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Cyclical disparity on catch configuration and effects of fishing gears on fish production of north-western part of the Chalan Beel, Bangladesh

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Abstract
This study provides an overview of the seasonal variation on catch composition, the pattern of gear used and their effects on fish production and management system of north-western part of the Chalan beel. Results of the study revealed that annual beel cycle can be divided into four phases namely, resting, preparatory, growing and decay. Harvesting of fishes in chalan beel was done by using a variety of fishing gears. A total of 27 different types of fishing gears were recorded during investigation period from the study area of the beel. Recorded fishing gears were categorized into three major types which were net, trap and wounding gear. Marked seasonal variation was observed in the use of gears which mostly dependent on the flooding and water depths of the beel. A total of 62 fish species were recorded from this study area including 51 indigenous fish species and 11 exotic species. Fishes were recorded under following 12 fish orders-Cypriniformes, Siluriformes, Perciformes, Channiformes, Mastacembeliformes, Clupeiformes, Osteoglossiformes, Cyprinodontiformes, Anguiliformes, Synbranchiformes, Beloniformes and Tetraodontiformes. Some gears like Shuti jal, Current jal, Khora jal, Ber jal/Badai jal and some traps and specialized fishing methods were identified as very harmful to the sustainable production of the beel as well as to the wild brood stock of these natural water bodies. About 8 fish species were recorded as threatened species due to irresponsible fishing. Overall fish production level of the study area was not satisfactory which ranged from 350-400 kg/ha/yr.

Keywords: Beel, fish, destructive fishing gears, stock recruitment, overfishing

Introduction
Fish is very important as major supplier of animal protein for the ever-growing population of the South and South-East Asian countries. Fish is the main dietary source of protein in Bangladesh and fish alone contributes about 60% of animal protein to the diet. On the other hand, fisheries are second only to Agriculture in the overall economy of Bangladesh currently contributing about 3.74% of the gross domestic product and about 2.70% foreign exchange earnings (DoF, 2011) [7]. The number of people involved in fishing and fishery-related industries are also considerable. It provides full time employment to over 1.1 million people constituting 3% of the active population and part-time employment to an additional 11% population (Rahman, 1992) [24]. Bangladesh, in the delta of enormous Brahmaputra, the Ganges and the Meghna river and their tributaries, possesses one of the largest and richest flood plain system in the world. Open water inland fisheries play a vital role in the production of fish in Bangladesh. The open water resources are estimated at 4.047 million hectares, of which 2.833 million hectares are flood plains. In the early sixties, the open water fisheries contributed about 90% of the total fish production which in recent years has dropped to 49% (Mazid and Hossain, 1995) [22]. Fish harvests from open water resources are declining and species compositions are changing rapid partly due to indiscriminate fishing, especially for harvesting the undersized fishes, and partly due to flood control measures but as a whole this may be attributed to the lack of proper management policy (DoF/BFRSS, 1985; 1986; 1991) [8, 10].

By nature, the beel is extremely rich in nutrients and has immense production potential as reflected by their rich soil quality. There are two energy flow chain: grazing chain and detritus chain. Most of the macrophytes are not directly grazed by herbivores and the unutilized nutrients sink to the bottom detritus pool. This energy can be best utilized by strengthening the detritus chain by stocking detritivores like *Cirrhina mrigala*, *Labeo rohita*, *L. bata* etc. (Jhingran, 1989) [17]. Naturally in an area like beel, the fishes also differ in their mode of living and special methods are designed to catch them *viz*. netting, trapping, spearing, angling etc. Beside these, katha or komor (brush parks placed in flowing canals running through the floodplain or rivers) fishing are also observed. During dry months, fishes congregated in the Kathas are harvested often more, than once by resetting the brush shelters after each spell of harvesting specially in case of kathas. This type of fish production depends upon some features such as suitability of natural spawning of fish in the beel, disturbance or restness in these areas, and some other management techniques etc. Complete removal of water from ditches and canals within the floodplains, the last fish that could have been the brood for the following season, had been taken out (Mazid and Hossain, 1995) [22].

