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Studies on the Production Potentials of 'Kua' Fisheries of Raktodaha Beel, Bogra, Bangladesh

[1]Somen Dewan, [1]Md. Jasim Uddin, [2]Mirza Md. Mozaffar Hossain,
[3]David Rintu Das and [4]Md. Sazzad Hossain
[1]Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, Bangladesh
[2] Bangladesh Fisheries Research Institute, Mymensingh, Bangladesh
[3] Bangladesh Fisheries Research Institute, Deputed to RFS Division, BRRI, Gazipur, Bangladesh
[4] Department of Aquaculture, BAU, Mymensingh, Bangladesh

Abstract: An investigation about the physico-chemical and biological parameters, management practices and production potential of kua fisheries of Raktodaha beel, Bogra, Bangladesh was carried out in three stations viz., station A (shallow), station B (medium deep) and station C (deepest). The physico-chemical parameters of the kuas, such as water depth, water temperature, turbidity, dissolved oxygen, pH and total alkalinity were found to range between 0.38-1.44 m, 20.1-28.7 ^{0}C, 52.1-86.0 ppm, 3.7-5.2 ppm, 5.5-6.4 and 55.7-97.0 ppm respectively among three stations. The abundance of phytoplankton and zooplankton varied between 28,000-58,000/l and 210-325/l respectively. The average fish production in the kuas of three stations was found to range from 300.6-459.6 kg/ha with the highest production in deeper region and the lowest production in shallow region. Out of 24 species recorded in the kuas, *Mastacembelus* spp. and *Heteropneustes fossilis* showed higher contribution to the total production.

Key words: Fish production, kua, species composition, phytoplankton and zooplankton

Introduction

Bangladesh is a reverine country. It is unique endowed with rich inland open water resources such as, rivers, beels, haors, baors, canals, flood plains etc. where we get the major portion of fish production. Natural depressions (beels, haors and flood plains) acts as a good natural breeding, spawning, nursing and feeding grounds of commercially important fish and crustaceans.

Among different open water resources beels and haors provide 5.10% of the total annual fish production of Bangladesh (FRSS, 1997-98). Beels are generally having two complementary phases, the aquatic phase and the terrestrial phase. As a part of terrestrial phase, a large number of ditches (including borrow pits) locally called "Kua" or "Apa" located mainly within the beel which are important sources of fish congregation and harvesting of fish during the dry season, i.e., January to March. Kua or apa refers to shallow ditch, dug-out in the beel or near a homestead which is normally flooded and is deliberately made for harvesting natural fish stock aggregated. These kuas are actually "Fish Aggregating Devices (FAD)".

Kua fishing is a very important component of floodplain fish production system as well as annual income of the farmers. Kua fish production depends upon some features such as the fertility of the floodplain, suitability of natural spawning of fish in the beel, shelter system in kua, size and depth of kua, disturbance or rest in the kua, food application and some other management techniques. Though kuas cover an insignificant area of the flood basin but it could play a significant role to the economy of farmers or owners.

With the view to help the kua owners, by increasing the fish production through improved management practices, the present study has been carried out with the following objectives :

i) To know the preparation and management practices of kua
ii) To determine the physico-chemical and biological parameters of kua
iii) To determine the fish production and species composition in kua.

Materials and Methods

The research work was carried out in Raktodaha beel in Bogra from October '1995 to March 1996. It is a big beel covering an area of about 1000 ha during flood period and 105 ha during dry season. There are about 101 kuas within the beel, the area of which ranges from 0.02-0.08 ha. For the study three sampling stations were selected in the beel considering the depth of the beel. The stations A, B and C were selected purposively from the shallow region, medium deeper region and the deepest region of the beel respectively. From each station three kuas of different sizes were selected randomly for the study. The areas of selected kuas ranges from 0.02-0.08 ha with an average area of 0.05 ha. The average depth of the kuas varied from 0.38-0.95 m in station A, 0.76-1.27 m in station B and 0.84-1.44 m in station C.

