

FISHING GEARS OF THE MEGHNA RIVER ESTUARY OF CHANDPUR REGION, BANGLADESH

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ABSTRACT

The Meghna river is one of the largest rivers in Bangladesh and sustains country's important multi-species commercial fishery. A large number of fishing crafts and gears are operated in the Meghna estuary for commercial exploitation of the fishery resources. The present study was conducted to know the types of fishing gears and their mode of operation in the Meghna river estuary of Chandpur. The survey was designed to gather information on the type of gears, process of operation, cost, manpower needed for operation, seasons of operation and principal species of fish caught. The survey revealed that a wide variety of fishing gears were operated throughout the year in the study area for commercial fishing. Of the total, 5 gill, 2 seine, 1 fixed purse, 1 cast, 1 dip, 1 lift and 2 drag nets, 6 traps, 7 hooks and lines and 3 wounding gears were found in the study area. Some of the gears were selective for a particular species, whereas others account for a number of species caught during operation giving multispecies nature of the fishing. But a number of the fishing gears was found to catch fish irrespective of their size or species and destroys the habitat of the wild species thus causing multiple harms to the biodiversity of the estuary. An awareness or training program should be conducted to the fishermen to create awareness of the long-term effects of different fishing gears and to impart knowledge of fishing laws.

KEY WORDS: Fishing Gear, Gill Net, Fishing Traps and Meghna River

INTRODUCTION

Fish and fisheries items have been providing food or animal protein for millions of poor people in Bangladesh (Akter *et al.*, 2012; Islam *et al.*, 2012; Ahmed *et al.*, 2012; Hossain *et al.*, 2013). The Meghna river is one of the largest rivers in Bangladesh (Hossain *et al.*, 2009, Hossain, 2011) and sustains country's important multi-species commercial fishery. A large number of fishing crafts and gears are operated in the Meghna and its estuary for commercial exploitation of the fishery resources (Moula *et al.*, 1993; Das and Banargii, 2000). Fishing gear is any form of equipment, implement, tool or mechanical device used to catch, collect or harvest fish (Banglapedia, 2006). The principal categories of fishing gears that are traditionally used in Bangladesh can be enumerated as the following: fishing nets, fishing traps, hooks and lines, wounding gears and fish aggregation device (Chakraborty *et al.*, 1995). Various types of materials are used to make these fishing gears include netting, twine, plastic structural and fasteners, clips and swivels, ropes, steel wire ropes, combination wire ropes, purse rings, polyester, polyethylene, nylon, cotton, polypropylene, mixed fibers, floats and sinkers, bamboo, wood etc. (Hameed and Boophendranath, 2000). The shape and size of the gear depends on the use of gears and the environmental condition of the water body. Published literatures outline the description, mode of operation and classification of fishing gears of the Meghna River is very scanty. Such information is very much essential for developing a sound management practice for the commercial fishery in the river. In view of the above, the present study was conducted to know the types of fishing gears and their mode of operation that are employed for the exploitation of the fishery resources in the Meghna river estuary of Chandpur region.

MATERIALS AND METHODS

The present investigation was imposed on Meghna river estuary of Chandpur district in Bangladesh during the period between 15 February and 14 July, 2010. The primary data were collected from fishermen of the fishing community, direct observation of fishing gears at the time of operation and from the local fishing gear market. Data about gear size, operation mode, building materials, fish species caught, etc. were collected by interviews and personal communication from the estuarine area. Interviews were conducted through face to face interview method by using semi-structured open ended questions. Cross-check interviews were conducted with key informants such as Upazila Fisheries Officer (UFO), District Fisheries Officers (DFO) and relevant GO and NGO officers and staffs. The data collected were compiled and discussed to have a clear idea about the gears operated in the Meghna river estuary.

RESULTS AND DISCUSSION

The survey revealed that a wide variety of fishing gears were operated throughout the year in the Meghna river estuary near Chandpur district for commercial fishing. Some of the gears were selective for a particular species, whereas others

account for a number of species caught during operation giving multispecies nature of the fishing. The gears found in the study area were classified into four types: fish net, fish trap, hook & line and wounding gear.