A fairly huge types and form of gears have been operated in the floodplains of this country to exploit wild fishes since time immemorial. The intensity of use of any form of gear in a beel is dependent on the intensity of target fish population presumed to be available in that beel. Some of the gears are selective for a particular species, whereas other account for a number of species caught during operation giving multispecies nature of the fishing (Moula *et al*., 1993) [23]. Some nets are specially meant for catching particular species of fish while other are used for netting any type of fish that comes in the way. The declining trend of fish production is assumed to be due to indiscriminate human interventions as mentioned earlier. So, some research works should be undertaken on the management of the open water resources which would be greatly helpful in planning and setting up of strategies for future development of this area. This study is designed to highlight the form and shape of different gears, fishing methods, catch composition and fish production of Chalan beel which may contribute largely in Fisheries sector by getting the optimum fish production through the application of improved management practices. The study was undertaken with the following objectives: to investigate the types and characteristics of fishing gears operated in the study area of the Chalan beel, to observe the catch composition of the study area, to observe the effects of fishing gears on fish production of the study area, to estimate the fish production of the study area, to estimate Catch Per Unit Effort of the dominant gears at the study area.

Materials and Methods

Location and description of the Chalan beel

The Chalan Beel one of the largest depressions of marshy character and also one of the richest wetland areas of the country. The Beel is also an important water resource in the north-west region of Bangladesh. The beel extends over four adjacent districts, Natore, Naogoan, Pabna and Sirajgonj. Most of the areas of the Chalan Beel covers Singra, Gurudaspur, Boraigram and Sadar Upazilas of Nature district, Atrai Upazila of Naogoan district, Chatmohor, Bhangura upazilas of Pabna district and Tarash, Ullapara, Raygonj upazilas of Sirajgonj district.

Study area

North-Western part of the Chalan beel including Singra and Natore Sadar upazila of Natore district were surveyed. The area of Chalan beel in Singra and Natore sadar upazila are 25,000 hectares and 2,000 hectares respectively in monsoon and 300-400 hectares in dry season. There are six rivers are running in the beel e.g. Atrai, Gur, Banoi, Mora Nagore, Vadoi and Tishi khali Mora river. During the field survey, different areas of the beel, fish landing centres, fish markets and harvesting spots were visited. Information was collected by direct interviews from fishermen, fish traders, beel's neighbors, Senior Upazila Fisheries Office Singra/Natore Sadar by using different questionnaires e.g. Gear Description Form, Month Based Gear Used Form, Fish Species Recording Form, CPUE Form etc.

Catch Per Unit Effort Data

The Catch Per Unit Effort (CPUE) data of dominant gears were collected during the study period. The data recorded for CPUE study were: Type and length of fishing gear; Number of gears used during each fishing; Number of fishermen attended in each fishing; Time interval between shooting and hauling of each gear; Number of shooting in each fishing; Total time spent and total hauling area in each fishing; Number of hours in fishing.

Analysis of Data

The data and information collected were systematically reduced to represent by figures and tables so that the findings of the study could be presented in a meaningful way.

Results and Discussion

Study on beel cycle

Beels of Bangladesh generally have two complementary phases, the aquatic phase and the terrestrial phase. The aquatic phase usually appears during July and lasts up to December while the terrestrial phase covers rest of the calendar year. However, with a close look into the results obtained and lesson gained during the study period, annual life cycle of beels under study has been divided into four phases, namely. Resting, Preparatory, Growing and Decay phase. Resting phase is characterized with almost dry condition of the beel basin leaving little water in canals and the internal ditches (kuas) and with little overlap usually January to March covers this phase. At this phase fishing becomes extremely limited to canals and kuas only. At the preparatory phase the beels are being cultivated to sow paddy (where possible) while the beel prepare to germinate the seeds of aquatic macrophytes, the fishes prepare to grow eggs in their ovaries. Eventually, some rain can be seen which catalyze faster germination and the maturation of eggs. April to June covers this phase. Growing phase is the most important phase in a beel life that covers July to September. With full monsoon water, paddy grows rapidly, almost all the fish spawns and microphates grow its maximum. Fishing activity also increases rapidly. Decay phase covers October to December when aquatic macrophytes and the vegetative part of paddy start to decompose. This poses remarkable changes in the water quality. At this phase fish reaches at its maximum growth.

