of this river using FGD (Focus Group Discussion) tools at seven important sites (Chayar Chor, Madhuna Ghat, Barua Para, Ramdas Munsir Hat, Azimer Ghat, Gardwara, and Sattar Ghat) at Raozan and Hathazari upazilas. Initially, all the spots and their approximate locations were identified based on statements from FGD. As local egg collectors are the people who collect eggs from this river, it is supposed that they have a better idea about the location and names of the kums and they were asked to give their opinions in this regard. By analyzing those data, a 35-km area of Halda's downstream region from Peshkarhat to Karnaphuli- Halda Confluence has been selected as the study area.

Duration

Data have been collected over three different periods. Initial data on river depths and fish numbers per area were collected in February 2019. Follow-up studies were carried out in February 2022 and February 2023. This survey was conducted in February because during this time the fish population got matured before spawning in the months between April and May. There are no seasonal differences found in this area.

Identification of Kums (biologically important deeper areas)

Investigations have been started from Non-Kum A (22°35′2.36″N, 91°49′15.03″E) of the Halda River with a speedboat at 1.3 Km/h speed. Since it is a tidal river, the depth of the river varies with tides and ebbs. Data were collected in two different ways to overcome that problem. First, Echo Sounder (KODEN Echo Sounder CVS 120) was used to determine the deeper points from the surface to the bottom of the river. The transducer of the Echo Sounder can determine the distance to the last obstacle by considering the reflection of acoustic energy. The transducer was set at a 90-degree angle to the surface of the river and started monitoring the river depth without any deviation. Whenever any kind of sudden depressions are observed in the river bed on the screen, the places were observed deeply and the deepest points around those places were identified. Generally, the river depth is higher during tides and lower during ebbs. An inch tap was used to measure the area from the highest point of the bank where water touches during high tide to the top of the transducer to avoid any mechanical error. Then, the actual deepest point of the determined deeper areas of the river was calculated by combining these two distances. Garmin Map 64s GPS (Global Positioning System) was used to locate locations of the identified areas.

Determination of changes in fish number per Kum area

Fish number/ 10,000 m^2 area from both identified deeper and randomly selected shallower sites was recorded in 2019, 2022, and 2023 to determine changes in fish data using the acoustic method[2, 5, 17]. Echo Sounder (KODEN Echo Sounder CVS 120) was used to measure the quantity of fish in confined areas. The acoustic energy pulse emitted from the Echo Sounder returns if it detects any obstacles in its way, like fish, and was detected by the Transducer TD-500T-3B (dual frequency combination type 50/ 200 kHz) and the lengths of the fish were displayed on a 5.7 inch LCD screen. The sizes of the fish were measured by keeping an eye on the data that was noticeable on the device's screen. Fish were tallied by zigzagging the boat around the entire Kum site for 5-10 minutes (depending on the size of the Kum). To know the impact of depth changes of kums in per area fish number, a regression model of fish reduction on a depth reduction was run.

Determination of causes of changes in Kum areas

By analyzing data from 2019, 2022, and 2023, changes in the deepest locations were determined. 66 egg collectors (from 66 families) out of around 600 egg collectors[10] were interviewed randomly to identify the reasons behind these changes. As the egg collectors are the local people and each year collect eggs from the River Halda, they know the location of each Kum and have information about the reasons for changes in Kum areas. As a result, possible causes of change were identified. Some other possible reasons were identified by observing the whole area from Manikchari in the upstream region of Halda to the Karnaphuli- Halda Confluence in the downstream region.

Results and Discussion

22 Kums were identified in 2019, 2022, and 2023, and a total of 22 non-Kum areas were selected randomly in parallel to Kum areas (Figure 1 and Table 1). By observing the data collected, it is found that the mean number of fish of Kum (30.47) and non-Kum (1.25) differ significantly at a 5% level of significance. Out of 22 Kums, 17 and 18 Kums had their depth lowered in 2022 and 2023, respectively, over the period starting in 2019 (Graph 1 and Table 2). It is evident that these 18 places had artificial impediments installed, such as cement concrete (CC) blocks and geobags. Among all, Kum J, Kum O, Kum Q, Kum R, and Kum T, were mostly affected. Again, Kum B, Kum H, Kum L, Kum M, and Kum V, showed no reduction rather than an increase in depth in 2022. But again, depth reduction is observed in Kum B in 2023.