The physico-chemical properties of water such as, temperature, turbidity, dissolved oxygen, pH and total alkalinity were determined. The temperature, turbidity, dissolved oxygen and pH were determined directly from the kua water thrice monthly with the help of Aquamate, Model WQC, 1A. The total alkalinity was also determined similarly with the help of Hach Test Kit (Model No FF-2).

To determine the concentration of phytoplankton and zooplankton, water samples were collected thrice monthly from different parts and different depths of each kua with the help of a Kemmerer Type Water Sampler. The collected samples were then filtered through a plankton net and concentrated to 20 ml and preserved. In the laboratory quantitative study of both the phytoplankton and zooplankton was done with the help of Sedgwick-Rafter Cell (S-R cell) and a binocular compound microscope (Olympus CK-2, ULWCD 0.3). Both the phytoplankton and zooplankton were expressed numerically as number/liter by the following formula.

$$N = \frac{A \times 1000 \times C}{V \times F \times L}$$

where,
N = Number of plankton cells per liter of original sample
A = Total number of planktons counted
C = Volume of final concentrate of the sample in ml
V = Volume of each square (1 cu mm)
F = Number of the squares counted
L = Volume of original water in liter

To collect the data on kua preparation, harvesting and production of fish, the sample kuas were visited at the time of water sample collection and harvesting of fish. The kua preparation data was collected from the direct interview of kua owners as well as from the physical observations of the kuas.

The harvesting and catch data of kuas were collected on the stations at the time of harvesting from each kua by the farmers. The catch data were recorded species wise for each kua in weight (kg). From the collected data the average production (kg/ha/yr) was determined for each station.

Results

Usually kuas are dug-out by the owners relatively in the lower regions of their homestead land inside the beel and ranges an area of 0.02-0.08 ha. The kuas are connected with the central part of the beel through a canal as fish passage. At the onset of the monsoon season when the kuas filled up with water, the farmers put mostly the branches of tamarind tree within the kuas as fish shelter. No feed was found to give in kuas by the farmers. The farmers enclosed the kuas by bana as soon as the embankments of the kuas start emerging up the water surface, keeping the openings unblocked. In this way they left the kuas undisturbed till harvesting.

The mean values of water depth varied from 0.38-0.95 m in station A, 0.76-1.27 m in station B and 0.84-1.44 m in station C (Table 1). The monthly water temperature of kuas did not vary widely with the stations during the study period, but it showed remarkable variation with months and the average values of it were found to range from 22.7-27.9°C, 20.5-28.7°C and 20.1-27.6°C in the kuas of stations A, B and C respectively. The highest average water temperature was recorded in October and the lowest of the same in January in all stations. The turbidity of water of kuas was found to range from 52.1-79.0 ppm, 56.2-82.4 ppm and 59.0-86.0 ppm at station A, B and C respectively. The highest value was recorded during January and the lowest of the same during October. However, among the three stations more turbidity was recorded in the kuas situated at station C. The average values of dissolved oxygen of the water recorded at different kuas at stations A, B and C were found to range from 3.7-4.9 ppm, 3.9-5.0 ppm and 4.3-5.2 ppm respectively. Relatively higher values were recorded during winter months in all the stations. Slightly higher values in the dissolved oxygen concentrations were observed in the kuas of the stations C where the water depth was high. The pH values of water were found to vary little with the months and with the stations. The ranges of its value recorded were 5.5-6.0, 5.5-6.3 and 5.6-6.4 in stations A, B and C respectively. The total alkalinity values fluctuated more widely and ranged from 55.7-83.2 ppm in station A, 61.3-89.2 ppm in station B and 65.6-97.0 ppm in station C. Maximum value of total alkalinity was recorded in January and minimum value of it was recorded in October in all the stations (Table 1).

The abundance of phytoplankton populations in kuas was found to vary with the stations and with the months. The number of phytoplankton fluctuated between 28,000-54,000/l in station A, 30,000-56,000/l in station B and 32,000-58,000/l in station C. The maximum population of phytoplankton was recorded in January and the lowest of the same was recorded in October in all the stations. Again the highest number of it (58,000/l) was recorded in station C and the lowest of the same (28,000/l) in station A (Fig. 1). The number of zooplankton was found to increase more or less gradually from October till the maximum was reached in January and then decreased more rapidly in all the stations. However, the number of zooplankton per liter of water varied from 210-300, 215-310 and 240-325 in station A, B and C respectively (Fig. 2).

