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Impact of carp stocking on the yield and biodiversity of non-stocked indigenous fish species in selected oxbow lakes of Bangladesh

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Abstract

Impact of carp stocking on the yield and biodiversity of non-stocked indigenous fish species in six selected oxbow lakes (baors) located in southwestern part of Bangladesh has been reported in this article. The stocking densities were 4636, 333, 3514, 1803, 5993 and 2404 fingerlings/ha in Benipur, Kayetpara, Saster, Bahadurpur, Nasti, and Bukbhara baor, respectively. The yield of non-stocked indigenous fish species (NIFS) in the studied baors varied from 0.52-134.56 kg/ha during the study period. The yield of stocked carps in the studied baors varied from 83-1027 kg/ha/yr during 2001-2002. Species abundance was different in the six selected baors. A maximum of 32 species were recorded in Bahadurpur baor while 25 in Bukhara, 16 in Kayetpara, 13 in Benipur, 9 in Nasti and 8 in Saster baor.

Keywords: Carp, Biodiversity, Non-stocked indigenous fish species (NIFS), Oxbow lakes (baors)

Introduction

Oxbow lakes locally known as *baors* are semi-closed water bodies occupying the dead channels of the rivers in the moribund delta of the Ganges. Oxbow lakes are believed to be resulted from the change of river courses leaving cut-off oxbow bends. They apparently look like lakes or reservoirs, but differ from them in having connections with the parent river through channels at least during in the monsoon. In dry season, most of the oxbow baors become converted to fully closed water bodies. The physico-chemical characteristics of water, nutrient loading, and the quantum and abundance of aquatic macrophytes in the baors also vary in different seasons. There are approximately 600 baors in southwestern Bangladesh with an estimated combined water area of 5488 ha (Hasan, 1990). The baors are especially rich in biodiversity and act as refuges for aquatic life at all levels and all kinds (Shiel, 1995). The baors of Bangladesh are an abode NIFS which breed and thrive there throughout the year; and have become a source of naturally recruited renewable fishery resource (Haque *et al.*, 1997).

Small indigenous fish species were once abundant in rivers, streams, canals, jheels, beels, haors, baors and ponds in Bangladesh. They are usually caught by a large number of subsistence fishermen and provide a major portion of animal protein intake of the poor households. Since 1960s, the production of small indigenous fish species has been declining despite their ability to reproduce at shorter intervals and withstand poor environmental conditions. There has been a major loss of their natural habitats including their breeding grounds due to implementation of flood control, drainage and irrigation projects (FCD & FCDI), which have considerably reduced the area of flooding, as well as the period of flooding. As a consequence, most of the perennial beels have become seasonal water bodies with remote possibility of survival of brood fish for breeding season. The other important factors, which are responsible for declining of small fishes in natural habitats, are: loss of natural habitats, over exploitation, use of mono filament net, fish diseases, application of

agrochemicals, pollution of water bodies from industrial wastes, water abstraction for irrigation and siltation. Considering the importance of small indigenous fish species the study was carried out to assess the impact of carp stocking on biodiversity and yield of NIFS in some selected baors.

Materials and Methods

The present study was carried out in six selected baors namely, Bahadurpur (110 ha), Bukbhara (138 ha), Kayetpara (116 ha), Nasti (54 ha), Saster (140 ha) and Benipur (45 ha) located in southwestern part of Bangladesh from August, 2002 to October, 2002. Supporting data of the preceding years were also collected in order to assess previous trend of fish yield and environmental features. NIFS catch data of each of the baors were collected twice a week. Total catch of a baor was estimated by multiplying average catch of 20% or more fishers' engaged in fishing on the sampling day with the total number of fishes. The number of fishers engaged in fishing on the day of sampling was estimated through interviewing the fishers and or direct observation. Sampling was done in the morning and evening and at the landing center when the fishers came one by one with their catch or at the fishing spot individually. Species wise total catches were recorded with specimen number and weight in data record sheet. Catch on the sampling date was calculated by dividing sampled catch (number and weight) by the number of fisher sampled multiplied by total number of fishers actually fished on the day of sampling. Monthly catch was estimated by dividing the total sampled catch (number and weight) by the number of sampling days multiplied by number of month days assuming that they catch throughout the month. The collected data were then coded, summarized, processed and analyzed using the concerned Microsoft (MS) Excel computer package programme.

Results and Discussion

The wide variation in sampling intensity in different baors as in Bahadurpur (27 days), Bukbhara (27 days), Kayetpara (25 days) and Nasti (22 days) Saster (13 days) and Benipur (12 days), was due to irregular catch of NIFS in the studied baors (Table 1).