Fishing nets

Fishing nets were grouped into 7 categories according to the mode of operation and catching of fish viz., gill net, seine net, fixed purse net, cast net, dip net, lift net and drag/push net (Table 1). Gill nets were the principal and common type of net used in the region mainly for catching Hilsa (*Tenualosa ilisha*). These are single walled nets with a mesh opening of such a size that the required fish is gilled themselves in the net. This is a passive gear, but fish can also be driven into the gill nets. The nets were used singly or in series. They are vertical walls of netting normally set out in a straight line. Floats and sinkers are attached plastic ropes are used as head ropes and foot ropes. Five types of gill nets were widely operated in the study area viz., *punti jal*, *bata jal*, *ilish jal/chandi jal*, *poa jal* and *fash jal*.

Punti jal: *Punti jal* is a rectangular shaped gill net commonly operated in the estuary made of cotton twine or monofilament. It is known as *punti jal* because it catches mainly *punti* and other small size fish. The net is 10 to 30 m long and 0.5 to 1.0 m wide having a mesh size between 2.2 and 3.5 cm. Most *punti jals* have both floats and weights attached to them, though some have only floats. The net is operated in both surface layer and bottom layer of the water body. The net is usually set in the morning in shallow water but sometime it is also operated from boat both day and night. One to two persons are needed to operate the net. Cost depends on the size of the net usually varies between 500 to 5000 BDT and the life span of the net is 1-3 years. Catch per unit effort was found to be 1 to 5 kg. It can be used in all over the year to catch small sized fish like *Punti (Puntius spp.)*, *Bele (Glossogobius giuris)*, *Gulsha (Mystus cavasius)*, *Bata (Labeo bata)*, *Koi (Anabas testudineus)*, *Pangus (Pangasius pangasius)*, *Poa (Otolithoides pama)*, etc (Table 1).

Ilish jal/Chandi jal: *Chandi jal* is the most common gill net operated in the area (Fig. 1). The length of the net is 650 to 700 m and width is 10 to 12 m having a mesh size between 4 and 4.5 cm. The net is constructed by Polyamide monofilaments, polypropylene or nylon rope. Both floats and sinkers are attached to the net. The net is rectangular in shape and 10 to 15 persons are needed to operate this net. The net is drifted with water current and the gill of fish is trapped in the mesh of the net. Construction cost of this net is 300000 to 400000 BDT having a life span of 3 to 4 years and has a catch per unit effort of 120 to 150 kg. The net is operated from the boat and generally used in the whole year except the fish banning period. Mainly Hilsa (*Tenualosa ilisha*) and *Poa (Otolithoides pama)* is caught by the net. This net is also used in Rajshahi, Khulna, Chittagong, Noakhali etc. (Ahmed, 1971).

Poa jal: *Poa jal* is a gill net made of polyamide monofilaments and nylon rope (Figure 2). The length of the net varies from 60 to 70 m and the width is 3.6 to 4.5 m. The net is rectangular in shape and the mesh size of the net is 3.5 cm. The net is operated by 4 to 5 persons from the boat in both day and night. Both floats and sinkers are attached to the net and the net is drifted with water current and the gill of fish is trapped in the mesh of the net. Construction cost of this net is 5000 to 100000 BDT having a life span of 1 to 3 years. Hilsa (*Tenualosa ilisha*), *Poa (Otolithoides pama)* and *Bata (Labeo bata)* are the main species caught by net. This net is also used in the river of Dhaka, Noakhali etc. (Ahmed, 1971).

Fash jal: *Fash jal* is a rectangular shaped monofilament gill net with a mesh size between 4.5 and 15.0 cm. The length of the net is 20 to 200 meter and the width is 1 meter. Floats are used at the head line, whereas ground line is provided with earthen weights. The net is fixed in the water with two bamboo poles like a large wall of net. Generally it is set on the border line or in shallow water of the estuary. The catch per unit effort of the net is 30-50 kg which is operated by 1 or 2 persons. Construction cost of this net is 15000 – 200000 BDT having a life span of 1 to 3 years. *Pangus (Pangasius pangasius)*, *Poa (Otolithoides pama)*, Hilsa (*Tenualosa ilisha*), *Bata (Labeo bata)* and *Ayre (Mystus aor)* are the main species caught by the net (Table 1).