Before the start of fishing the farmers encircled the kuas with bana including the openings and then fishing is done after removing the branches of trees and water hyacinths from the kuas with the help of seine net and cast net.

After fishing, the farmers put back the branches of trees into the kuas and left the kuas open to the beel water by removing the enclosure. About a month later the farmers again catch fish in the same way and finally the kuas were dewatered with the help of low-lift pump and harvest all the fish from the kuas. The catch data were collected on the spot at the time of fishing from the kuas by the farmers.

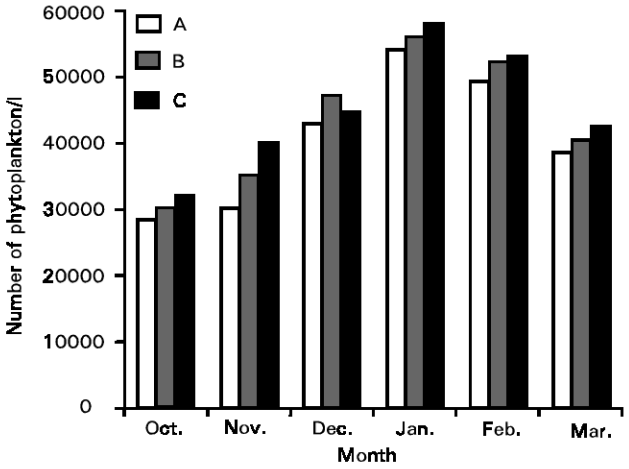

Fig. 1: Monthly variations in the abundance of phytoplankton in kuas at three stations.

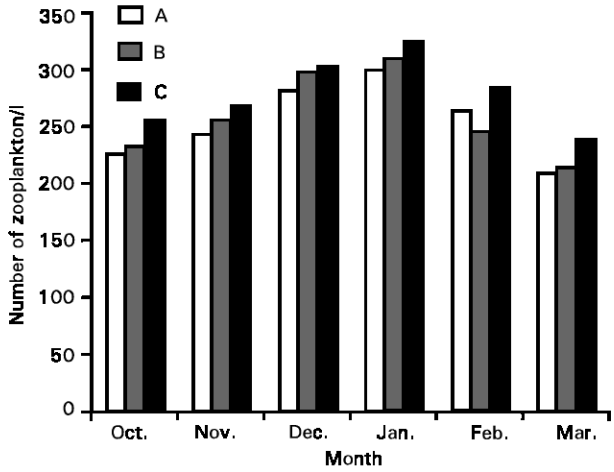

Fig. 2: Monthly variations in the abundance of zooplankton in kuas at three stations.

Among the kuas of three stations the highest average production of fish was recorded in station C (459.6 kg/ha), which was successively followed by the production of fish in station B (363.3 kg/ha) and A (300.6 kg/ha) (Table 2). The kuas of the station C were found to be the most productive and superior to the kuas at station B and A. Difference in the production of fish among the kuas were also found highly significant.

The major species of fish harvested by the farmers from the kuas were *Labeo rohita, Catla catla, Wallago attu, Channa striatus, C. marulius, C. punctatus, Notopterus chitala, N. notopterus, Mastacembelus* spp., *Heteropneustes fossilis, Clarias batrachus, Anabas testudineus, Puntius* spp., other small fish and shrimps. However, among the other small fish the species recorded were *Ambassis* spp., *Colisa* spp., *Corica soborna, Rohtee cotio, Badis badis, Amblypharyngodon mola, Esomus danricus, Glossogobius giuris, Lepidocephalus guntea, Danio devario, Xenentodon cancila, Nandus nandus* and *Botia dario*.

Among the major species, *Mastacembelus* spp. showed highest contribution (17.5%) to the catch which was closely followed by *H. fossilis* (16.6%). Other small fish also contributed significantly (20.7%) to the catch. Only two species of major carps, *L. rohita*

Table 1: Monthly variations in physico-chemical parameters of kuas at different stations of Raktodaha beel.