Table 1. Summary of fishing effort and catch estimates of NIFS in the six studied baors

Baor (Lake)	*SWA (ha)	Total fisher days	Fisher engaged/ day	Total No. of sampling days	Total catch (kg)	Catch/ month (kg)	Catch/ day (kg)	Catch/ fisher/ day	Monthly yield (kg/ha/ month)
Bahadurpur	110	7,236	80	27	12,611.05	4,203.68	140.12	1.75	38.22
Bukbhara	138	12,743	142	27	1,8569.8	6,189.94	206.33	1.46	44.85
Kayetpara	116	2,410	27	25	3,069.64	1,023.21	34.11	1.27	8.82
Nasti	54	480	5	22	250.69	83.56	2.79	0.52	1.55
Saster	140	358	4	13	73.49	24.50	0.82	0.21	0.17
Benipur	45	318	4	12	398.9	132.97	4.43	1.25	2.95

* Standard Water Area

Yield of NIFS

The yield of NIFS in the six studied baors varied from 0.52 -134.56 kg/ha in the three studied months. The highest yield (134.56 kg/ha) was found in Bukbhara and the lowest (0.52 kg/ha) in Saster baor. A total of 13 NIFS groups were recorded from the six baors during the study

period. Distribution and abundance of the NIFS were found to vary widely in different baors, Gobies, the only NIFS group was recorded from all the studied baors. Of the NIFS groups clupeids gave the highest yield (90.57 kg/ha) in Bukbhara baor followed by prawns (42.30 kg/ha) in Bahadurpur baor and gobies (20.85 kg/ha) in Bahadurpur baor (Table 2).

Table 2. Yield of non-stocked indigenous fish species (NIFS) in six selected baors (lakes)

Baors (Lakes) / Species Groups	Bahadurpur baor		Bukbhara baor		Kayetpara baor		Nasti baor		Saster baor		Benipur baor	
	Yield (kg/ ha)	%	Yield (kg/ ha)	%	Yield (kg/ ha)	%	Yield (kg/ ha)	%	Yield (kg/ ha)	%	Yield (kg/ ha)	%
Catfishes	10.67	5.67	2.53	0.80	3.13	10.26	2.58	72.81	0.20	44.61	-	-
Clupeids	4.68	5.11	90.57	36.37	-	-	-	-	0.02	22.19	6.69	44.31
Glass fishes	1.69	5.07	3.08	8.60	-	-	-	-	-	-	-	-
Gobies	20.85	7.72	3.00	1.25	2.88	4.00	0.10	2.40	0.07	5.23	0.25	0.77
Loaches	5.29	3.40	6.45	0.22	-	-	-	-	-	-	-	-
Minnows and minor carps	13.64	16.86	5.34	4.64	2.37	6.61	-	-	0.05	7.45	0.52	4.77
Needlefishes	-	-	1.90	0.60	1.08	6.62	1.57	20.09	-	-	-	-
Snakeheads	7.61	0.73	2.06	0.07	3.78	1.47	-		0.12	10.11	-	-
Spiny eels	3.40	1.12	1.82	0.71	3.43	2.94	0.40	4.70	0.02	9.24	-	-
Prawns	42.30	49.36	16.59	45.57	4.73	3.41	-	-	-	-	1.18	48.39
Mud purches	-	-	-	-	3.70	61.80	-	-	-	-	-	-
Climbing perches	-	-	-	-	-	-	-	-	0.04	1.16	-	-
Others	7.43	4.95	1.23	1.18	1.36	2.89	-	-	-		0.22	1.77
Total	117.55	100.00	134.56	100	26.46	100.00	4.64	100.00	0.52	100.00	8.86	100

The yield of NIFS as obtained for the studies baors is more or less similar to that of Haque *et al.* (1996) who recorded total yield to range from 32-78 kg/ha/month in two baors of Bangladesh. Haque *et al.* (1999) recorded total catches of indigenous non-stocked fish and which was 557 kg/ha in Bukbhara, 593 kg in Kannadah and 529 kg/ha in Rajgonj. He also recorded annual yields of stocked carps of 367 kg/ha in Bukbhara and 678 kg/ha in Kannadah baor. In an another study Haque *et al.* (1999) stated that stocking of local and exotic carp fingerlings in lakes under the Oxbow Lakes Project increased total fish yield 2.5-fold with retention of 75% of the yield of non-stocked indigenous fish species (NIFS). Hossain *et al.* (1994) reported from a field survey in Bangladesh open water fish culture practices, that total production of fish from this sources cover 60% on average of the annual production which were 4.43, 4.80, 5.30 lakh MT during 1990-91, 1991-92 and 1992-93, respectively and their increase in production was 3% annually.