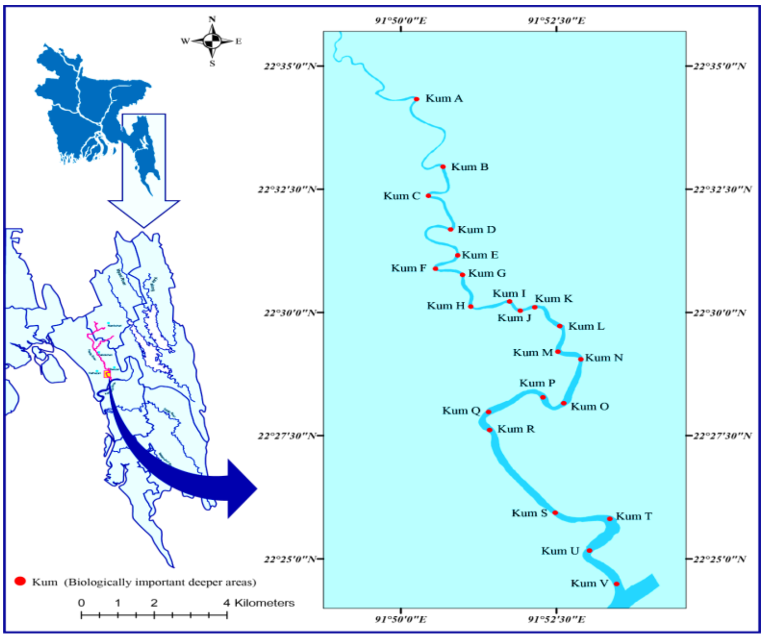


Figure 1: Map of Halda River

Table 1: Identified Kum and Selected Non-Kum areas of Halda River

NO.	Name of the Kum	Fish number/ 10000 m^2 in 2019	Fish number/ 10000 m^2 in 2022	Fish number/ 10000 m^2 in 2023	Survey area (m^2)	Coordinate
1	Non-Kum A	1.5	2	1	20000	22°35'2.36"N 91°49'15.03"E
	Kum A (Peshkar Hat Kum)	30	25.455	39.091	11000	22°34'19.74"N 91°50'15.15"E
2	Non-Kum B	3	1	1	20000	22°33'38.79"N 91°50'42.39"E
	Kum B (Terpalir Khal)	99.138	101.72	132.76	11600	22°32'57.28"N 91°50'40.63"E
3	Non-Kum C	2.5	2	2	20000	22°32'34.30"N 91°50'46.05"E
	Kum C (Alamer Kum)	77.622	68.531	30.769	14300	22°32'21.89"N 91°50'26.67"E
4	Non-Kum D	1.5	1	1.5	20000	22°32'2.05"N 91°50'45.04"E
	Kum D (Onnopurna Kum)	50.215	62.232	31.33	23300	22°31'40.88"N 91°50'48.00"E
5	Non-Kum E	0.5	1	1	20000	22°31'24.78"N 91°50'34.65"E
	Kum E (Sattar Khal Kum)	30.357	27.143	20.714	28000	22°31'9.62"N 91°50'54.68"E
6	Non-Kum F	1	1.5	2	20000	22°31'0.58"N 91°50'45.54"E
	Kum F (Boalia Khal Kum)	47.471	35.798	15.953	25700	22°30'53.27"N 91°50'33.32"E
7	Non-Kum G	0.5	1	1.5	20000	22°30'50.60"N 91°50'46.51"E
	Kum G (Mogashastri Bakh Kum)	16.923	34.359	12.308	19500	22°30'45.71"N 91°50'59.41"E
8	Non-Kum H	0.5	0	1	20000	22°30'25.83"N 91°51'5.90"E
	Kum H (Ankuri Ghona Kum)	10.922	25.939	20.137	29300	22°30'6.91"N 91°51'7.34"E
9	Non-Kum I	2	0	1	20000	22°30'7.28"N 91°51'26.14"E
	Kum I (Keramtolir Bak Kum)	45.031	15.528	41.304	32200	22°30'13.25"N 91°51'44.72"E
10	Non-Kum J	1	2	1	20000	22°30'5.97"N 91°51'49.61"E
	Kum J (Noyahat Kum)	32.588	18.53	6.0703	31300	22°30'2.17"N 91°51'55.07"E
11	Non-Kum K	1	1	0.5	20000	22°30'4.13"N 91°52'1.63"E
	Kum K (Shipahir Ghat Kum)	27.578	8.8729	26.859	41700	22°30'6.15"N 91°52'8.98"E
12	Non-Kum L	0	1	0.5	20000	22°29'55.26"N 91°52'21.73"E
	Kum L (Kagotia Kum)	14.173	16.339	5.1181	50800	22°29'43.28"N 91°52'33.20"E
13	Non-Kum M	1.5	2	2	20000	22°29'28.60"N 91°52'35.98"E
	Kum M (Pora Khopali Kum)	18.704	17.593	12.407	54000	22°29'12.28"N 91°52'31.33"E
14	Non-Kum N	1	1.5	2	20000	22°29'8.94"N 91°52'44.41"E
	Kum N (Ajimer Ghat Kum)	20.131	17.505	8.3151	45700	22°29'3.14"N 91°52'53.46"E
15	Non-Kum O	2	2	1	20000	22°28'38.68"N 91°52'48.76"E
	Kum O (Napiter Ghat Kum)	38.93	23.616	33.21	54200	22°28'9.31"N 91°52'36.99"E
16	Non-Kum P	3	2	2	20000	22°28'3.49"N 91°52'26.15"E
	Kum P (Amtua Kum)	32.842	46.834	29.013	67900	22°28'16.49"N 91°52'17.03"E
17	Non-Kum Q	2	1.5	2	20000	22°28'16.35"N 91°51'51.94"E
	Kum Q (Hore Krishna Mohajon Ghat Kum)	13.073	11.317	7.4146	10250	22°27'58.67"N 91°51'24.48"E
18	Non-Kum R	1	1	0.5	20000	22°27'47.24"N 91°51'17.90"E
	Kum R (Ramdas Munshir Hat Kum)	25.759	21.821	5.9885	121900	22°27'36.89"N 91°51'25.58"E
19	Non-Kum S	0.5	1	0.5	20000	22°26'44.26"N 91°51'47.90"E
	Kum S (Khondokia Kum)	14.68	16.06	2.6976	159400	22°25'56.21"N 91°52'28.76"E
20	Non-Kum T	1	0.5	1	20000	22°25'47.84"N 91°52'52.38"E
	Kum T (Chayar Chor Kum)	16.086	15.657	12.286	350000	22°25'48.74"N 91°53'21.34"E
21	Non-Kum U	0.5	0	0	20000	22°25'26.99"N 91°53'19.72"E
	Kum U (Kalakarhat Kum)	3.7224	4.9842	4.0379	158500	22°25'9.89"N 91°53'1.82"E
22	Non-Kum V	0	0.5	1	20000	22°24'50.53"N 91°53'12.85"E
	Kum V (Karnaphuli- Halda Confluence Kum)	4.4444	5.8025	5.5556	162000	22°24'29.28"N 91°53'27.88"E

