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Analysis of gill net selectivity on *Labeo rohita* in Kosi River of Madhepura, Bihar

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ABSTRACT

In this study Analysis of gill-net selectivity for Labeo rohita in the River Kosi was estimated. Fishermen are using small mesh size gill net and capturing immature fishes. Study of Length at first maturity has been carried out to prevent the catch of immature fish. Traditional fishing was performed by using gill-net with 90 mm, 110 mm and 140 mm mesh-size during February, 2023 to October 2023. From the Kosi River tributary, a total of 630 specimens of *L. rohita* were caught by gill-net during the study period. Mean total lengths were calculated as 25.7 ± 2.7 cm, 32.2 ± 2.78 cm and 36.33 ± 4.69 cm for 90 mm, 110 mm and 140 mm mesh sizes gill-net respectively. Selectivity analysis indicated an optimum catch length of 290.50 mm for the 90 mm mesh size, 368.26 mm for the 110 mm mesh size and 390.89 mm for the 140 mm mesh size gill-nets. The predominant species was *Labeo rohita* (57%) followed by *Catla catla* (22%), *Cirrhinus mrigala* (16%) and *Cyprinus carpio* (5%) with respect to the total landings. The cast net fishery consists of five species being the Murrel (*Channa* sp.), Tilapia (*Tilapia mossambicus*), Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*) and Catla (*Catla catla*) whose mean Catch Per Unit Effort (CPUE) was found to be 50-60 kg per day. The catch percentage of *L. rohita* by 90 mm, 110 mm and 140 mm mesh size gill-net were 36.68%, 41.20% and 23.22% respectively. The majority of fishes caught by these three-mesh size gill-net were found to be matured. Therefore, 110 mm mesh size were suitable for the sustainable fisheries of *L. rohita* in the River Kosi in Madhepura district of Bihar.

Key Words - Length at First maturity, Gill Net, *Labeo rohita*, Gear Selectivity, Fishing pressure, Kosi river.

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INTRODUCTION

India ranks as the world's third- largest fish producing country, accounting for 8 percent of global fish production and holding the second position in aquaculture output. In the year 2021-22, the total fish production reached 16.24 million tonnes, with 4.12 million tonnes from marine sources and 12.12 million tonnes from aquaculture. There are wide varieties of fish species available in the reverine system. Out of the, 28500 fish species now known to exist in the world, 2200 fish species are known to exist in the various aquatic ecosystem of India. Anthropogenic pressure has been exerted heavily on reverine ecosystems over past few decades, causing deterioration and the loss of fish habitat. As a result, numerous fish species are now seriously threatened. The combined interplay of several ecological characteristics, such as temperature, size and surface area, yearly discharge, depth, flow velocity, topography, substrate nature, and climate determine the

velocity of fish species in river and their tributaries. In addition to being a significant component of the aquatic food chain, energy flow, nutrient cycling, and ecosystem services, fish are an essential consumable food source for human. Kosi River is an important tributary of mighty Ganga River system. It originates from Himalaya, Nepal and flow through the different districts of Bihar and meets the Ganga River system at Kursela, Katihar, Bihar. India boasts a diverse array of commercially significant fish species, thriving in its abundant water resources encompassing seas, estuaries, rivers, canals, reservoirs, streams, and associated wetlands. Rivers are playing an important role in the country's inland fish production and thereby helping the country to meet the challenges of nutritional security of the people, besides providing opportunities for livelihood and new employment generation. Despite this fact, rivers are one of the most threatened habitats. Inland fish production as well as fish diversity is decreasing because of pollutions, wanton fishing methods and other anthropogenic activities. However, scientific and eco-friendly approaches of development, coupled with an integrated management plan are the right options for increasing fisheries production of the country. India is one of the mega biodiversity hotspots in the world and stands on the ninth position in terms of freshwater mega biodiversity (Mittermeier *et al.*, 1997). A survey conducted in Madhepura district of Bihar discovered 12 fish species in the river Kosi, belonging to the Cyprinidae and Botinae families (Selakoti, 2018). Pinkey (2016) conducted surveys during August 2015 to January 2016 to predict the diversity of the fishes in Koshi Barrage; species diversity was found to be higher in winter (1.47) than in rainy season (1.18). The Kosi River and its surrounding area play a crucial role as a significant resource for fishing and irrigation, supporting the livelihoods and employment of numerous fishing communities. Despite its significance in fisheries, there is limited research on the diversity of fish species, the eco-fishery status, and ecology of this region. The Kosi River and its surrounding area play a crucial role as a significant resource for fishing and irrigation, supporting the livelihoods and employment of numerous fishing communities. Despite its significance in fisheries, there is limited research on the diversity of fish species, the eco-fishery status, and ecology of this region. The present communication deals with ichthyofaunal diversity, Growth pattern & gill net selectivity in this river at Madhepura district of Bihar.