Bata jal: The rectangular shaped gill net which is mainly used to catch Bata fish is locally known as *bata jal*. The length and width of the net is 6.5 to 33 m and 1.25 to 2 m respectively, whereas the mesh size varies from 2.5 to 5 cm. The net is fixed on tide near the shore by using bamboo, wood and iron but sometimes the net is operated from the boat which requires 2 to 3 persons. The construction cost of this net is 50000 BDT having a life span of 1 to 2 years. The main species trapped in the net are *Bata (Labeo bata)*, *Chewa (Odontambyopus rubicundus)* and *Poa (Otolithoides pama)* with a catch per unit effort of 4 to 10 kg. Seine nets are designed to be towed in an arc around fish shoals to surround them. As the seine net has a very fine mesh size, fish of both small and large size are vulnerable to such gear. Usually one end of the net is attached to a pulley or anchored on the shore and a boat is used to pull the net into a large arc back to the shore before hauling in (Kibria and Ahmed, 2005). *Shatting jal/jagat ber jal* and *gosi jal/khoti jal* are the most used type of seine net in the study area.

Shatting jal/ Jagat ber jal: *Ber jal* is a fine mesh size seine net which is commonly used in estuary (Figure 3). It is large in size, usually 50 to 200 m long and 5 to 6 m wide with a mesh size ranges between 0.5 and 2.3 cm. Length, depth and mesh size vary with the depth of the area and the species to be caught. After surrounding the part of a water body with this net, the two ends of the net are drawn together and the ground rope is hauled up from the center of the water body to catch the fish. As it has a very fine mesh size so during operation, this gear catch fish irrespective of their size or species and destroys the habitat of the wild species thus causing multiple harm to all the fish living on the estuary. So, the use of this gear is banned in the estuary in spawning season (June to October). Generally 12 to 15 people are needed to operate the net and the construction cost of this net is 200000 to 300000 BDT. Although it catches almost all types of fishes but it is mainly used to catch Juvenile Pangas (*Pangasius pangasius*), Poa (*Otolithoides pama*) and Juvenile Hilsa (*Tenualosa ilisha*).

Gosi jal/Khoti jal: *Gosi jal* is a very large size seine net, usually 0.5 to 1.0 km long and 1 to 2 m wide. It is generally operated in the *char* area (River Island). A lot of bamboo poles are staked in the soil and the net is kept at the bottom of the pole. When the high tide reaches its higher level, then the net is moved upward by the fishermen up to the top of the bamboo pole and the bottom side of the net remains in the soil. After the complete removal of water by the low tide, fish remain in soil and they are collected from the ground easily by fishermen. One to ten persons are needed to operate the net and it is operated both in day and night. The cost of the net is 20000 to 100000 BDT having a catch per effort of 5 to 100 kg. Small fishes and Hilsa (*Tenualosa ilisha*) are the main species caught by this net. Fixed purse nets are purse shaped net placed against water current in rivers, estuaries and foreshore. This net is locally called *behundi jal* which is also known as *Shangala jal* (Hornell, 1923).