Fishing gears operated in the study area

Various types of fishing gears were found to operate in the study area, they were mostly of traditional type and some of

them were unique for the particular locality. Gears may be classified into three major groups, such as-Nets, Traps and Wounding gears.

Seasonal variation of gear used in the sampling sites

A heuristic study on the use of fishing gear in the study area was conducted and the month-wise variation of different types of gear used in the study area. It was found that January, February, March and April cover almost dry condition. So, during this period the use of any type of gear was limited. As soon as the monsoon rain comes down and water level increased the use *of* gears increased simultaneously. Due to presence of current, traps are widely used in the canal connecting the beel with river and adjacent shallow water up to October and then decreased gradually during rest of the month of the year. At this time, the wounding gears are used in increasing numbers in shallow water due to abundance of pelagic fish. Wounding gears are generally not used as commercial purposes rather used by the subsistence fishermen. When the water level started to decrease during post monsoon period the number of nets used also decreased. It was a general trend that, the use of wounding gears is increased with the increasing of water body. Table 1, 2 and 3 showing use of types of net, trap and wounding gear in different months at study area of the Chalan beel.

Table 1: Particulars of different types of net used for fishing in the study area.

SL. No.	Name of gear	Materials Used in making gear	Fishing period	Major species Caught	Fishermen and boat needed for operation
1	Ber jal	Nylon twine or double cotton twines, tier cord	January-December	Catla, Silver Carp, Common Carp, Rui, Mrigal, Sarpunti, Baila, Taki, Tengra, Mola, Chela etc.	12-24 Fishermen and 1-2 dingi
2	Shuti jal	Nylon twine or double cotton twines	August-March	Catla, Silver Carp, Common Carp, Rui, Mrigal, Sarpunti, Baila, Taki, Tengra, Mola, Chela etc.	1-2 Fishermen
3	Koi jal	Monofilament/Multifilament, Nylon twine or double cotton twines, tier cord	June-September	Koi, Magur, Shing, Baila, Taki, Sharpunti, Tengra etc.	1-2 Fishermen and 1 dingi
4	Fash jal	Monofilament/Multifilament, Nylon twine or double cotton twines, tier cord	July-September	Catla, Silver Carp, Common Carp, Rui, Mrigal, Sarpunti etc.	1-2 Fishermen and 1 dingi
5	Khora jal	Nylon/cotton twines and bamboo frame	May-October	Catla, Silver Carp, Common Carp, Rui, Mrigal, Sarpunti, Baila, Taki, Tengra, Mola, Chela etc.	1 Fisherman and 1 dingi
6	Dharma jal	Nylon/cotton twines and bamboo frame	July-November	Punti, Baila, Taki, Tengra, Mola, Chela etc.	1 Fisherman
7	Kheo jal	Nylon/ cotton	January-December	Catla, Silver Carp, Common Carp, Rui, Mrigal, Sarpunti, Baila, Taki, Tengra, Mola, Chela etc.	1 Fishermen and 1 dingi
8	Thela jal	Nylon twine or double cotton twines and bamboo frame	January-December	Punti, Baila, Taki, Tengra, Mola, Chela etc.	1 Fisherman

Table 2: Particulars of different types of trap used for fishing in the study area.

SL. No.	Name of gear	Materials Used in making gear	Fishing period	Major species Caught	Fishermen and boat needed for operation
1	Chari	Split of bamboo and cane material	July-October	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
2	Ichar-Chai	Split of bamboo and cane material	June-October	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
3	Cheng	Split of bamboo and cane material	June-October	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
4	Bair	Split of bamboo and cane material	June-October	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
5	Chandi bair	Split of bamboo and cane material	July-October	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
6	Dheal	Thin bamboo stick and cane material	June-December	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
7	Dubo-fand	Split of bamboo and cane material	June-October	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
8	Anta	Thin bamboo stick and cane material	January-October	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
9	Polo	Split of bamboo and cane material	November-March	Taki, Shol, Gozar, Magur, Common Carp etc	1 and donga
10	Ucha	Split of bamboo and cane material	November-February	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
11	Hogra	Split of bamboo and cane material	July-October	Baila, Batashi, Chanda, Mola, Punti, Taki, Tengra etc.	1 and donga
12	Chunga	Split of bamboo and cane material	June-December	Baila, Batashi, Chanda, Mola Punti, Taki, Tengra, Guchi etc.	1 and donga
13	Bana	Split of bamboo and cane material	July-September	-	1 and donga

Table 3: Particulars of different types of wounding gear used for fishing in the study area.