Only 9 and 5 of the 22 Kums exhibited no fish reduction from 2019 to 2022 and 2023, respectively. Kums that showed a fish reduction in 2022 include Kum A, Kum C, Kum E, Kum F, Kum I, Kum J, Kum K, Kum M, Kum N, Kum O, Kum Q, Kum R, and Kum T. Again, Kum D, Kum G, Kum L, Kum P, and Kum S showed additionally fish reduction in 2023. It is evident that (Table 2), areas being under more human pressure and human interventions such as geobags and cement concrete (CC) block dumping, wastage dumping reduced the depth of the Kum area and as a result, the fish number was reduced in those areas. Though, fish is increased in Kum A in 2023 (Table 2).

To extract the dependency of per area fish number on depth, a regression model of fish reduction on depth reduction in the period of 2019 to 2022 and 2019 to 2023 was run. The dependent variable, 'Fish Reduction' is calculated by subtracting the amount of total fish present on different Kums in survey time in 2022 and 2023 from 2019. The independent variable, 'Depth Reduction' is calculated in the same way.

$Y = \alpha + \beta X + e$ ……………..(i)

Where, Y = Fish Reduction

X = Depth Reduction

α = Intercept

β = Regression Coefficient

e = error term

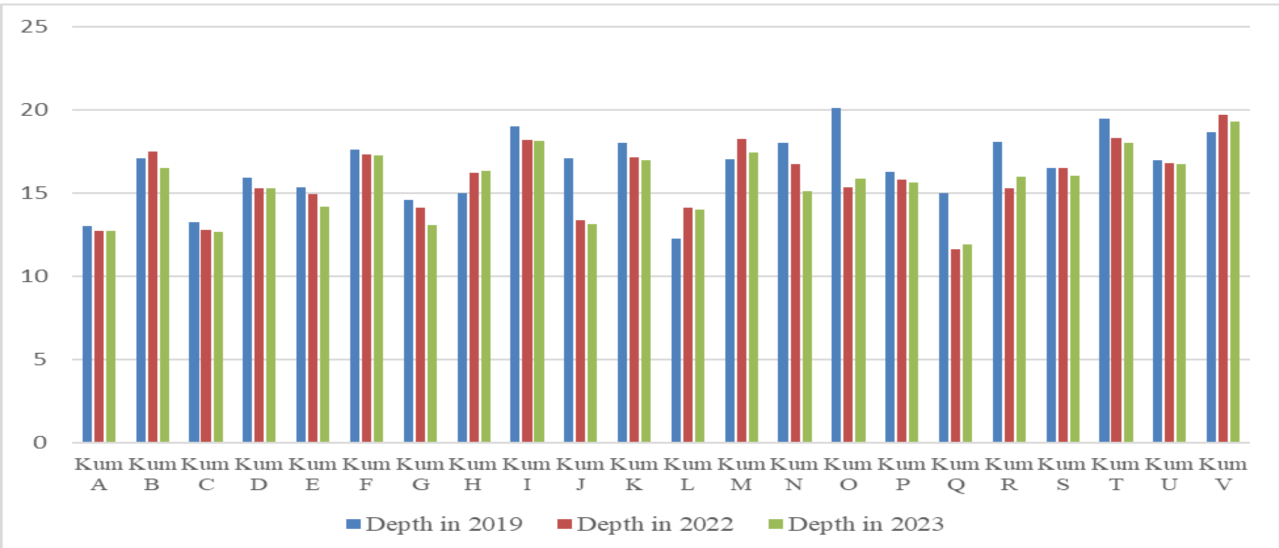
The scatter plot showed that there is a positive correlation between depth reduction and the amount of fish reduction (Graph 2).