Behundi jal: *Behundi jal* is a purse or conical in shape net and has two extensions (Fig. 4). The length of the net is 12 to 15 m and width of mouth of the net is 11 to 12 m. The mesh size at the mouth of the net is 5 to 6.25 cm and at the end of the pouch is 0.5 to 1.25 cm. The net is constructed by polyamide monofilaments, polypropylene, polyvinyl chloride or nylon rope, in traditional practice the net is made up of nylon ropes and is knotted. Mouth of the net is spread and fixed on tide by bamboo, wood or iron. Fish is trapped in the centre pouch of the net and net is monitored carefully for 2 to 3 hours. Two persons are required to operate the net where the catch per unit effort is 100 to 300 kg. The durability of the net is 2 to 3 years whereas the construction cost is 200000 BDT. The main species trapped in the net are Bata (*Labeo bata*), Kuchia (*Monopterusuchia*), Koral (*Lates calcarifer*), Koi (*Anabas testudineus*), Chewa (*Odontomyxus rubicundus*), Chiring (*Apocryptes bato*), Bashpata (*Brachypleura novaezealandiae*), Poa (*Otolithoides pama*). This net is also found in Khulna and Chittagong locally known as *behuti jal* (Ahmed, 1971). Cast net is made up of three parts: the upper section (net band), the middle section (a conical-shaped net mesh), and the lower section containing pockets fixed by iron weights. Cast net, locally known as *Jhaki jal/Khapla jal*, is used in the shallow region of the river and estuary to catch different types of fish.

Jhaki jal/Khapla jal: The net is conical shaped where it is 3 to 6 m long from anterior part to the posterior end with 6 to 12 m in diameter of the mouth (Fig. 5). The mesh size of the net is 0.625 to 1.25 cm. One person can operate this net as the weight of the net is 3 to 6 kg. The net can be operated in tide, ebb-tide and in the freshwater also at both day and night. Construction cost of the net is 5000 to 10000 BDT having a catch per unit effort of 1 to 5 kg. The main species caught by the net are Bata (*Labeo bata*), Chela (*Salmostoma bacicala*), Taposhi (*Polynemus paradiseus*), Baim (*Mastacembelus armatus*), Koi (*Anabas testudineus*), Koral (*Lates calcarifer*), Kuchia (*Monopterusuchia*) and Prawn. The net is found in all over the Bangladesh, known as '*khapla*' in Dhaka, Mymensingh, Rajshahi, Jessor, Bogra, Pabna, Rangpur and Dinajpur, '*jhanki*' in Rangpur, '*chlatki*' in Chitragong, '*Dhundi and kheo*' in Sylhet, '*teora*' in Jessor and '*pheka*' in Dinajpur (Ahmed, 1971). Framed or Dip net are triangular shaped small fishing net made of bamboo frame with which the net is fixed in a water body. This net is locally named as *khara jal* and mainly used at the mouth of the canal to river.

Khara jal: The net is 5 to 7 m long where the front side is 2.5 to 3.5 m wide and the mesh size of the net is 0.5 to 2 cm (Fig. 6). Two bamboos are attached at an angle of 35° to make the triangular shape and a bamboo frame stage is build over the narrow canal for staying, pulling and collecting the net from the water body. The triangular portion of the net is lowered to the shallow water areas, the lower portion of the net block total passes way of fish and the fishes are trapped. The net is constructed by polyamide monofilaments, polypropylene or nylon rope but in traditional practice the net is made up of mosquito net available in the market. All small size fish are caught by the net but the main species are Ketchki (*Corica soborna*), Bele (*Glossogobius giuris*), Shoal (*Channa striatus*), Taki (*Channa punctatus*), Puntii (*Puntius spp.*), Koi (*Anabas testudineus*), Pangus (*Pangasius pangasius*), Poa (*Otolithoides pama*), Tengra (*Mystus vittatus*) and Prawn. The net is operated by one person and generally used in the rainy season having a life span of 1 to 2 years. The construction cost of the net is 10000 to 20000 BDT having a catch per unit effort of 1 to 5 kg.

Lift net is a hand operated and portable net generally used in the shallow region of the river to catch small fish. This net is locally named as *dharma jal*.