Yield of stocked carps

The yield of stocked carps in the studied baors varied between 32-1027 kg/ha/yr during 2001-2002. The highest yield (1027 kg/ha) was found in Benipur baor and lowest (83 kg/ha) in Kayetpara baor. The yields of stocked carps in the other baors were 722 kg/ha in Saster, 660 kg/ha in Bahadurpur, 642 kg/ha in Nasti, 356 kg/ha in Bukbhara baor against the stocking density were 4636 fingerlings/ha in Benipur, 333 fingerlings/ha in Kayetpara, 3514 fingerlings/ha in Saster, 1803 fingerlings/ha in Bahadurpur, 5993 fingerlings/ha in Nasti, and 2404 fingerlings/ha in Bukbhara baor (Table 3). The yield of stocked carps as obtained in the present study is similar to that of Haque *et al.* (1999) who recorded annual yields of stocked

carps to be 367 kg/ha in Bukbhara and 678 kg/ha in Kannadah baor. Hasan *et al.* (1999) stated that the annual carp yields in 17 oxbow lakes averaged 508 kg/ha/year for 1994-95 and 1995-96, ranging between 140 and 1008 kg/ha/year against average stocking density of 2608 fingerlings/ha and average secchi depth of 95 cm. Oxbow Lakes Project II (1997) recorded annual yields of stocked carps during 1994-95 to be 407 kg/ha in Bahadurpur, 471 kg/ha in Bukbhara, 162 kg/ha in Kayetpara, 964 kg/ha in Nasti, 298 kg/ha in Saster and 660 kg/ha in Benipur lake, where the stocking density were 751 fingerlings/ha in Bahadurpur, 2601 fingerlings/ha in Bukbhara, 549 fingerlings/ha in Kayetpara, 1504 fingerlings/ha in Nasti, 844 fingerlings/ha in Saster and 1345 fingerlings/ha in Benipur lake. During 1995-96, annual yields of stocked carps were 530 kg/ha in Bahadurpur, 363 kg/ha in Bukbhara, 130 kg/ha in Kayetpara, 1052 kg/ha in Nasti, 167 kg/ha in Saster and 566 kg/ha in Benipur lake, where the stocking density was 4691 fingerlings/ha in Bahadurpur, 2049 fingerlings/ha in Bukbhara, 1562 fingerlings/ha in Kayetpara, 5496 fingerlings/ha in Nasti, 1732 fingerlings/ha in Saster and 4806 fingerlings/ha in Benipur lake. During 1996-97, annual yields of stocked carps were 575 kg/ha in Bahadurpur, 367 kg/ha in Bukbhara, 114 kg/ha in Kayetpara, 2000 kg/ha in Nasti, 575 kg/ha in Saster and 727 kg/ha in Benipur lake, where the stocking density was 2710 fingerlings/ha in Bahadurpur, 1193 fingerlings/ha in Bukbhara, 1552 fingerlings/ha in Kayetpara, 9018 fingerlings/ha in Nasti, 4639 fingerlings/ha in Saster and 3795 fingerlings/ha in Benipur lake.

Biodiversity

A total of 32 species were recorded in Bahadurpur baor where prawns were the most dominant group which contributed 49.36% to the total catch (Fig. 1 and Table 2). A total of 25 species were recorded in Bukbhara baors, prawns (chingri) were found to be the most dominant group contributing 45.57% to the total catch. A total of 16 species were recorded in Kayetpara baor. Here also prawns were found to be the most dominant group, which contributed 61.80% to the total catch.

Table 3. Stocking, harvesting and recovery percentage of carps in six selected baors during 2001-2002 (July'01-June'02)

Sl. No.	Name of Lake	SWA (ha)	Stocking/baor		Stocking/ha		Production/baor		Yield/ha		Recovery percentage	Harvest size (kg)
			Number	(kg)	Number	kg	Number	kg	Number	kg		
1	Bahadurpur	110	198,296	12,453	1,803	113	218,122	72,641	1,983	660	110	0.33
2	Bukbhara	138	386,985	14,231	2,804	103	69,580	49,137	504	356	18	0.71
3	Kayetpara	116	38,675	1,686	333	15	6,584	9,628	57	83	17	1.46
4	Nasti	54	323,634	16,504	5,993	306	58,264	34,665	1,079	642	18	0.59
5	Saster	140	492,023	22,253	3,514	159	169,941	101,054	1,214	722	35	0.59
6	Benipur	45	208,626	8,764	4,636	195	91,919	46,229	2,043	1,027	44	0.50

A total of 9 species of fishes were recorded in Nasti baor, catfishes were found to be the most dominant group contributed 72.81 to the total catch. A total of 8 species of fishes were recorded in Saster baor, catfishes were found to be the dominant group which contributed 44.61% to the total catch. A total of 13 species of fishes were recorded in Benipur baor where prawns were found to be the most dominant group which 46.48% to the total catch (Table 2 and Fig. 1).