The estimated model becomes,

$$y = 2.54236 + 2.70467\ x$$

The ANOVA table (Table 3) indicates that the regression coefficient 2.70467 is significant at a 5% level of significance and it implies that if the depth of Kum is decreased by about one meter, then on average about 3 fish/ 10000 m^2 is decreased from that Kum and vice versa.

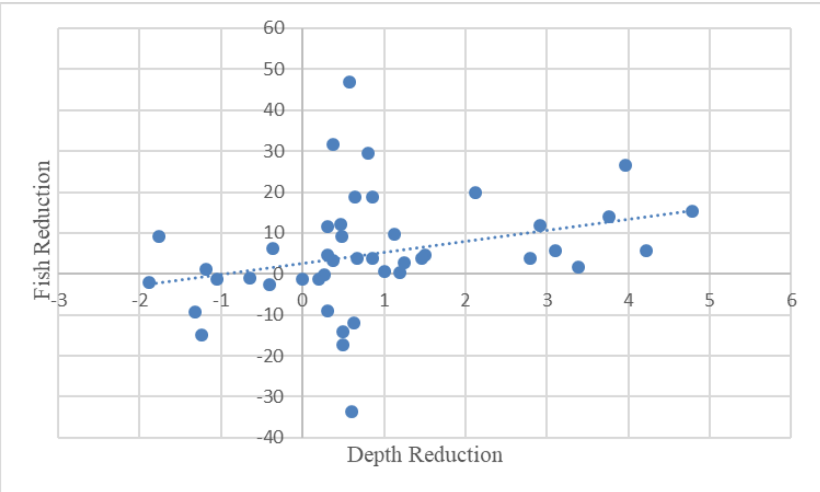
Fish length data from the size 10 cm to 96 cm were recorded in 2019, 2022, and 2023 with the help of Echo Sounder. Later, those data were organized into 6 categories, viz., Category A (10- 25 cm), Category B (26- 40 cm), Category C (41- 55 cm), Category D (56- 70 cm), Category E (71- 85 cm), and Category F (86- 100 cm). The correlation table and scattered plots (Table 4, Graph 3- 14) indicate that depth reduction has a positive correlation with the reduction of the number of fish of different sizes. Especially the sizes of types C, D, E, and F have a significant correlation with depth. Large fish are now in danger of losing their habitat since the depth of the several Kums in the Halda River is diminishing at an alarming rate.



Graph 1: Depths of Kums in 2019, 2022 and 2023

Table 2: Changes in depth and fish number over the period from 2019 to 2022 and 2023

Name of the Kum	Depth Changes in 2022 Compared to 2019 (m)		Depth Changes in 2023 Compared to 2019 (m)		Fish Changes in 2022 Compared to 2019 (Number/ 10000 m^2)		Fish Changes in 2023 Compared to 2019 (Number/ 10000 m^2)	
	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase
Kum A	0.30	-	0.30	-	4.545	-	-	9.091
Kum B	-	0.40	0.60	-	-	2.582	-	33.622
Kum C	0.48	-	0.58	-	9.091	-	46.853	-
Kum D	0.63	-	0.64	-	-	12.017	18.885	-
Kum E	0.38	-	1.13	-	3.214	-	9.643	-
Kum F	0.30	-	0.37	-	11.673	-	31.518	-
Kum G	0.50	-	1.50	-	-	17.436	4.615	-
Kum H	-	1.24	-	1.32	-	15.017	-	9.215
Kum I	0.81	-	0.86	-	29.503	-	3.727	-
Kum J	3.76	-	3.96	-	14.058	-	26.5177	-
Kum K	0.86	-	1.00	-	18.7051	-	0.719	-
Kum L	-	1.88	-	1.77	-	2.166	9.0549	-
Kum M	-	1.18	-	0.37	1.111	-	6.297	-
Kum N	1.25	-	2.91	-	2.626	-	11.8159	-
Kum O	4.78	-	4.22	-	15.314	-	5.72	-
Kum P	0.49	-	0.67	-	-	13.992	3.829	-
Kum Q	3.38	-	3.10	-	1.756	-	5.6584	-
Kum R	2.80	-	2.12	-	3.938	-	19.7705	-
Kum S	-	-	0.47	-	-	1.38	11.9824	-
Kum T	1.20	-	1.47	-	0.429	-	3.80	-
Kum U	0.20	-	0.27	-	-	1.2618	-	0.3155
Kum V	-	1.05	-	0.65	-	1.3581	-	1.1112