Dharma Jal: The common shape of the net is square and it is fitted with two bamboo strips arranged in cross-bars and connected at the four corners of the net (Fig. 7). The arranged crossbars with the net are then attached with another lever for lifting the net from of the water. The mesh size of the net is 0.5 to 2 cm. Sometimes the size could be made bigger and fixed at some strategic water areas e.g. *Khoda Jal* and *Konaghar Jal*. The net is generally used in the rainy season and the construction cost is 5000 to 50000 BDT. The main species caught by the net are Bele (*Glossogobius giuris*), Taki (*Channa punctatus*), Shoal (*Channa striatus*), Puntis (*Puntius spp.*), Koi (*Anabas testudineus*), Gulsha (*Mystus cavasius*) and Baim (*Mastacembelus armatus*). The net is also used in Potuakhali, Barishal, Comilla, Dhaka, Khulna and Chittagong district of Bangladesh (Das and Banerjee, 2000)

Drag nets/push nets are held apart with triangular bamboo frame and pushed manually to fish in the traditional waters of river, beels and floodplains, locally called *Moi Jal* and *Thela Jal*.

Moi jal/Tana jal: *Moi jal* is a small fishing gear having a length of 2 to 3 m, width 1.2 to 2.2 m and mesh size 2 to 5 cm (Fig. 8). The upper end of the net is fastening with a bamboo pole and the lower part of the net contains sinkers. It is operated in the bottom of the river from a boat by using a long thread. The construction cost of the net is 1000 to 1200 BDT which is relatively cheaper than other nets. The net is mainly used to catch prawn and can be used in the whole year having a catch per unit effort of 5 to 20 kg.

Thela jal: *Thela jal* is a triangular shaped push net constructed by polyamide mono-filament nylon rope with an extended handle of two bamboo poles, one is longer than other, are fixed at an angle of 30° (Fig. 9). Its two arms are 2 to 3 m long and front side is 1 to 1.5 m long having a mesh size of 0.2 to 1.0 cm. The triangular portion of the net is lowered and pushed forward along the bed of the shallow water areas. The net is used at all time of the year and one person can operate this net. Construction cost of this net is very low ranges from 200 to 1000 BDT. All small size fish is caught by the net but the main species are Gulsha (*Mystus cavasius*), Koi (*Anabas testudineus*), Chewa (*Odontambyopus rubicundus*), Bashpata (*Brachypleura novaezeelandiae*) and Prawn.

Table 1. Different types of net used in the Meghna river estuary of Chandpur region

Gear type	Local name	Construction cost (BDT/net)	Mesh size (cm)	Fishermen needed for operation	Species caught
Gill net	<i>Punti jal</i>	500 to 5000	2.2 to 3.5	1 to 2	Punti, Bele, Gulsha, Bata, Koi, Pangas, Poa
	<i>Ilish jal / Chandhi jal</i>	300000 to 400000	4 to 4.5	10 to 15	Hilsa, Poa
	<i>Poa jal</i>	5000 to 100000	3.5	4 to 5	Hilsa, Poa, Bata
	<i>Fash jal</i>	15000 to 200000	4.5 to 15.0	1 to 2	Pangas, Poa, Hilsa, Bata, Aire
	<i>Bata jal</i>	50000	2.5 to 5	2 to 3	Bata, Chewa, Poa
Seine net	<i>Shatting jal/ Jagat ber jal</i>	200000 to 300000	0.5 to 2.3	40	Juvenile Pangas, Poa, Juvenile Hilsa
	<i>Gosi jal/Khoti jal</i>	20000 to 100000	0.2 to 1	01 to 10	Small fishes, Hilsa
Fixed Purse Net	<i>Behundi jal</i>	200000	5 to 6.25 and 0.5 to 1.25	02	Bata, Kuchia, Koral, Koi, Chewa, Chiring, Bashpata, Poa
Cast net	<i>Jakhi jal / Khapla jal</i>	5000 to 10000	0.625 to 1.25	01	Bata, Chela, Taposhi, Prawn, Baim, Koi, Koral, Kuchia
Dip net	<i>Khara jal</i>	10000 to 20000	0.5 to 2	01	Ketchki, Bele, Shoal, Taki, Puntis, Koi, Pangas, Poa, Tengra and Prawn
Lift net	<i>Dharma jal</i>	5000 to 50000	0.5 to 2	01	Bele, Taki, Shoal, Puntis, Koi, Gulsha, Baim
Drag/ Push net	<i>Moi jal</i>	1000 to 1200	2 to 5	02	Mainly prawn
	<i>Thela jal</i>	200 to 1000	0.2 to 1	01	Gulsha, Koi, Chewa, Prawn, Bashpata



