Traditional Fishing Gears, Fish Catch and Species Composition of Selected Floodplain Wetlands of Lower Gangetic Plains, West Bengal, India

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Abstract

Floodplain wetlands (locally called as *beels*) are biologically sensitive habitats playing vital role in fish recruitment as well as acting as nursery ground for fishes and play an important role in the rural economy of West Bengal. Catch composition and details of fishing gears used in eight *beels* from four districts of West Bengal were documented. Gears based on their operation were categorised into active and passive fishing gears. Use of these gears were found to vary according to water depth, season, water area, type of fish species, availability of raw material for gear fabrication etc. The socio-economic background of the fishers as well as their traditional knowledge in fishing is also very important in the selection of gears. Most of the fishers were using gears made with netting material of nylon for catching the fishes. A total of 12 gear types along with their details, gear efficiency in terms of the type of species caught and the catch per day were recorded. Average fish catch/day was maximum for *Berjal* which varied from 75-105 kg comprising of stocked fishes like Indian Major Carps, Exotic carps as well as indigenous fishes. Use of small meshed nets was recorded in this region which may lead to imbalances in fish stocks affecting icthyodiversity as well as sustainable exploitation of fishes. Creating awareness among the *beel* fishers on the adverse effects of fine mesh nets on biodiversity was felt necessary.

Introduction

Floodplain wetlands are among the world's most productive ecosystems. They are home to a diverse array of organisms, including aquatic and terrestrial vegetation, micro and macro-invertebrates, fishes, birds, amphibians and reptiles (Ralph & Rogers, 2010). These water bodies usually represent the lentic component of floodplains *viz.,* oxbow lakes, sloughs, meander scroll depressions, residual channels and the back swamps. Floodplain wetlands are an integral component of the Ganga basin (Sugunan et al., 2000). Floodplain wetlands commonly called as *beels* in West Bengal, India are an important water resource in the state and thousands of fishermen depend on these water bodies for their livelihood (Sugunan et al., 2000). Fishing gears operated in the wetland ecosystems of north-eastern states of India have been reported by various workers (Yadava et al., 1981; Bhagawati & Kalita, 1987; Kar et al., 1999; Dutta et al*.,* 2012; Upadhyay & Singh, 2013; Purakayastha & Gupta, 2014). Traditional fishing methods and management practices called as 'fisher's knowledge' has a prominent role in the optimum exploitation of resources from these water bodies (Haggan et al., 2003). Ram & Sudip (2014) and Ishita & Surjya (2014) have studied about fishing gears in inland water bodies of selected districts of West Bengal. However details regarding gear used along with their catch details and species diversity from *beels* are scanty. The practice of catching fry and fingerlings using fine mesh nets have been reported from *beels* which may lead to depletion of several species of fishes (Sugunan et al. 2000). Proper documentation of fishing gear practices is very

significant for their scientific development and for improvement of fishermen community, as the future of the fishery is dependent on the gear selection, intensity of fishing and the level of exploitation. So the present study was an attempt to document and generate baseline information on the fishing gears and specifications, average fish catch/gear/day and species composition from selected *beels* in four districts in Lower Gangetic plains of West Bengal.

Materials and Methods

The study was conducted during January 2013 to December 2014 in eight randomly selected *beels* in West Bengal covering four districts *viz.*, Nadia, North 24-Parganas, Hooghly and Bardhaman (Fig. 1). The *beels* were Khalsi and Bhomra in Nadia district; Akaipur and Borti in North 24-Parganas; Kole and Dekole in Hooghly district; Kalbour and Kobla in Bardhaman district respectively. A total of 160 fishers (20 fishers in each *beel*) were personally interviewed through a semi-structured and pretested interview schedule. During the interviews,

information regarding the type of fishing gears operated, gear operation, their dimensions, cost of gear, species composition and average catch were collected. Field surveys were conducted along the *beels* during different harvesting periods for observing operations of the fishing gears and their catch composition. Secondary data on fishing methods, their operation and the knowledge system associated with it were also collected from literature. Fishers were personally interviewed as well as focus group discussions were held to cross check the information on various aspects of fishing gears.