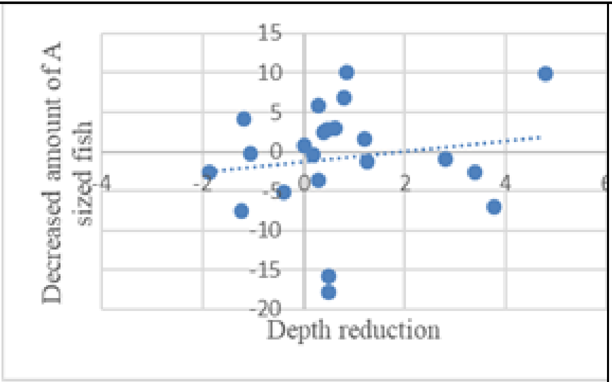
Graph 2: Scatter plot showing fish reduction in relation to depth reduction

Table 3: ANOVA table

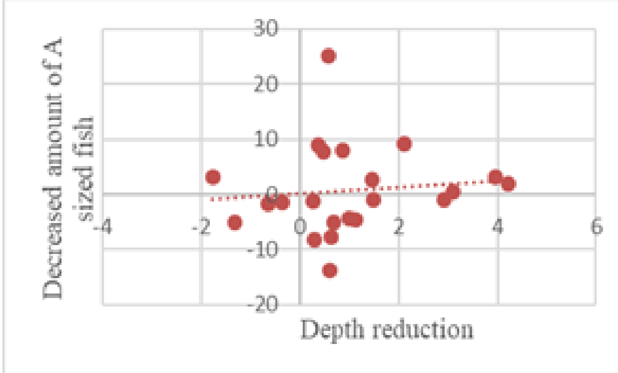
Source of Variation	Degree of Freedom	Sum of Squares	Mean Sum of Squares	F	Significance F
Regression	1	784.8693	784.8693		
Residual	42	7538.342	179.4843	4.372912	0.042602
Total	43	8323.211			

Table 4: Correlation between sizes of fishes and depth reduction over the periods

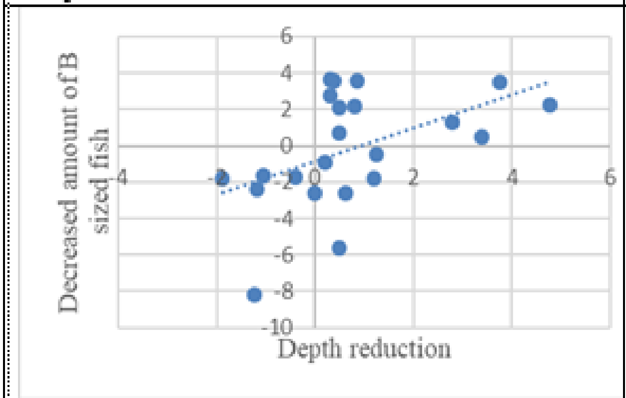
Size of fish	Per area fish number in relation to depth Changes in 2022 compared to 2019	Per area fish number in relation to depth Changes in 2023 compared to 2019
A	0.151358	0.11173
B	0.484151	0.084384
C	0.210671	0.187232
D	0.257671	0.280146
E	0.177054	0.263037
F	0.332866	0.375735



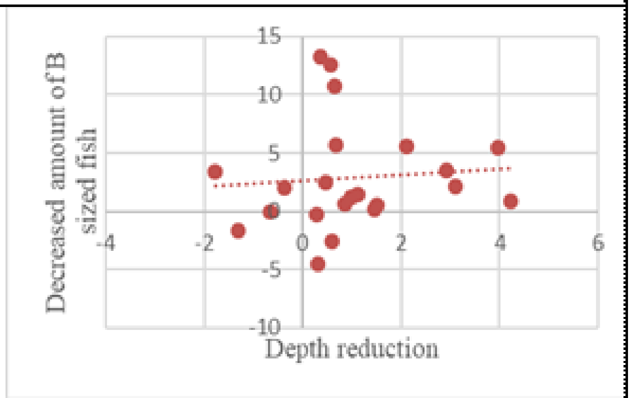
Graph 3: Scatter plot between depth reduction (m) and decreased amount of A sized fish in 2022 compared to 2019.



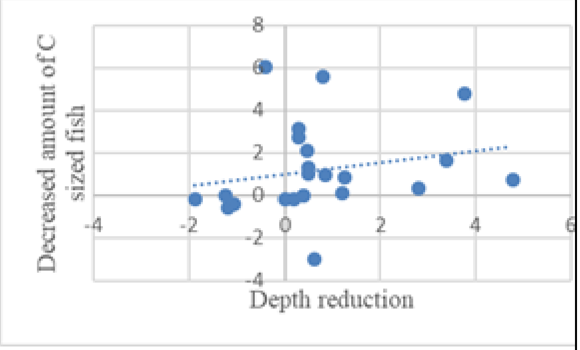
Graph 4: Scatter plot between depth reduction (m) and decreased amount of A sized fish in 2023 compared to 2019.