MATERIALS & METHODS

Primary data collection involved surveying various fishers using survey sheets and conducting on- site observations to gather information on fishing gear. This information encompassed the technical specifications of design, operation, and catch details for both gillnets and cast nets. Secondary information was obtained from research papers and local fishermen. This present study was conducted between February, 2023 and October, 2023.

STUDY AREA

River Kosi also known as Gumati in Madhepura & its tributaries like Sahogar, Arar ghat. Main Fishing centers located at Birpur-Nepal, Supaul, Lalpur, Singheshwar, Jajhat sabda, Patarghat, Silet, Saur bazar, Kursela, Khagaria and its meet to Ganges basin. Fishes caught in Kosi River are Kanti, Boari, Tengra, Bami, Magur, Darhi, Bhunna, Sauraki, Bhora, Rohu, Catla, Mrigal, Silver carp, Grass carp, Common carp, Reva, Singhi & others. Common net used are Cast net, Mosquito net, Mardi (One finger, less than 100gm fish), Drali (2 fingers,100-150gm fish), Tiani (3 fingers,150-200gm fish), Chauali (4 fingers,2-5kg fish), Panchaudha (5 fingers,5-10kg fish), Mahajal (150x25 feets), Current jaal. Common Gear used are Bhala-Sauhat, Boat with light, Assi cage, Gill net, Hook & lines and Boat used are Wooden plank built (15x6 feet).

Sustainable aquaculture development necessitates sustained production at a level which creates minimal impact on the environment. This is possible only when one carefully applies the economic and ecological principles to aquaculture. Presently most of the world's fishery resources are near the point of over exploitation it is because of the fact harvesters prefer to avoid under exploitation. Therefore, over exploitation of fish

Gill Net used in Kosi River

Fisherwomen involved in fishing activity in Kosi River

Fish caught by Gill Net in Kosi River

Fish caught from Kosi River

Fish caught by Cast Net in Kosi River

Fish caught from Kosi River

stocks becomes almost unavoidable. At global level, there has been observed a declining trend in fisheries due to pollution of water bodies, Lack of fish, unethical fishing methods/nets/gears, over exploitation and other anthropogenic disturbances etc. Therefore, there is urgent need to check or control these factors for sustainable development of fisheries through Analysis of Gillnet Selectivity to commercially important carp fishes in Kosi River and adjacent areas, so that the fish should be caught after the first maturity stages and the adequate fish population should be maintained in the Kosi River.

The Kosi River system comprises of several smaller rivers, viz, Bagmati, Burhi Gandak, Tilinga, Dhemura, Balan, Kamla, Jibachh and other rivurlets and innumerable dhars, Ox-bow lakes, Chaurs, Wetlands, mauns and swamps which serve variously for irrigation, inland fisheries and for the production of several other aqua crops. The river Kosi drains a total catchment area of 7403089 sq. kms. out of which only 1140817 sq. kms. (15.41 per cent) lies in Bihar and remaining 6262272 sq. kms. {84.59 per cent) is in Tibet and Nepal. It has a total length of 492 km. (Rao, 1975) which constitutes the mainstay of fresh water capture fishery of north Bihar. Fisheries from this region faced the requirement of not only various parts of Bihar but also to other states (Srivastava & Munshi 1983). Right from the entrance of this river in the