Results and Discussion

About 12 types of fishing gears were mainly used by fishers in *beels* in Lower Gangetic plains of West Bengal. Fishing gears along with their vernacular names, dimensions, mesh size, cost of gear, number of fishermen required for operation, targeted species, average catch per/day are given in Table 1. Fishing gears based on their operation has been categorised into (I) Active fishing gears (Fig. 3-9)
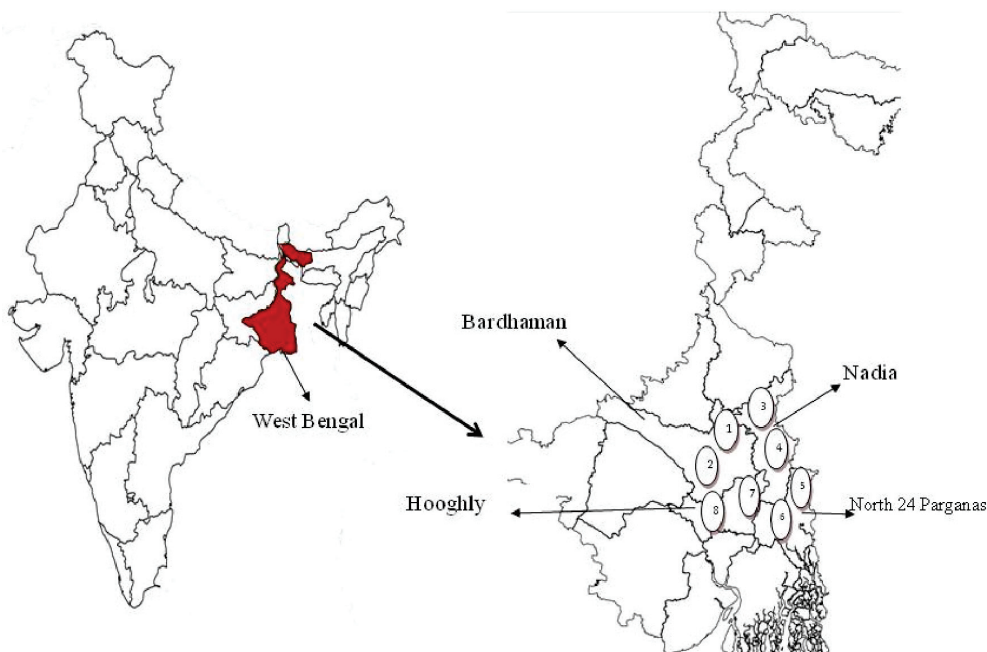
(source. www.adamrains.com/wp-content/uploads/indiawire.png)

1	Kalbour	5	Akaipur
2	Kobla	6	Borti
3	Kholsi	7	Kole
4	Bhomra	8	Dekole

Fig. 1. Map of the study sites

Table 1. Types of gears used by *beel* fishers in Lower Gangetic Plains of West Bengal