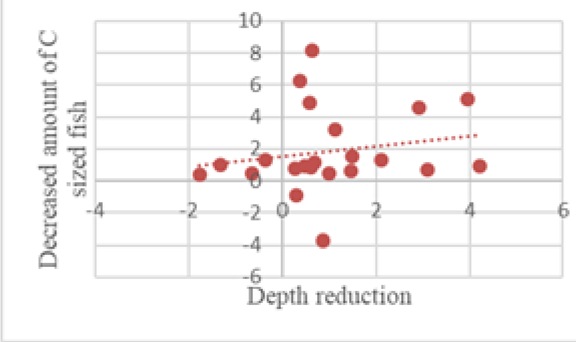
Graph 5: Scatter plot between depth reduction (m) and decreased amount of B sized fish in 2022 compared to 2019.



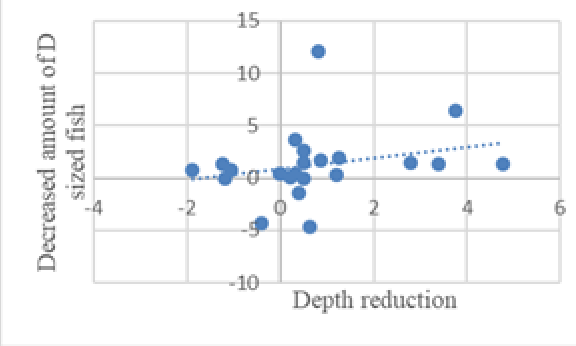
Graph 6: Scatter plot between depth reduction (m) and decreased amount of B sized fish in 2023 compared to 2019.



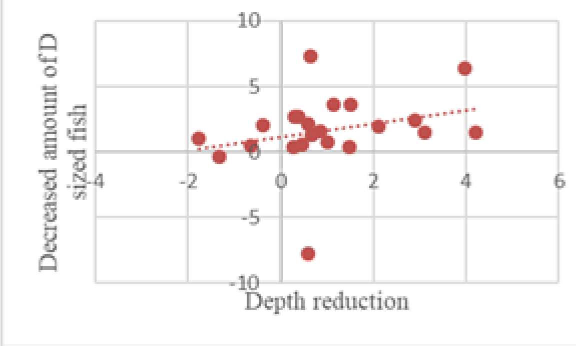
Graph 7: Scatter plot between depth reduction (m) and decreased amount of C sized fish in 2022 compared to 2019.



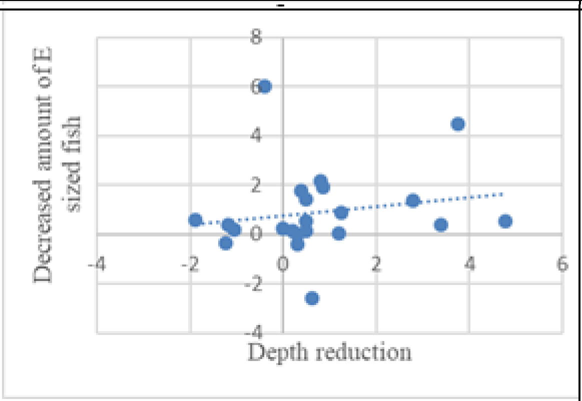
Graph 8: Scatter plot between depth reduction (m) and decreased amount of C sized fish in 2023 compared to 2019.



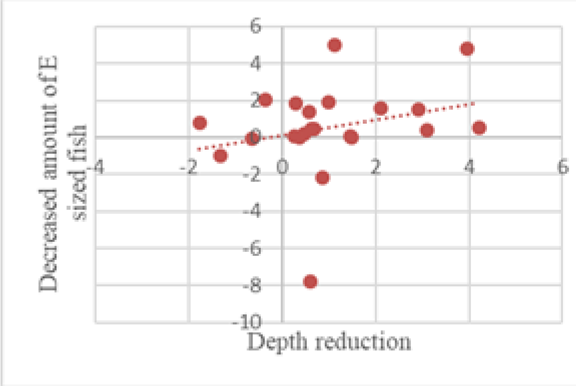
Graph 9: Scatter plot between depth reduction (m) and decreased amount of D sized fish in 2022 compared to 2019.



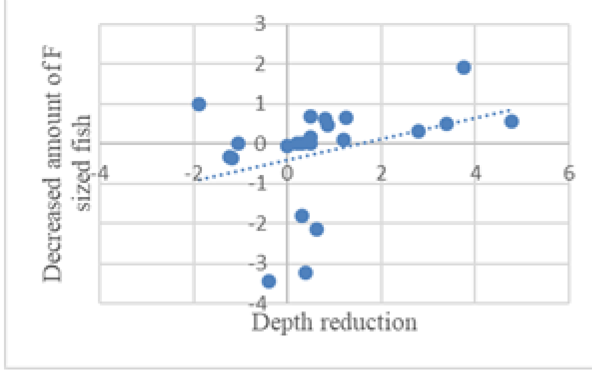
Graph 10: Scatter plot between depth reduction (m) and decreased amount of D sized fish in 2023 compared to 2019.