SL. No.	Name of gear	Materials Used in making gear	Fishing period	Major species Caught	Fishermen and boat needed for operation
1	Tekata	Bamboo made hook	July-October	Boal, Shol, Gozar, Catla etc.	1 and donga (Optional)
2	Koch	Bamboo made hook	July-August	Silver, Catla, Tilapia, Magur etc.	1 and donga (Optional)
3	Ek-kata	Bamboo made hook	July-September	Boal, Shol, Gozar, Catla etc.	1 and donga (Optional)
4	Achra	Bamboo made hook	December-March	Guchi, Baim, Magur, Shing, Taki etc.	1 Fisherman
5	Chare	Bamboo stick,Twine with hook	August-February	Magur, Shing, Koi, Taki, Baim etc.	1 and donga (Optional)
6	Borshi	Bamboo stick,Twine with hook	January-December	Magur, Shing, Koi, Taki, Baim etc.	1 and donga (Optional)

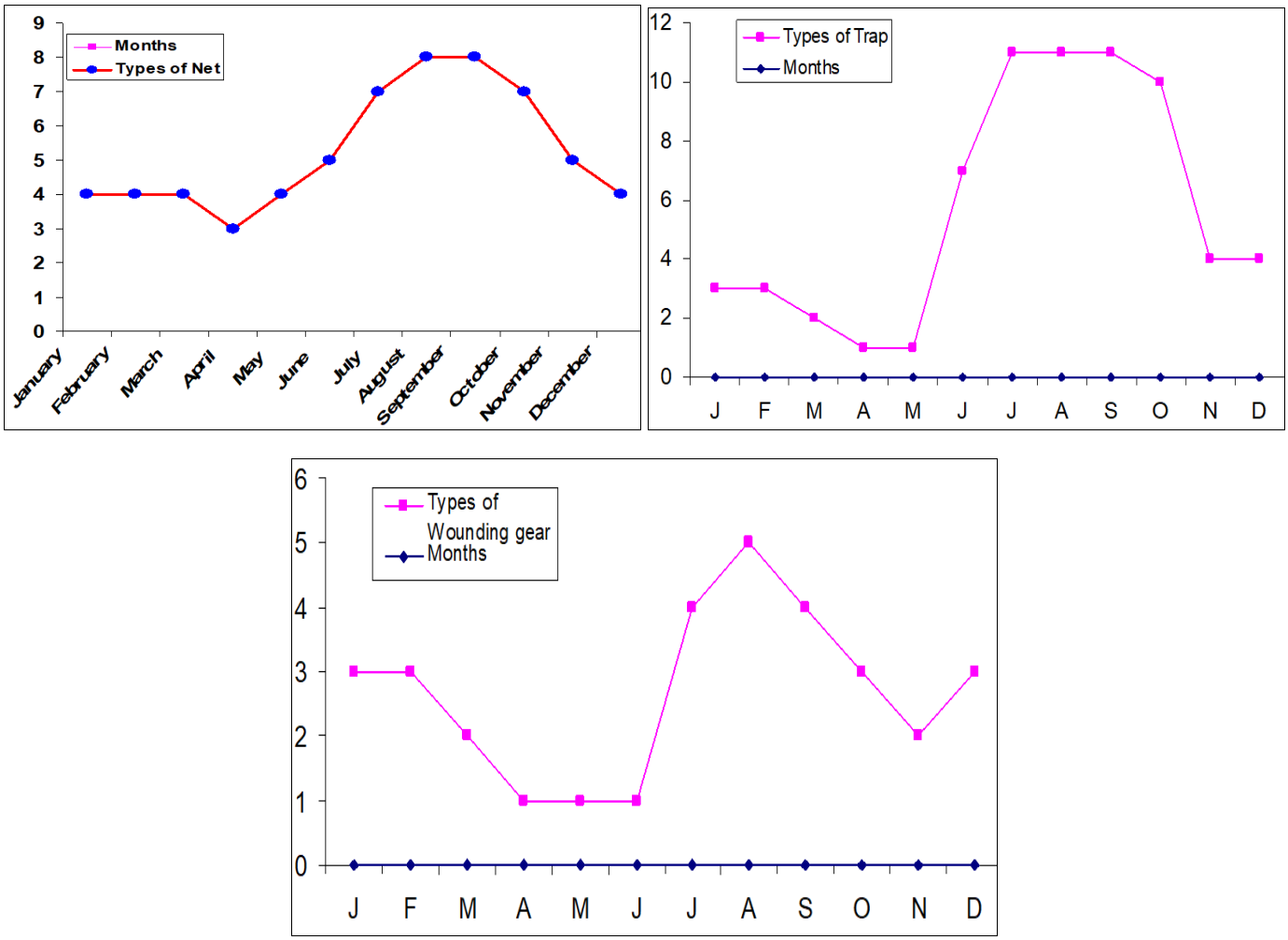

Fig 1: Month wise Use of Fishing Nets (A), Traps (B) and Wounding's Gears (C) at the Study Area

Seasonal variation of species abundance in the sampling sites

The total no. of species observed at north-western part of the Chalan Beel in this study period was 62. In terms of species abundance 46 no. of species were found in Bagihar beel (FAP-17, 1994) [12]. Kibria *et al.* (1980) [19] identified 73 species of fish in Chandpur Irrigation Project Area and there appears to be little impact by the embankment. Species abundance on beel did not follow closely. Instead, species numbers in the beels increased more gradually, coinciding with the water rise and full flood period. Maximum species numbers were recorded during the late monsoon/early winter. In study area maximum no. of species were found in October and minimum in April. (Table 6, 7 & 8).