Fig. 1- *Chandi jal*, Fig. 2- *Poa jal*, Fig. 3- *Jagat ber jal*, Fig. 4- *Behundi jal*, Fig. 5- *Jhaki jal/Khapla jal*, Fig. 6- *Khara jal*, Fig. 7- *Dharma jal*, Fig. 8- *Moi jal*, Fig. 9- *Thela jal*, Fig. 10- *Vair*, Fig. 11- *Kholsun*, Fig. 12- *Banar Ghop*, Fig. 13- *Icha chai*, Fig. 14- *Borshi*, Fig. 15- *Teta*.

Fishing traps

Fishing traps are mostly bamboo and wooden made mechanical devices used in shallow water by both professional and non-professional fishermen. It is very difficult to classify the traps because same device has different names in different districts. Six types of fishing traps were identified in the study area viz., *Vair*, *Kholsun*, *Unta/icha chai*, *Bitte*, *Banar ghop* and *Pangus chai*.

Vair: *Vair* is a long box like trap with a door extending from its base to its apex which is made of split bamboo sticks tied with creeper or cane (Figure 10). The general features of trap: height 1 to 1.2 m, length 0.5 to 1 m, width 0.5 to 0.85 m and gap between two bamboo sticks is 1 to 4 cm. In front of *Vair* a barrier is created with split bamboo made *Bana*. The trap is used in shallow portion of the estuarine area and the main species caught by the trap are Carpio (*Cyprinus carpio*), Rui (*Labeo rohita*), Catla (*Catla catla*), Boal (*Wallagonia attu*), Taki (*Channa punctatus*), Shoal (*Channa striatus*), Gazar (*Channa marulius*) and Baim (*Mastacembelus armetus*).

Pangus chai: *Pangus chai* is a large box type trap made of bamboo splits having two or three trap door in each of the side of the trap. Its length is 3 to 5 m and width is about 2 to 3 m. The trap is suspended under water just below surface level by using a bamboo pole or by a boat. Different types of bait are used to lure the small size *pangus* (*Pangasius pangasius*). Due to the bait large number of small fish of different species is attracted to the trap which makes this trap a destructive one for fish biodiversity.

Kholsun: *Kholsun* is a rectangular box shaped fish trap made of split bamboo, tied with jute rope or cane and consisted of two doors from its apex for fish opening (Figure 11). Height, length and width of the trap are 0.75 to 1 m, 1 to 1.25 m and 0.3 to 0.5 m respectively and the gap between two bamboo sticks is 0.5 to 1 cm. The trap is set in shallow part of the estuary with the help of bamboo pole or tree branches during early morning or evening from January to July. Small fish like Baim (*Mastacembelus armetus*), Koi (*Anabas testudineus*), Punti (*Puntius spp.*), Tengra (*Mystus vittatus*), Katchki (*Corica soborna*), Mola (*Amblypharyngodon mola*), Chanda (*Chanda nama*), Khalisha (*Colisa fasciatus*) and small prawn are trapped in the trap.

Bitte: *Bitte* is a basket shaped fishing trap, made of split bamboo with two or three entrances and an opening on the trap for collecting fish. Height, length, width and gap between two bamboo sticks of the trap are 0.25 to 0.5 m, 0.25 to 1 m, 0.1 to 0.5 m and 0.5-1.0 cm respectively. The trap is sunken (0.1 to 0.75 m below from water surface) in shallow water, where small current is present during early morning and evening checked up every one or two hour interval. Usually small fishes are caught by the trap including Baim (*Mastacembelus armetus*), Koi (*Anabas testudineus*), Punti (*Puntius spp.*), Tengra (*Mystus vittatus*), small prawn etc.