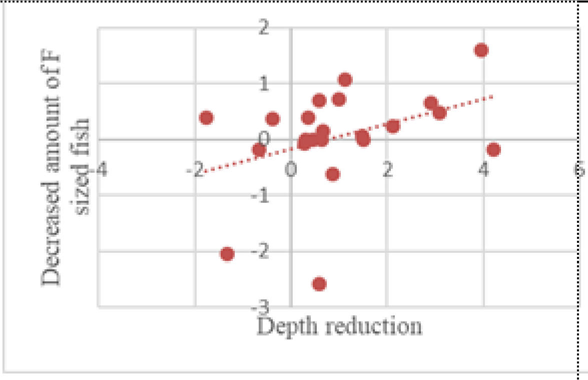
Graph 11: Scatter plot between depth reduction (m) and decreased amount of E sized fish in 2022 compared to 2019.



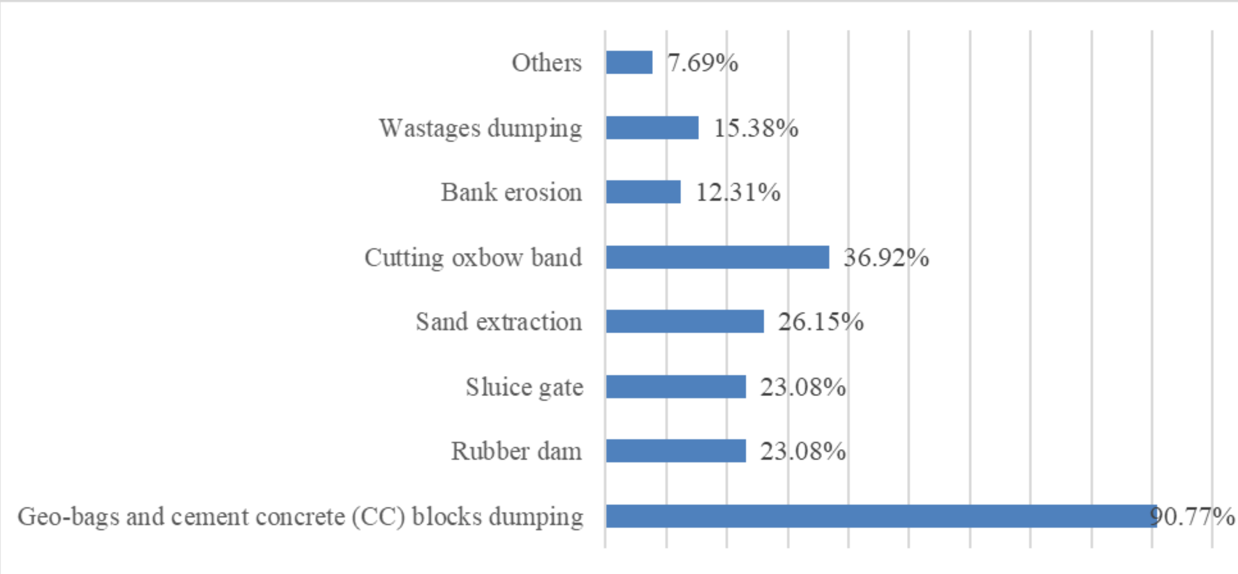
Graph 12: Scatter plot between depth reduction (m) and decreased amount of E sized fish in 2023 compared to 2019.



Graph 13: Scatter plot between depth reduction (m) and decreased amount of F sized fish in 2022 compared to 2019.



Graph 14: Scatter plot between depth reduction (m) and decreased amount of F sized fish in 2023 compared to 2019.



Graph 15: Reasons for the Destruction of Kums

No research program has been conducted on Kums of Halda River earlier. During this survey, a total of 22 Kums were identified with the help of the Echo Sounder (KODEN Echo Sounder CVS 120). A significant change can be observed between the years 2019 and 2022 and between the years 2019 and 2023 in the depth of Kums where 77.3% of Kums were seen reduced in 2022 and 81.8% of Kums were seen reduced in 2023 compared to 2019 (Graph 1). Fish were seen to be significantly reduced with the reduction of Kum depth. Among all Kums, fishes of Kum I (Keramtolir Bak Kum), Kum J (Noyahat Kum), Kum O (Napiter Ghat Kum), and Kum R (Ramdas Munshir Hat Kum) were mostly affected and reduced. Again, the increase in depth in Kum B (Terpalir Khal) and Kum H (Ankuri Ghona Kum) showed an increase in fish over the period (Table 2). It means when the depth is increased, the abundance of fish is increased, and vice-versa. Although there are many causes for Kum destructions, eight important causes in particular have been identified. These include-

Geobags and Cement Concrete (CC) block dumping

To preserve the bank of the Halda River, the Bangladesh Water Development Board (BWDB) began construction work in 2018. To provide support, geobags were first placed in the Kums, and afterwards, cement concrete (CC) blocks were dumped on top of those geobags. As a result, the depths of Kums have been reduced significantly. Out of 66 interviewees, 90.77% think, Kums were destroyed due to the geobags and cement concrete (CC) blocks dumping (Graph 15).