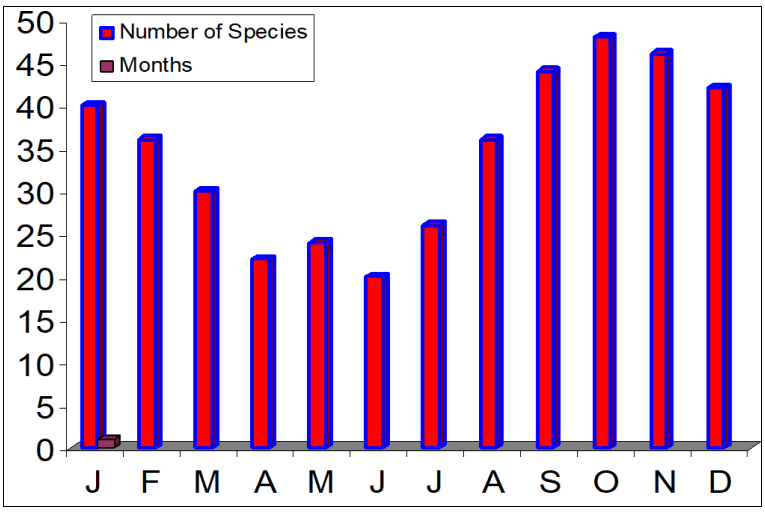

Fig 2: Number of Species Caught in Different Months at Study Area

Effects of fishing gears on fish production and catch composition in the selected area

In the study area, fairly 27 types of gears and one type of specialized fishing (Katha) method were found in operation. Many of these gears are now being used in catching fingerlings before they attain minimal marketable size.

Unplanned and unhindered uses of a few gears have posed a serious threat to fingerlings in the beels. Again, some gears are not harmful for fingerling in the beels at all. It was also found that, some gears are harmful in one season but not during other seasons. (Fig.3 &4) The gears may be categorized as very harmful, harmful and not harmful for the selected beel and shown in Table 4.

Table 4: Showing the gear which are very harmful, not harmful for the selected beels

SL. No.	Limit of harmfulness of gear	Name of the gear
1.	Very harmful	Net:Shuti jal, Fash jal(Current jal), Ber jal/Badai jal, Khora jal Specialized Fishing: Katha
2.	Harmful	Net: Kheo jal, Koi jal Trap: Anta,Chari, Ichar-chai, Cheng, Chandi bair Wounding gear: Borshi,Chare
3.	Not harmful	Net: Dharma jal, Thela jal Trap: Bair, Dheal, Dubo-fand, Ucha, Polo, Chunga, Hogra,Bana Wounding gear:Achra,Ek-kata, Koch,Tekata