Table 1. Fish species available in Kosi River, Madhepura, Bihar

Sl. No.	Family	Species	Common Name
1	Cyprinidae	*Catla catla* (Hamilton-Buchanan)	Catla
2		*Labeo rohita* (Hamilton-Buchanan)	Rohu
3		*Cirrhinus mrigala* (Hamilton-Buchanan)	Mrigal/Naini
4		*Cirrhinus Reba* (Hamilton)	Reba carp
5		*Ctenopharyngodon idella*	Grass Carp
6		*Hypophthalmichthys molitrix*	Silver Carp
7		*Cyprinus carpio*	Common carp
8		*Puntius sophore* (Hamilton-Buchanan)	Pool barb/Spotfin swamp barb/Stigma barb/Pothi
9		*Puntius conchonius* (Hamilton-Buchanan)	Red barb/Rosy barb/Kharauli Pothi
10		*Puntius phutunio* (Hamilton-Buchanan)	Spottedsail barb/Dwarf barb
11		*Puntius terio* (Hamilton-Buchanan)	Teri barb/ Onespotbarb
12		*Puntius sarana sarana* (Hamilton-Buchanan)	Olive barb/Pothia
13		*Amblypharyngodon mola* (Hamilton-Buchanan)	Mola carpet
14		*Parluciosoma daniconius* (Hamilton-Buchanan)	Blacline rasbora
15		*Esomus danricus* (Hamilton-Buchanan)	Indian Flying barb
16	Clupidae	*Gudusia chapra* (Hamilton-Buchanan)	Indian river shad
17	Bagridae	*Mystus vittatus* (Bloch)	Striped dwarf catfish/Tengra
18		*Aorichthys seenghala* (Sykes)	Giant River Catfish/Tengara Seenghari
19		*Aorichthys aor* (Ham-Buch)	Long whiskered catfish
20		*Mystus cavasius* (Ham-Buch)	Barsingarah/Singarah
21	Schilbeidae	*Pseudeutropius atherinoides* (Bleeker)	Indian Potasi
22		*Eutropiichthys vacha (*Hamilton,)	Batchwa vacha
23	Siluridae	*Wallago attu* (Schneider)	Boal/ Helicopter catfish
24		*Ompok bimaculatus* (Bloch)	Butter catfish
25	Mastacembelidae	*Mastacembelus armatus*	Zig-zag eel/spiny eel/
26	Belonidae	*Xenentodon cancilla*	Asian needlefish
27	Cobitidae	*Lepidocephalichthys guntea* (Hamilton,)	Guntea loach
28		*Botia lohachata*	Reticulate loach
29	Clariidae	*Clarias batrachus*	Magur/Walking catfish
30	Heteropneustidae	*Heteropneustes fossilis*	Singhi/Stinging catfish

Indian territory of Bhimnagar Barrage, the river is bounded by two embankment the eastern and western to control flood. The river forms many interlacing channels due to its profuse branching. On account of vast ramification of the river course the fisheries of this region is greatly diffused with a multitude of landing and production centers. There are twelve leading fishing centers and Arhat (assembling centers) located at Bhimnagar barrage, Saraigarh (35 km. downstream of barrage), Supaul (20 kms down stream of Saraigarh), Naunatha (25 km down stream of Supaul), Saharsa, Simri bakhtiyarpur (40 km. downstream of Nauhatta), Dumarighat (30 kms down stream of Simiribakhtiyarpur), (Narayanpur 99), Sonbarsa ghat, Satishnagar, Kotana and Kursella (situated near the confluence of Kosi and Ganga). Fishing at all these centers is very lucrative over a major part of the year. So far, the flood prone areas in Kosi River basin are concerned it is to be pointed out that out of 15 river basins in Bihar, 7 falls in North Bihar, one the Ganga stem and 7 in Central Bihar. The river basins of north Bihar are mainly known for Kosi River basin, which has the largest flood prone areas (10.80 lakh ha). It is a snowfed river and hence perennial. The catchments area falling in Bihar is distributed under several districts of North Bihar plains (Sub-zone I) and North-East plains (Sub zone II) of middle Gangetic Plains Agro Climatic Zone. The total population in the Kosi River basin is about 85 lakhs and out of it 85 per cent population constitute the workforce 11 in agriculture which are destroyed by recurring floods. However, the occurrence of floods in the region has a peculiar advantage of possible fishery area in the form of flood plains, called in common parlance as 'chaurs' having a water spread area of about 2 lakh hectares as estimated in Investigation into Selected Water land Problems in north Bihar (1991). Thus, the region has much of potentials of fish farming but due to non-promotional exercises of the government it is almost halted. In Kosi River basin, floods are regular, recurrent and unfailing annual visitors. Between the year from 1953 to 888 2003 the flood damages have been enormous and all crops washed away. Houses collapsed. Public utility vanished. Bihar is primarily agricultural state and floods destroy agriculture. The result is that the people have nothing to eat.

RESULT

In the Kosi River, fishing activities have primarily been carried out using gillnets and cast nets. Gillnets are widely used fishing equipment and are categorized based on the mesh size, targeting species such as catla, rohu, mrigala and common carp. The river is currently being fished using coracles. The country craft is a saucer-shaped object made from split bamboo mats, and it is not created using the fishing craft. The internal space of the coracle varied in diameter, measuring between 2 and 2.5 inches. It is straightforward, affordable, and long lasting. The FRP coracles have also been utilized for fishing in rivers, with internal areas ranging from 1.5 to 2 diameters.