Cutting Oxbow Band

River has been straightened, cutting 11 oxbow bands over the last hundred years[10]. As a result, some Kums have been abolished over the period. 36.92 % of interviewees agreed with this opinion (Graph 15).

Sand extraction

Sand extraction is one of the important reasons for the pollution of the Halda River[3]. The current study finds its contribution to the reduction of Kum too. According to 26.15% of interviewees (Graph 15), the third most important reason for Kum destruction is sand extraction. Residues from extracted sand in the upper Halda region follow river flow and settle down to the Kums of the lower Halda region, which, as a result, reduces the depth of Kums.

Rubber Dam

Another significant reason for Kum's destruction is the establishment of one rubber dam at Bhujpur Union, Chattogram. About 23.08% of interviewees (Graph 15) expressed their concern for that reason. About 8-13.5 crore litres of water are extracted from the Bhujpur rubber dam during the dry season[15]. The Rubber dam blocks the natural flow of water and creates an opportunity to settle down the turbid particles in Kum areas.

Sluice Gate

18 sluice gates have been established in 19 branch canals of the Halda River[13]. As a result, the flow of water from the tributaries has been reduced significantly. 23.08% of interviewees claimed this is one of the reasons for Kum's destruction (Graph 15).

Waste dumping

Upper Halda adjacent to Najirhat municipality directly dumps wastage into the Halda River. Hathazari and Raozan upazilas are indirectly responsible for waste dumping to the Halda River too. As a result, those wastes are settling down to the Kum area and reducing Kum depth. 15.38% of interviewees showed their opinion on this point (Graph 15).

Bank erosion

Bank erosion is another reason for the Kum destruction. 12.31% of interviewees showed their opinion on this point.

Others

The interview and direct observation revealed a few other causes. It includes the usage of an earthen dam in the upper Halda region for irrigation reasons. Deforestation in the upper Halda area is another reason for problems related to erosion and indirectly contributes to the shallowing of Kum.

Recommendations

Geobags and CC Blocks

Geobags and CC Blocks are proven to be involved as the main elements in destroying Kums and fish. In the future, for the protection of the river bank, no such kind of approach should be promoted. There are many ways to protect the river bank, and the authors inspire us to adopt environmentally friendly ways here. For existing implications, authors don't suggest uprooting those, as those activities may help to face the consequences of riverbed destruction for a second time.

Cutting Oxbow Band

By analyzing the multiple historical incidents of the oxbow band, it is observed that local muscle power always helped to do so. Law enforcement authorities should play a strong role in ruling the riverway artificially. Any kind of canal excavation near the river should be discouraged.

Sand extraction

During sand mining upstream of the river, a portion of the sand flows and fills the basins downstream. If we want to reduce the filling of the rivers due to unplanned sand mining, then this unplanned sand mining must be stopped first. The exact places of the Halda River from which there is no possibility of damage due to the extraction of sand should be identified.

Rubber Dam

The rubber dam is one of the biggest reasons for the Halda river bed's continuous destruction. There should be alternative ways to promote agriculture upstream. The authors suggest the eradication of rubber dams to maintain the water flow.

Sluice Gate

By reviewing all the sluice gates that have been installed in the various tributaries of the Halda River, it can be easily surmised that these sluice gates are one of the obstacles to ensuring the normal flow of water in the river. All these sluice gates along the Halda River should be constructed in such a way that both water and fish can move freely.

Waste dumping

Waste management should be increased in upazilas around the Halda River such as Nazirhat, Raozan, and Hathazari. Various awareness programs can be conducted to highlight the importance of waste management to the local people.

Conclusion

Halda River significantly contributes to the national natural seed demand of IMCs. So, features like Kums, which are valuable homes for those fish and others should be protected. However, developmental projects like the use of geobags and cement concrete (CC) blocks to preserve river banks were carried out without the required scientific input, and as a result, Kums and dependent fish are disappearing over time. In the future, it is advised that sufficient scientific engagement be made before any type of construction in this Bangabandhu fishery heritage. The government should carry out a proper project to replace the rubber dam and sluice gate with the environmental and fish-friendly alternatives. Additionally, it is not advised to remove geobags and attached cement concrete (CC) blocks because doing so will disturb the fish population once more. Deforestation should also be prevented, and proper law enforcement should be increased to reduce sand extraction in the upper stream.

Competing Interests

The authors declare no conflict of interest to the research, authorship, and publication of this article.

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Ethics approval and consent to participate

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Compliance with ethical standards

This research does not contain any studies with human participants.

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