Fig 3: Destructive gears operating in the study area

However, some traps like chari, ichar-chai, cheng, chandi bair which catch huge number of fingerlings, must be kept suspended from June to September. Shuti jal, Current jal, Badai jal and khora jal are very harmful for stocked and wild species and catch huge number of fingerlings from the beels before attaining legal size. Moreover, these gill and seine nets destroy spawning, nursing and feeding grounds of the wild fish species and must be kept suspended from June or July to October. Katha fishing is very harmful for wild brood stock. Katha fishing in running water (Open river) is not legal according to the Fish Act. This regulation is intended to protect brood fish which have moved from haors into river to seek over-wintering grounds. Instead of moving into the duars, the brood stock take shelter in the katha. However, the Fish Act's provisions are ignored by lease holders who use katha in rivers exclusively as a trap for brood. This fishing methods result in heavy mortality of brood stock in rivers in the winter. Another negative impact of the installation of katha in rivers is increased deposition of silt which is trapped by the reduction in current velocity caused by the katha. In the study, it was found that 8 fish species were threatened (Table 4) due to irresponsible use of fishing gears.

Table 5: Fish which are threatened at the study area.

Scientific Name	Bengali Name	Order
Labeo bata	Bata	Cypriniformes
Mylopharyngodon piceus	Black carp	Cypriniformes
Mystus aor	Airh	Siluriformes
Eutropiichthys vacha	Bacha	Siluriformes
Rita rita	Rita	Siluriformes
Nandus nandus	Bheda	Perciformes
Notopterus chitala	Chital	Osteoglossiformes
Tetraodon patoca	Potka	Tetraodontiformes

The average catch composition and production of the study area of the beel

From this study, it has been found that Cypriniformes is the most dominant order, Siluriformes is 2nd highest next to Cypriniformes followed by Perciformes, Channiformes, Mastacembeliformes, Tetraodontiformes, Osteoglossiformes, Beloniformes, Cyprinodontiformes, Clupeiformes, Synbranchiformes and Angulliformes. The total harvest, that is, production (kg.)/ha/yr. in North-Western part of the Chalan beel was ranged from 350-400 kg/ha/yr. The dominant gears catch composition are shown in Fig.4 Systematic production methods are rudimentary or absent in open-water system of Bangladesh, generally not involving stock management aimed at sustainable productions. The best technique to make floodplain water productive is to go for open-water stocking by which fish could utilize the abundant feeds available in the open-water system. It has already been proved that silver carp is unsuitable in the floodplains while detritus feeder like common carp have been doing well in the floodplains.