Fishing gear	Local name	Dimensions	Mesh Size (mm)	Cost of the gear (Rs)	Number of fishermen required	Targeted Sp.	Average catch/day (kg/day)
Siene net	*Ber jal*	80-200 m length and 5-6 m breadth	35-50	5000-8000	10-15	Indian Major Carps, Exotic carps, *Puntius chola, P. sophore, Pethia conchonius, Trichogaster fasciatus, T.sota, Nandus nandus, Parambassis ranga, Chanda nama, Salmophasia bacaila, Amblypharyngodon mola, Xenentodon cancila*	75-105
Cast net	*Khapla Jal*	4-5 m length and bottom 5-6 m	15-30	1000-1500	1	*Pethia phutunio, Puntius terio, P. sophore, Badis badis, Macrognathus pancalus, Chanda nama, Pethia gelius, Trichogaster fasciatus, Channa punctata, C. marulius, Anabas testudineus*	1- 5
Lift net	*Bhasal jal*	1-2 m length with net area of 3x4 m	5-10	2000	1	Indian Major Carps, *Wallago attu, Channa striata, Channa marulius, Mystus cavasius, Mystus tengara, Glossogobius giuris, Puntius* sp, *Amblypharyngodon mola,*	20-30 during monsoon; rest of the months 2-3
Push net	*Khuchni jal*	0.5-1m length	1-2	200-400	1	*Puntius* sp, *Chanda nama, Trichogaster sota, T. fasciata, Rasbora daniconius, Parambassis ranga, P. lala* ; prawns, crabs, snails	1-1.5
Hook & line	*Borshi*	Round barbed hook (no 6-20), diameter of line nylon (0.4-0.6 mm) or cotton twine (1.2 -1.5mm)		50	1	*Channa punctata, C. marulius, Anabas testudineus, Heteropneustes fossilis, Clarius batrachus, Mystus tengara*	0.5-2
Lantern net	*Chak Jal*	3.5 m length and bottom 2 m	25-30	1000	1	*Puntius* sp, *Chanda nama, Trichogaster sota, T. fasciata, Rasbora daniconius*	1-3
Cover pot	*Polo*	70-90 cm with bottom radius of 50 cm, top opening of 15 cm	-	100-120	1	*Channa* sp, *Anabas testudineus, Notopterus notopterus, Mastacembelus armatus, Macrognathus pancalus, Monopterus cuchia, Lepidocephalichthys guntea*	1-4
Gill net	*Phasa jal*	40-50 m length, height 2-4 m	50-100	2000	1-2	Indian Major Carps, Exotic carps, *Mystus* sp, *Glossogobius giuris, Anabas testudineus*	3-10

Small meshed gillnet	*Punti jal*	10-20 m length, height 0.5 to 1m	20-30	1000	1	*Puntius sp, Trichogaster sp, Chanda nama, Rasbora daniconius, Amblypharyngodon mola*	0.5-3
Long line	*Dhaon borshi*	Round barbed hook (no 8-18), diameter of main line (1.5-2 mm) and branch line (1.5 mm)	-	600	1	*Channa punctata, C. striata, Clarius batrcahus, Anabas testudineus, Macrognathus pancalus, Mystus* sp.	5-6
Box trap	*Ghuni*	0.8-1.5 m length, width 0.2-0.3 m, height 0.3-0.4 m	-	120-150	1	Prawns, *Trichogaster fasciata, Puntius* sp., *Pethia terio, Parambassis ranga, P. lala*	0.5-2
	Atol	1.2-1.5 m length, width 1-1.2 m, height 0.5-0.8 m.	-	200-250	1	Small carps, *Mystus* sp, *Channa* sp, *Puntius* sp., *Pethia terio, Parambassis ranga, P. lala* and prawns	1-3
Spindle traps	*Chai*	0.5-1m height, width 0.3-0.4 m	-	120-150	1	*Puntius* sp., *Pethia terio, Parambassis ranga, P. lala* and prawns	1-2

and (II) Passive fishing gears (Fig. 10-14). Active fishing gears comprise of moving nets or gears for capturing fishes whereas passive fishing gears trap fishes that voluntarily moves into a stationary device (Daniel et al., 2013).

It was found from the survey that most of the fishers used gears made of nylon. About 23% of the fishers were using *Berjal* or seine net in the *beels* for harvesting fishes (Fig. 2). Gill nets were used by 21% of the sampled fishers followed by lift nets (14%) and cast nets (9%). Hook and line (8%) is also used by the fishers. Traditional traps were commonly used for catching small indigenous fishes (SIFs). About 7% of the respondents reported that they use box traps (*Ghuni, Atol*) followed by spindle shaped trap, *Chai* (4%) to harvest small indigenous fishes. Only 2% use cover pot or *Polo* to catch fishes from the *beels*.