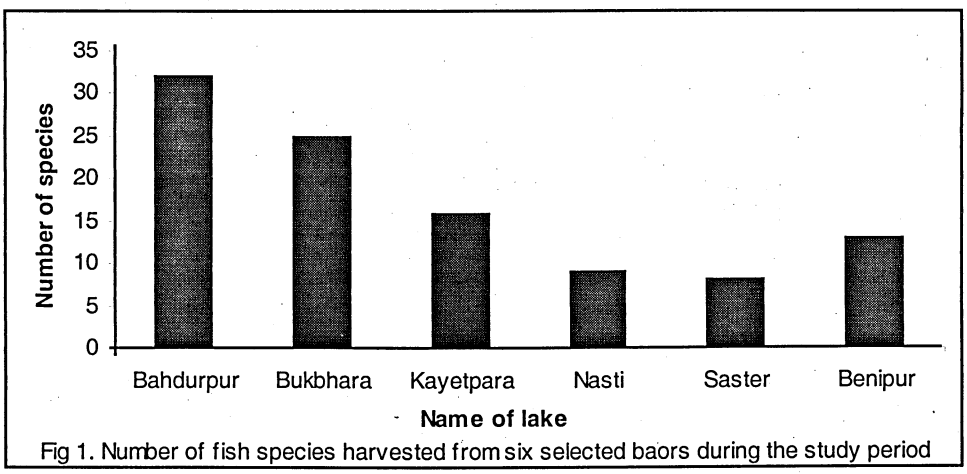

Fig 1. Number of fish species harvested from six selected baors during the study period

The number of species were recorded in the present study is not satisfactory in case of Nasti, Saster and Benipur baors, the probable reasons might be irregular fishing of NIFS, disturbance in breeding of NIFS by seine netting or high stocking density of stocked carps in these lakes. Haque *et al* (1996) identified 50 species in two oxbow lakes in southwestern Bangladesh. Haque *et al* (1999) recorded 58 indigenous fish species in Bukbhara, 52 in Kannadah and 56 in Rajgonj baor. In another study Haque *et al* (1999) recorded 58 species of fish in two OLP lakes (Bukbhara and Konnadah) with low stocking density and 43 species in two OLP lakes (Nasti and Marufdia) with high stocking density while 60 species were found in two control lakes (Rajganj and Kapotakkhy) having no stocking of carps. BCAS (1991) observed that total annual catch of the Roail beel fishery composed of punti (13.69%), chapila (13.69%), batashi (13.54%), bujuri (8.92%), pabda (5.0%), mola (4.46%), tengra (2.3%), chanda (2.23%), bele (0.46%), carps (0.92%), taki (2.31%), chona (0.92%), shole (0.92%), and others (32.03%). But in the monsoon, punti, bujuri, chanda, and tengra were the dominant species for the combined fishing efforts at Arial Khan beel accounting to 24.87%, 23.64%, 14.97%, and 14.97%, respectively. The rest were mola (5.55%), carps (0.35%), catfish (0.23%), pabda (2.46%), pholi (0.62%), and others (12.30%). They also recorded the contribution of dominant species in the catches of cast net in the beel of Arial Khan to be punti (30%), pabda (5%), taki (5%), baila (10%), baim (5%), shoal (10%), and others (30%).

Conclusion

In view of the present study, it may be concluded that some negative impact on natural diversity and recruitment may occur with high carp stocking rates. It is expected that at substantially higher carp yields, lesser nutrients will be available for indigenous fish and as a result, yields of such fish will fall. Intensive purse seine netting for carps coupled with regular cleaning of floating vegetation by fisher groups caused a change in habitat and turned the water colour from clear towards green (Hasan *et al*, 2001). The grazing of grass carp and common carp is thought to exert an adverse impact on the trophic and reproductive niches of the indigenous fish. The construction of dams and other flood control structures reduced natural recruitment and contributed to stock depletion. Frequent netting of carps might disturb the patterns of NIFS breeding and destroy substratum and aquatic vegetation. In order to increase the yield and biodiversity of NIFS from baors, a sound knowledge of eco-biology of the indigenous species and a rational fishing model with regulations on types of gear used, mesh size, fishing season and intensity of fishing effort might lessen the possibility of the complete loss of indigenous species from the baor ecosystem.

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