Parameters	Station	Months					
		October	November	December	January	February	March
Water depth (m)	A	0.95±0.10	0.81±0.08	0.72±0.80	0.61±0.11	0.53±0.05	0.38±0.04
	B	1.27±0.06	1.14±0.09	1.02±0.07	0.91±0.06	0.79±0.04	0.76±0.04
	C	1.44±0.08	1.27±0.07	1.18±0.05	1.07±0.07	0.91±0.05	0.84±0.04
Temperature (°C)	A	27.9±1.05	26.5±0.35	24.7±0.49	22.7±1.1	23.9±0.9	26.0±1.20
	B	28.7±0.62	26.9±0.71	22.3±0.40	20.5±1.05	22.7±0.82	26.0±0.90
	C	27.6±0.68	25.8±0.71	21.1±0.80	20.1±0.65	22.3±0.79	24.5±0.90
Turbidity (ppm)	A	52.1±6.4	60.2±5.8	71.5±10.1	79.0±5.6	73.6±3.4	69.0±9.1
	B	56.2±7.1	64.1±6.9	72.3±5.2	82.4±3.4	75.0±2.9	71.8±8.1
	C	59.0±5.9	66.0±4.2	75.9±3.9	86.0±6.2	78.1±7.1	73.2±6.4
Dissolved oxygen (ppm)	A	3.9±0.90	4.2±0.72	4.5±0.57	4.9±0.81	4.4±0.43	3.7±0.25
	B	4.0±0.70	4.3±0.81	4.8±0.52	5.0±0.60	4.5±0.29	3.9±0.34
	C	4.5±0.50	4.7±0.62	5.0±0.49	5.2±0.61	4.8±0.34	4.3±0.52
pH	A	5.5±0.19	5.6±0.25	5.9±0.43	6.0±0.21	5.8±0.61	5.6±0.35
	B	5.5±0.24	5.7±0.31	5.9±0.48	6.3±0.21	6.0±0.31	5.7±0.33
	C	5.6±0.32	5.8±0.41	6.2±0.52	6.4±0.63	6.1±0.52	5.9±0.29
Total alkalinity (ppm)	A	55.7±2.5	60.2±2.9	69.9±4.9	83.2±4.1	72.7±3.2	65.7±2.2
	B	61.3±3.1	67.9±2.1	78.7±4.2	89.2±4.5	75.5±2.7	67.2±3.1
	C	65.6±2.5	73.9±1.6	79.9±5.4	97.0±4.9	82.9±3.2	72.2±2.2

Table 2: Fish production in kuas of each station

Station	Production of fish (kg/ha)				
	Kua			Av. of each station	Av. of all stations
	K_1	K_2	K_3		
A	290	312	300	300.6±8.99[a]	
B	350	375	365	363.3±10.27[b]	374.50
C	445	472	462	459.6±11.14[c]	

(Different letters indicate significant difference)

Table 3: Species-wise contribution to the average total catch of kua fisheries

Species		Quantity	
Local Name	Scientific name	Kg/ha	Percentage
Rui	*Labeo rohita*	15.0	4.0
Catla	*Catla catla*	4.5	1.2
Boal	*Wallago attu*	11.2	3.0
Shol	*Channa striatus*	31.1	8.3
Gozar	*C. marulius*	9.7	2.6
Taki	*C. punctatus*	8.9	2.4
Chital	*Noropterus chitala*	7.5	2.0
Foli	*N. notopterus*	16.9	4.5
Baim	*Mastacembelus* spp.	65.5	17.5
Shing	*Heteropneustes fossilis*	62.2	16.6
Magur	*Clarias batrachus*	15.7	4.2
Koi	*Anabas testudineus*	12.7	3.4
Punti	*Puntius* spp.	11.6	3.1
Other small fish	----------	77.5	20.7
Small shrimp	----------	24.3	6.5
	Total	374.5kg/ha	

and *C. catla* were reported in the catch of the kuas. *C. catla* was very rarely available and it contributed to the total catch insignificantly (Table 3).