Ber jal is the most common type of gear used in *beels* made of nylon operated especially during harvesting of the stocked fishes such as Indian Major carps *Catla catla, Labeo rohita* and *Cirrhinus mrigala* and exotic carps *Hypophthalmichthys molitrix, Ctenopharyngodon idella* and *Cyprinus carpio* (Ram & Sudip, 2014). It's a large wall of rectangular netting. The size of the net varies from 80-200 m length and 5-6 m breadth with head rope carrying floats and foot rope with sinkers. Floats were made of thermocoal pieces attached to headrope at regular intervals and lead sinkers were attached to footropes. *Ber jal* is similar to *Ber jaal* in Assam but floats are mainly plastic cans, wood piece or bamboo (Praveen et al., 2009). The duration of operation is around 3-5 h and operated throughout the year. Mesh size varies from 35-50 mm and this is usually operated by a group of 10-15 people. About 80% of the stocked fishes are caught with this net and average catch varies from 75-105 kg day^{-1}. The net is operated from two boats, one boat which remain stationary carries one side of net and the other end carried by a second boat encircles the water spread and drags the net towards shore and fishes are handpicked. Indigenous fishes like *Puntius chola, P. sophore, Pethia conchonius, Trichogaster fasciatus, Trichogaster sota, Nandus nandus, Parambassis ranga, Chanda nama, Salmophasia bacaila, Amblypharyngodon mola, Xenentodon cancila* etc are caught by *ber jal* and their catch ranges about 200 g to 1 kg day^{-1}. Sometimes fishermen also use small seine nets of very fine mesh sizes (mosquito nets) for catching juveniles.

Cast net *(Khapla jal)* is a type of falling gear most commonly used in vegetation free or clear zones of
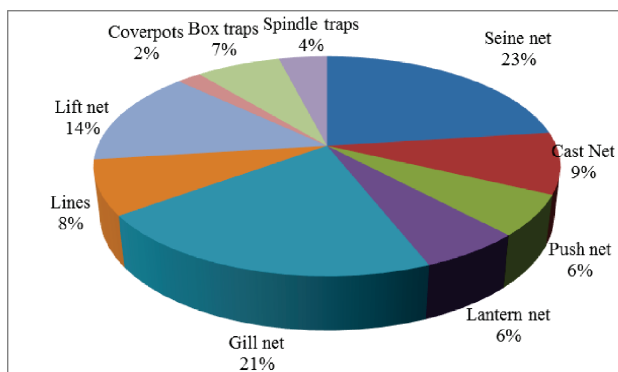
Fig. 2. Percentage composition of *beel* fishers using various traditional gears in Lower Gangetic Plains of West Bengal

beels either from a boat or from shore for catching small fishes like *Pethia phutunio, Puntius terio, P. sophore, Badis badis, Macrognathus pancalus, Chanda nama, Pethia gelius, Trichogaster fasciatus.* The same gear also catches air breathing fishes like *Channa punctata, C. marulius, Anabas testudineus* etc. as they come to water surface for gulping air. *Khapla jal* is a cone shaped net mostly made of nylon material with a head line to haul the net and cylindrical iron sinkers at the distal end of the net which is folded inward to form a pocket to trap the fishes while hauling. These castnets are similar to stringless castnets with pockets reported from Kerala as well as north-east hilly regions (Ramesan et al., 2018; Praveen et al., 2009). The net is operated by single person and the height of the net is around 4-5 m. The net has a circumference of about 5-6 m at the bottom which when thrown over the water surface covers the fishes from the top and as the headline is reeled, the fishes inside the net get trapped in the pocket and the net is lifted up.