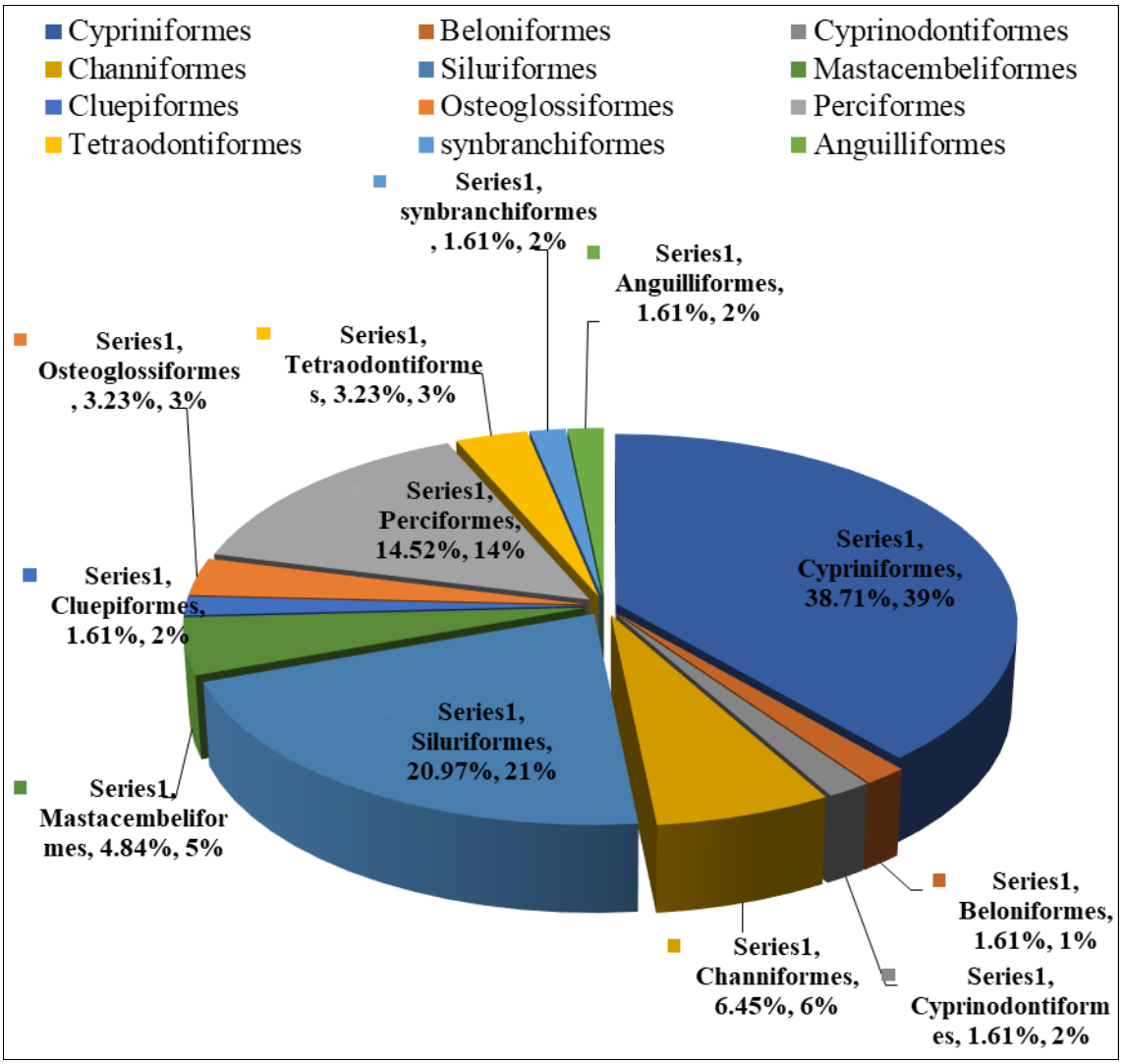

Fig 4: Catch composition of fish at the study area of the Chalan beel

Table 6: The major catch composition of the dominant gears (Net) at the study area.

Catch composition (% by number)										
Species	**Ber jal**		**Khora jal**		**Koi jal**		**Khepla jal**		**Fash jal**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Silver carp	22	1.83	1	1.59	-	-	2	2.70	22	23.4
Catla	8	0.66	-	-	-	-	1	1.35	8	8.50
Common Carp	18	1.50	-	-	-	-	-	-	10	10.64
Kalibaus	12	1.0	-	-	-	-	-	-	4	4.26
Mrigal	14	1.16	-	-	2	1.71	-	-	8	8.51
Rui	16	1.33	1	1.59	3	2.56	1	1.35	20	21.28
Thai punti	16	1.33	3	4.76	8	6.84	2	2.70	14	14.89
Baila	130	10.81	4	6.35	8	6.84	8	10.81	-	-
Baim	-	-	4	6.35	12	10.26	2	2.70	-	-
Bheda	1	0.08	-	-	-	-	-	-	-	-
Kakila	32	2.66	4	6.35	-	-	6	8.11	-	-
Kholisha	248	20.61	12	19.05	-	-	8	10.81	-	-
Koi	-	-	-	-	22	18.8	-	-	-	-
Magur	-	-	-	-	8	6.84	-	-	-	-
Punti	260	21.61	14	22.22	-	-	16	21.63	-	-
Shing	-	-	-		8	6.84	-	-	-	-
Shol	2	0.17	-		-	-	-	-	4	4.26
Taki	32	2.66	2	3.17	42	35.9	2	2.70	-	-
Tengra	72	5.99	6	9.52	4	3.42	4	5.41	-	-
Others	320	26.6	12	19.05	-	-	22	29.73	4	4.26

*Others-Mola, Pabda, Dhela, Chapila, Gutum, Chanda, Tilapia, Icha etc.