Banar Ghop: *Banar Ghop* is used as a barricade or trap for fish, made of split bamboo (Fig. 12). The bamboo pieces are tied with one another either by coconut fiber, nylon or by iron wires. Have no definite size, width of the barricade or traps depend upon the water level. It is fixed vertically in shallow water areas of the estuarine area against the water current with the help of bamboo poles. Mainly large sized species are caught but Rui (*Labeo rohita*), Catla (*Catla catla*), Tengra (*Mystus vittatus*) and prawn are the main target species. It is used from July to January.

Icha chai: *Icha chai* is a triangular or cylindrical shaped trap made of bamboo splits and threads (Fig. 13). The length and the width are typically about half and quarter of a meter respectively. The device has small trap doors at one end and the other end remain close by a rope and also used to collect fish. Bait is used to lure the fish. The trap is kept at the shore area where the intensity of the water flow is low and generally operated at the night period. This trap is used in the whole area to catch Baim (*Mastacembelus armetus*) and prawn.

Hooks and Lines : Hooks are manufactured in a wide range of size, and the gap between the point and the shank appears to be the dimension, which determines the size range of fish caught by a particular hook. The most familiar type of manufactured steel hook is “J” shaped, which is mostly used for hook and line fishing. Seven types of hooks and lines were found in the study area.

Sip or Barshi: *Sip or Barshi* is a very simple barbed hook tied with one end of a line and the other end with a bamboo stick (Figure 14). Above the hook there is a float used to drift the hook into desired sub surface of water level which also indicates that if the fish is baited or not. Earth worm and small prawn is used as bait. Main fish species caught by this type of gear are Kalibaus (*Labeo calbasu*), Koi (*Anabas testudineus*), Shing (*Heteropneustes fossilis*), Punti (*Puntius spp.*), Rita (*Rita rita*), Tengra (*Mystus vittatus*) and some carp species.

Borsha: *Borsha* is a gear where a narrow small portion of dried bamboo reed is used as float from which a small about one hat long line is hanged with barbed baited hook. It is used to catch Koi (*Anabas testudineus*), Taki (*Channa punctatus*), Puntti (*Puntius spp.*), Tengra (*Mystus vittatus*) and some other small fish.

Daun: *Daun* is a long line measuring from 46 to 450 m, which is set into shallow water with bamboo poles 4 to 6 cm above water. A small line of 0.45 to 1 m with barbed hooks is lowered into water with bait. The baits include earthworm, cockroach, puntti and guchi fish and toad. One *daun* may contain even more than 500 hooks. In the secondary river, the two opposite and the long line is set on the two opposite banks across the river sinkers. But in the Estuary the line is attached with large sinker for lowering and the two other ends are attached to two floats. Fish caught by this long line are Rita (*Rita rita*), Baim (*Mastacembelus armatus*), Taposhi (*Polynemus paradiseus*), Shoal (*Channa striatus*), Taki (*Channa punctatus*), Gazar (*Channa marulius*) etc.

Maita Daun: *Maita Daun* is a baited long line which may contain even up to 4 to 5 thousand hooks. It is usually used in flowing water with heavy current. The baits include earthworm, small prawn/icha, puntti and guchi fish. The hooks are set with 10 cm interval. A boat is needed to operate this lines and two to three people are involved to operate the line. Fish caught by this long line are Boal (*Wallago attu*), Ayre (*Sperata aor*), Koi (*Anabas testudineus*), Taki (*Channa punctatus*), Puntti (*Puntius spp.*), Kalibaus (*Labeo calbasu*), Shing (*Heteropneustes fossilis*), Rita (*Rita rita*) etc.

Tana Barshi: *Tana Barshi* contains one or two baited hooks having no float, is used to catch bottom water fish where earthworms are used as bait. The free end of the line is tied with a fixed stake posted on the ground of the riverbank or in hand of the fishermen. Baim (*Mastacembelus armatus*), Gaura (*Clupisoma garua*), Boal (*Wallago attu*), Kalibaus (*Labeo calbasu*), Rui (*Labeo rohita*) and Mrigal (*Cirrhinus migala*) are the main fish species caught by this gear.