Lift net *(Bhasal jal)* are manually operated, usually by a single person. Net is of square shaped made of nylon and four corners are fastened to a flexible crossed bamboo frames. Each bamboo frame is of 1-2 m length with net area of 3x4 m. A lifting pole is attached at the centre of the crossed bamboo frames in order to lift the net from the water. The front part of net facing the water current is usually dipped into the water and the rear end remains about 2 m above the water surface. When the fish swimming along with water current moves into the dipped part of the net, the fisherman lifts up the net to prevent escape of the fish and fishes are then collected. The net is operated throughout the year

mainly in the channels of open *beels* with water current. Lift nets were also reported to be in operation in rivers from North Eastern states of India (Gurumayum & Chaudhury, 2009; Kar et al. 2007). The maximum catch is obtained during monsoon months upto 20-30 kg day^{-1} and the average catch varies from 2-3 kg day^{-1} during rest of the year. The fishes mainly caught were both the large sized fishes like Indian Major Carps, *Wallago attu, Channa striata, Channa marulius, Mystus cavasius, M. tengara* and small fishes like *Glossogobius giuris, Puntius* sp, *Amblypharyngodon mola*, etc.

Push net *(Khuchni jal)* is a very common, simple and handy net used to capture small fishes especially in weed infested shallow areas of *beels* and operated throughout the year. This is made up of 3 bamboo pieces tied together to form a triangular frame to which a fine meshed net is attached. A single person operates the net by pushing it below the aquatic vegetation for scooping out various animals including fishes, prawns, crabs, snails etc. The fishes caught are mainly small sized species like *Puntius* sp, *Chanda nama, Trichogaster sota, Trichogaster fasciata, Rasbora daniconius, Parambassis ranga, P. lala* etc. This net is widely used by women and children of fishermen community for household consumption.

Hook & line *(Borshi)* is a type of hand line fishing with a nylon (0.4-0.6 mm Ø) or cotton twine (1.2 - 1.5 mm Ø) tied to one end of a flexible bamboo rod and the other end of the twine tied with a hook having baits for attracting the fishes. Commonly used baits are earthworm, small prawns, snail meat, and wheat flour paste. Normally round barbed hook with hook no 6-20 is used. *Borshi* is operated by a single person and the fishes caught are mainly carnivorous fishes like *Channa punctata, C. marulius, Anabas testudineus,* and catfishes like *Heteropneustes fossilis, Clarius batrachus* and *Mystus tengara. Borshi* is used for catching the fishes throughout the year. Choudhury (1989) has also reported that *Borshi* are used round the year with greater intensity during monsoon.

Lantern net *(Chak jal)* is another kind of falling gear having a conical net fitted inside a bamboo frame. The bamboo frame consists of a circular ring fitted with four bamboo poles which are tied together at the top to form a cone. The net is usually operated throughout the year when water level are low in the vegetation infested areas of the *beel. Chak jal* is

Fig. 3-9. Active fishing gears used by *beel* fishers in Lower Gangetic Plains of West Bengal:
(3) *Ber jal* (4) *Khapla jal* (5) *Bhasal jal* (6) *Khuchni jal* (7) *Borshi* (8) *Polo* (9) *Chak jal*

Fig. 10-14. Passive fishing gears used by *beel* fishers in Lower Gangetic Plains of West Bengal: (10) *Phasa jal* (11) *Dhaon borshi* (12) *Ghuni* (13) *Atol* and (14) *Chai*

reported to be operated in *beels* of Assam in shallow macrophyte infested areas (Bhattacharjya et al., 2004). It is operated by a single person. When the fishes are located, the fisherman thrusts a bamboo stick into the bottom so that the fishes jumps out of the mud and he drops the lower part of the net which is tied to the circular frame into the water, while holding the upper portion of the net. As the fishes get trapped in the nets, the upper part is untied and the fishes are taken out from the net. Mostly *Puntius* sp, *Chanda nama, Trichogaster sota, T. fasciata, Rasbora daniconius* are caught and the catch varies from 1-3 kg day^{-1}.