Discussion

The shape of the kuas was more or less square and the size ranged between 0.02-0.08 ha in the Raktodaha beel. Whereas, the size of kuas recorded by BCAS (1994) were 0.121 ha in Chanda beel, 0.057 ha in BSKB beel and 0.28 ha in Halti beel. The depth of the kuas was found to vary positively with the depth of the beel. The farmers were found to put branches of Tamarind tree (*Tamarindus indicus*) as fish shelter at the beginning of the monsoon, but the BCAS (1993) in their studies reported that the farmers of Chanda, BSKB and Halti beels used to put the branches of Babla tree (*Acacia nilotica*) as fish shelter in their kuas. However, the farmers of the Raktodaha beel reported that the branches of Hizol (*Beringtonia acutangula*) are the most preferred tree for fish shelter in the kua/katha, but they could not use it due to its non-availability.

The highest water depth in the kuas of Raktodaha beel was recorded in January, after which the depth decreased gradually towards dry season. The lower depth of the kuas might be associated with the higher rate of surface evaporation and no rainfall during dry season. The water temperature varied remarkably with the months and highest value of it was recorded in October and the lowest of the same was recorded in January. But the mean water temperature of the beels reported by FRI (1994) in the study during the year 1992 (September - November) and in 1993 (June - November) were 28.6 and 29.7°C in Chanda beel, 28.6 and 29.3°C in BSKB beel, and 28.5 and 29.9°C in Halti beel respectively. The turbidity values of water varied little with the depth of the kuas and more widely with the months. The highest values of it were recorded during the peak season when the water of the kuas mostly remain turbid. The average oxygen values were found to vary little with the month and with the depth of the kuas. Comparatively low values of oxygen were recorded in shallow kuas and higher values of the same were recorded in deeper kuas. Again, higher values of oxygen were recorded during winter months and the lower values during the rest of the months. The average oxygen values recorded in the present study were found to be within the ranges of dissolved oxygen recorded by FRI (1994). The pH values recorded in the present study were found to range from 5.5-6.4 in the kuas of different stations which are almost close to the ranges of pH values (6.0-6.9) recorded by Paul *et al.* (1994) in the same beel during the period July to October. The higher values of total alkalinity were recorded in deeper kuas and the lower values of the same were recorded in shallow kuas. Again, higher values of total alkalinity were recorded during winter and lower values of the same were recorded during monsoon similar to Dewan (1973).

Comparatively high density of phytoplankton and zooplankton population were recorded during winter months and low density of the same recorded during October in all the stations. The density of phytoplankton and zooplankton population recorded by Mazid and Hossain (1995) in their study from October to March in beels was almost similar to the present study. The ranges of phytoplankton and zooplankton population recorded by them were 40,000-60,000/l and 200-300/l respectively.

The production of fish varied significantly ($p<0.01$) with the depth of the kuas and was found to range between 290.0-472.0 kg/ha. The highest production was recorded in the deepest region (Station C) and the lowest production was recorded in shallow region (Station A). The average fish production recorded in the

kuas of three stations was 374.5 kg/ha which is almost close to the production recorded by BCAS (1994) in Halti beel (417 kg/ha). But the production of the present study is lower than the production recorded by BCAS (1994) in other two beels namely, Chanda (1,633 kg/ha) and BSKB (659 kg/ha) which might be associated with the size of the kuas, and size and relative productivity of the beel.

The major fish recorded in the kuas were *Labeo rohita, Catla catla, Wallago attu, Channa* spp., *Notopterus* spp., *Mastacembelus* spp., *Heteropneustes fossilis, Clarias batrachus, Anabas testudineus, Puntius* spp., other small fish and small shrimps. Among the major species of fish *Mastacembelus* spp. showed the highest contribution to the total yield which was closely followed by the yield of *H. fossilis*. The next important fish are *Channa* spp., *Notopterus* spp., *Clarias batrachus* and *L. rohita*. However, other small fish showed highest contribution to total catch (20.7%) than the above species. Among the other small fish, 14 species were recorded. But in total, 24 species of fish were recorded in the kua of the Raktodaha beel during the present study.

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