Table 7: The major catch composition of the dominant gears (Trap) at the study area.

Catch Composition (% by number)						
Species	**Anta**		**Chandi bair**		**Dheal**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Baila	4	1.61	2	3.33	6	5.45
Baim	2	0.80	1	1.67	4	3.64
Batashi	22	8.83	-	-	10	9.09
Chanda	24	9.65	-	-	14	12.73
Chela	14	5.62	-	-	8	7.27
Cheng	4	1.61	6	10	6	5.45
Darkina	80	32.13	-	-	-	-
Foli	1	0.40	-	-	-	-
Guchi	4	1.61	6	10	4	3.64
Gutum	6	2.41	12	20	8	7.27
Kanpona	14	5.62	-	-	-	-
Kholisha	20	8.03	-	-	16	14.54
Koi	2	0.80	4	6.67	-	-
Magur	-	-	1	1.67	1	0.91
Punti	14	5.62	4	6.67	8	7.27
Shing	-	-	2	3.33	1	0.91
Taki	2	0.80	4	6.67	4	3.64
Tengra	6	2.41	6	10	6	5.45
Others	30	12.05	12	20	14	12.73

*Others-Mola, Pabda, Dhela, Chanda, Potka, Icha etc.

Table 8: The major catch composition of the dominant gears (Wounding gears) at the study area.

Catch composition (% by number)								
Species	**Line Borshi**		**Koch**		**Chhip Borshi**		**Achra**	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Catla	-	-	2	20	-	-	-	-
Common Carp	2	1.63	1	10	3	6.38	-	-
Baila	40	32.52	-	-	8	17.02	-	-
Baim	2	1.63	-	-	4	8.51	16	36.36
Cheng	16	13.01	-	-	4	8.51	-	-
Chital	-	-	1	10	-	-	-	-
Koi	9	7.32	-	-	6	12.77	-	-
Magur	12	9.76	1	10	2	4.25	2	4.55
Punti	-	-	-	-	4	8.51	-	-
Shing	10	8.13	-	-	2	4.25	2	4.55
Shol	-	-	1	10	-	-	-	-
Taki	24	19.51	4	40	8	17.02	-	-
Tengra	8	6.50	-	-	6	12.77	-	-
Guchi	-	-	-	-	-	-	24	54.54

Rajpunti is suitable in defined habitat having considerable volume of vegetation and paddy. In this study the Fish production of the selected area of the beel was varied from 350 to 400 kg/ha/yr. It is not at all a gratified fish production, though the Department of Fisheries has undertaken an extensive stocking programme in this area. In 2005-2006.the annual fish production in chalan beel was 12217 tonnes (Hossain *et al*. 2009) [16]. The fish production statistics of Cherain binor, Pagla beel and Dhalai beel in Netrokona district showed 550-620 kg/ha/yr (Bashet, 1996) [5]. However, fish production in the floodplain, lakes under natural condition was recorded up to 1000 kg/ha/yr. in India (Gupta *et al.*, 1991) [15]. The appropriate management and input application in inland freshwater bodies like swamp, beel, baor and reservour were better (about 1500 kg/ha/yr) and profitable and yield even may be increased to a tune of 2606-3066 kg/ha/yr with high inputs and intensive care of the water bodies in India as reported by Ranadhir (1994) [26].

Conclusion

The fish production in the beel has declined alarmingly due to indiscriminate gear use, unplanned use of water resources and as a whole due to absence of a management policy for the open water resources of Bangladesh. In order to increase the fish production from the open water bodies some immediate action should be taken. For example, good productive permanent beel should be converted into sanctuaries. The sanctuary area of beel should include the surrounding shore line to a certain distance from the edge of the minimum water level in the beel. It is necessary to undertake active stocking programme and to formulate regulations banning the use of harmful gears for a particular period of time. The present study suggests that the total productivity of the beel can be increased to about 1000-1500 kg/ha/yr easily if some special cares are taken for improve of beel management in Bangladesh. Open water capture fishery is a natural uncultured fish production system found in all open inland water bodies in the country. Unless over-fished, disturbed or habitats altered the fish populations of the rivers, beels and floodplains are self-sustaining and self-reproducing. There is clearly a need for implementing fisheries regulations, particularly to protect nature fish during the breeding season.

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