Cover pot/ Plunge basket *(Polo)* is a bell shaped hand operated trap. The proximal opening is narrow gradually widening towards the distal opening. Polo is made of large number of thick bamboo sticks which are tightly tied using either coir or nylon thread and the basket is reinforced from inside with the help of broader piece of bamboo stick. The height of bamboo basket ranges from 70-90 cm with bottom radius of 50 cm and top opening of 15 cm. These baskets are usually operated in the shallow marginal areas of *beel* during dry season when water level is low. The tip of each bamboo stick forming the lower margin of the *polo* is made pointed for easy penetration in the mud. The trap is pushed inside the mud to prevent fish escape. With the help of oar/ bamboo stick, fishers randomly disturb the encircled bottom so that the fish comes out of the mud or vegetation. Once the fisherman feels the presence of the fish, he collects the trapped fish through the proximal opening of the trap. Fishes living or hiding inside the mud such as *Channa* sp, *Anabas testudineus, Notopterus notopterus, Mastacembelus armatus, Macrognathus pancalus, Monopterus cuchia, Lepidocephalichthys guntea* etc are usually caught by this gear.

Gill net *(Phasa jal)*: This is a long wall of netting made of nylon monofilament with several panels hung from the head line with floats on the upper side and attached to a foot line with lead sinkers in the lower side. The net is deployed from a boat and spread vertically in the water column with the help of two poles on both the ends which are anchored to the bottom. The size of the net varies from 40-50 m length with a height of 2-4 m and mesh size of 50-100 mm and is operated from evening to early morning hours by one or two fishermen. The net is operated throughout the year mainly for catching the stocked fishes like Indian Major carps, Exotic carps and indigenous fishes like *Mystus* sp, *Glossogobius giuris, Anabas testudineus* etc and the average catch per day is about 3-10 kg. *Phasa jal* is also a major gear operated in rivers throughout the year (Ram & Sudip, 2014). Small sized gillnet with smaller mesh sizes locally called as *Punti jal* are also used for catching small indigenous fishes like *Puntius* sp, *Trichogaster* sp, *Chanda nama, Rasbora daniconius, Amblypharyngodon mola* etc. The size of the net usually varies from 10-20 m length and height of 0.5 to 1 m with a mesh size of 20-30 mm. The average catch per day of *Punti jal* is about 0.5 to 3 kg. Some gears such as *Punti jal* are designed in such a way to catch particular species in water body especially for *Puntius* sp and *A.mola* as reported by Ishita & Surjya, 2014 based on their studies from rivers in Birbhum district of West Bengal.

Dhaon borshi is a drifting long line having a main line of cotton twine (1.5-2 mm Ø) to which about 20-25 branch lines (1.5 mm Ø) are hung at regular intervals. Each of these branch lines are provided with hook on one side and other side is tied to small wooden floats which keeps the line floating. A series of such wooden stakes are set in water and all of them are tied to the main line. Round barbed hook with hook numbers 8-18 are normally used. The main line is anchored on both sides with the help of poles. *Dhaon borshi* is operated throughout the year. Fishes caught by this gear are mainly *Channa punctata, C. striata, Clarius batrcahus, Anabas testudineus, Macrognathus pancalus, Mystus* sp etc.

Box trap *(Ghuni)* is a rectangular shaped box trap made of fine bamboo sticks and tied up with coir rope or nylon twines. Both the front and back walls of the trap are involuted at two places leading to vertical opening which guide the fishes into the trap. Fishes trying to move either way along the obstruction get into the device and get trapped inside the box in the process. In the upper portion an opening is provided to collect the trapped fishes. *Ghuni* is structurally similar to *Ghani/Boldha* operated in *beels*, derelict waterbodies and inundated paddy fields from Assam and the only difference is that baits such as crushed snails are used in *Ghani* wheras in *Ghuni* no baits are used (Praveen et al., 2009). Most of these traps are unique, indigenously designed and fabricated by traditional fishermen themselves based on area, location and behaviour of the fishes (Deepjyoti et al., 2013). Size of the trap varies from 0.8-1.5 m in length, width of 0.2-0.3 m and height of 0.3-0.4 m. Traps are usually hung in