Chara Basrhi: *Chara Basrhi* is a special type of gear composed of a small stick with a very small thread and a barbed hook. Before two or three hours of fishing, the fisherman tied his boat in a fixed place with bamboo poles posted on the bed or in the bank of the river. Then the fisherman hanged the pieces of viscera of livestock with bad smell down the water to attract the fishes and small pieces of rotten viscera are also thrown into water to confuse fishes. When large number of fish aggregates, the fisherman laid the chara barshi and hauled very quickly without bait. As a result, fish gutted the hook consuming as food. The efficiency of this gear is very good in terms of fishing time required to about 40 to 60 kg fish within an hour. Different types of fish are caught by this gear but the main species are Rui (*Labeo rohita*), Kalibaus (*Labeo calbasu*), Mrigal (*Cirrhinus migala*), Ayre (*Sperata aor*), Pangus (*Pangasius pangasius*) and Taposhi (*Polynemus paradiseus*).

Zomka Barshi: *Zomka Barshi* is similar to *barshi* or *sip* but here more than 5 hooks are used in the same thread after a definite interval with bait. Fish caught by this device are Rui (*Labeo rohita*), Kalibaus (*Labeo calbasu*), Mrigal (*Cirrhinus migala*), Ayre (*Sperata aor*), Pangus (*Pangasius pangasius*) etc.

Wounding gears

Spears are the fishing devices which are used to catch fish by throwing or wounding fishes. Three types of spears are mainly used in the Meghna Estuary.

Juti: *Juti* is made of 5 to 10 bamboo splits attached to the shaft by cords measuring 2 to 3 m in length. The gear is thrown to the surface feeding fish like Boal (*Wallago attu*), Shoal (*Channa striatus*), Taki (*Channa punctatus*) etc.

Konch: *Konch* is similar to *juti* but more than 10 pieces of bamboo splits are firmly fixed in a bunch. The pointed ends of the bamboo splits are covered with sharp and pointed iron caps to increase the efficiency. The fishermen wait with great patience from a boat or from any craft or just standing on the bank of water body and when find the fish, throw the gear with a great force at the fish so as to pin down, when strikes the fish. Fish caught by this gear are Rui (*Labeo rohita*), Catla (*Catla catla*), Shoal (*Channa striatus*), Gozar (*Channa marulius*) etc.

Teta: *Teta* is a wounding gear made of a long bamboo handle about 2 to 4 long and several iron hooks with iron rod at the base (Figure 15). The length of iron rod is about 60 to 65 cm with hooks at the apex. The iron rod with hooks is tightly tied with the bamboo handle by coconut thread or iron wire. The fisherman throws the gear to target species like Boal (*Wallago attu*), Shoal (*Channa striatus*), Taki (*Channa punctatus*), Bele (*Glossogobius giuris*) and others fish species. In addition to the use of gears for fishing, other devices viz. hand catch, fishing by *katha fishing* (spots where bushes/branches of plants are accumulated to gather fishes) are also practiced in all the study area.

CONCLUSIONS

Although Meghna Estuary is rich with fishery resources but the use of fishing gears that catch fish irrespective of their size or species will destroy the habitat of the wild species thus causing multiple damages to all the fish living in the estuary. For that, the use of selective fishing gears which have the capability to catch fish of distinguishing size and species will help to protect the target species hence reduce the loss of fish biodiversity. Though the use of several types of fishing gear is limited and regulated under the national fishery laws, but they are still used. As the operation of all types of gear cannot be banned immediately to allow the stocked fingerlings to grow out, it is important to identify the gear that can be operated without exploiting undersized fingerlings stocked under the government plan and the gear that should be regulated. The main fundamental objective of responsible fishing is to maximize economic returns to the fishermen without affecting the long-term sustainability of the fishery resources and with minimum impact on the ecosystem. At the same time, an awareness or training program should be conducted under the supervision of DoF (Department of Fisheries, Bangladesh) to the fishermen to create awareness of the long-term effects of different fishing gears and to impart knowledge of fishing laws.

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