a series of 10-20 numbers in the water column inside the submerged macrovegetation with the support of ropes and poles. Sometimes the traps are also deployed intermittently along a barricade made of mud or macro vegetation in the marginal areas of the *beel*. Traps are set for whole day mostly in weed infested areas and taken out from water about 4-5 h interval for removing catch. These traps are operated throughout the year. Small prawns and fishes are caught, mostly the small fishes such as *Trichogaster fasciata, Puntius* sp, *Pethia terio, Parambassis ranga, P. lala* etc. Another type of Box trap called as *Atol* is of larger size having one or two 'V' shaped inlet. This is made of bamboo splits and the frame is made of bamboo sticks. In the opposite side of the inlet there is a small opening covered with a flap to collect the fishes. The trapping mechanism is designed in such a way that at the entrance two split bamboo strip are arranged vertically in such a manner that bamboo splits remain loosely interspersed into each other making the trap a non-returning device. Sometimes these traps are also baited with insects/snail meat. Fishes like small sized carps, *Mystus* sp, *Channa* sp, small indigenous fishes *Puntius* sp., *Pethia terio, Parambassis ranga, P. lala* and prawns are caught by these traps. These traps are about 1.2-1.5 m long, 1-1.2 m width and 0.5-0.8 m in height.

Spindle trap *(Chai)* is a spindle shaped trap used by the fishers in open *beels* as well as rivers, particularly to catch prawns and other small fishes. These traps are usually set in a series of 8- 12 numbers, hung just below the water level with the help of ropes and anchored on both sides with the help of bamboo poles. Traps are set for the whole night and taken out from water about 6-7 h interval and catches are removed. Size of the trap varies from a height 0.5-1 m and width of 0.3-0.4 m. Fishes caught by *Chai* are mainly *Puntius* sp, *Pethia terio, Parambassis ranga* and *P. lala*.

In the present study 12 types of traditional fishing gears were documented from *beels* in Lower Gangetic plains of West Bengal. These fishing methods vary according to season, water depth, ecological zones, physical characteristics of the selected *beels* particularly on hydrological connectivity, as well as type of fish species and availability of raw material for gear fabrication (Sugunan et al., 2000). Floodplain wetlands can be categorized into microhabitats such as macrophyte infested area, macrophyte free zone, deeper zones, etc necessitating diversified gear application. In the macrophyte infested areas gears like pushnet, lantern net, boxtraps like *Ghuni* are employed, where as in shallow macrophyte free zones, castnets are used. In the deeper macrophyte free zones of wetland, gillnets and hook and line are used, and in the open *beels* with water current lifnets are used. The type of fishing method is vital to fish stocks as the fishing methods directly influences their sustainable exploitation. This can be achieved by wise deployment, modification and selection of appropriate fishing methods. Fishing with traditional gears is eco-friendly compared to the destructive fishing like chemical poisoning, dynamiting, electro-fishing, use of fine mesh-sized nets etc., which not only captures the non targeted fishes but also damages the whole aquatic environment (Dutta et al., 2012). Except the gears made of very fine mesh nets (eg: small meshed seine nets, castnets etc), the traditional gears reported in the present study are mostly selective gears such as traps, hook and line and gillnets. These gears capture large sized fishes and thereby indirectly allowing the immature fishes to grow to bigger sizes. Increased development and continued conversion of wetlands to other uses result in wetlands being degraded or destroyed. In Asia alone, about 5000 km² of wetland area are lost annually to agriculture, dam construction, and other uses (McAllister et al., 2001), with resultant decrease in suitable habitats. In the present study gears with very fine mesh nets are also reported and indiscriminate use of the fine mesh nets may exert high fishing pressure to the fishery resources which will lead to imbalances in sustainable wetland fisheries (Suresh et al., 2010). Sensitisation of fishers towards the importance of best management practices through awareness campaign and imposition of gear restrictions, mesh size regulations and ban if needed, can ensure healthy ecosystem and sustainable fisheries. People's participation through cooperation in the management of these aquatic resources by selecting the appropriate gears during different fishing season will be useful for proper exploitation of fishes and thereby promoting sustainable *beel* fisheries.

Acknowledgements

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