The Design and technical specifications of the gill nets were carefully considered and planned:

The technical specifications of set gill nets (specific target species) in the Kosi River are outlined in table 2. The study revealed that Set gillnet, as the dominant fishing gear, was used with a length of 300 meters, maintaining a constant presence. The range of mesh sizes used was from 3000 to 4500, with mesh sizes varying from 110 to 280mm. The number of mesh size was found to be lower for catla compared to rohu, mrigala, and common carp net, as similar for length and weight. The number of meshes used in the catla net, rohu, mrigal, and common carp net were 30 and 35mm for the former two and 50mm for the later three. The horizontal hanging coefficient was 0.5 and the vertical hanging coefficient was 0.86. The depth at which the gillnets were set varied between 5 and 10 meters, influenced by the natural habitat and intended catch of the species. The maximum depth of 10 meters was necessary to operate the mrigala and common carp net, which had a thickness of 0.3 to 0.4 millimeters, and a minimum depth of 5 meters for catla, which had a thickness of 0.4 millimeters. This varies the risk of mesh breakages by more strengthened fishes, such as catla. In contrast, 15 pieces of thermocole (20 grams) were

utilizes as floats, while 60 numbers of cement stones or led beads (5 grams) were employed as sinkers. Polypropylene twines were utilised as head rope, foot rope, and for rigging purposes. The intricate design elements of gill nets utilized in the Kosi River are depicted in the figure 1.

Table 2. The Technical specifications of commercial gill nets operated in Kosi River

Sl. No	Particulars	Rohu gill net	Catla gill net	Mrigala gill net	Common Carp gill net
1	Webbing material	Nylon	Nylon	Nylon	Nylon
2	Twine Thickness	0.3 mm	0.4 mm	0.3 mm	0.3 & 0.4 mm
3	No. of meshes in length	4500	3000	4500	4500
4	No. of meshes in breadth	50	30 & 35	50	50
5	Mesh size	110 and 120 mm	180, 200, 220, 240, 260 & 280 mm	110 and 120 mm	120 mm 180 mm
6	Horizontal hanging co-efficient	0.5	0.5	0.5	0.5
7	Vertical hanging co-efficient	0.86	0.86	0.86	0.86
8	No. of floats	15	15	15	15
9	Specifications of float	20 g of Thermocole	20 g of Thermocole	20 g of Thermocole	20 g of Thermocole
10	No. of sinker	60	60	60	60
11	Specifications of sinker	5 g lead	5 g lead	5 g lead	5 g lead
12	Type of mounting	Reeving	Reeving	Reeving	Reeving

The Seasonal changes in gill net catches were observed and recorded:

The species composition and catch per unit effort of fish caught using gillnets from February to October in 2023 were recorded in Kosi River was observed. The catch was accounted for, with 58% of its being *Labeo rohita*. Following the order of *Cirrhinus mrigala* (29%), *Catla catla* (12%) and *Cyprinus carpio* (2%), the fish species were observed in the sum of all landings. The data collected on catch and effort showed that there were noticeable variations depending on the season. It observed that the highest CPUE value of 11.66 was recorded on July 2023. The catch rate was consistently high from June to September, surpassing the catch per unit effort of 11kg/boat/day. The share of rohu was greater. The minimum daily consumption of 5.07 kg/boat was recorded in the study. During the July months, the catch per unit effort (CPUE) showed a moderate level of fish landings, ranging from7.34 to 9.61 kilograms of waste were generated per boat per day. It was clear that the catch was higher during the monsoon season.

DISCUSSION

Various fishing gears was utilized in the river of India, including passive gear. Gillnets were widely used and appeared to be effective fishing equipment. The water level of the river is regulated by rain that will vary on season and flow of water. Approximately 60% of the total catches were contributed by gill nets of various mesh sizes, including 44, 60 and 75mm. The consistent number of meshes in length, the horizontal hanging coefficient remain unchanged. The number of sinkers and their weight, along with the different mesh sizes, varied from 120 to 160 mm guage, which operated in the Kosi River of Bihar, was significant mode of operation in the region. The extent and width of the gillnet were extensive. The fishery in the Kosi River is similar to the hilsa gillget, with both methods being used to catch fish. Gillnets are made up of Polyamide monofilament, the present finding coherent figure with reports of George (2002), and Ramesan and Ramchandran (2005). In Ganga fishery dissimilar fishing gear were operated among gill nets found to be higher contributed about 68% of the total fish catch followed by traps (15%), seine (7%) and other gears (10%).

George *et al.* (1975) studied the catch efficiency of different coloured fishing gear, found that, yellow coloured gillnet dominated in CPUE followed by orange, green and white in Govindsagar reservoir, though white coloured gillnet was prominently operated in Kosi River and majorly contributed to overall production of the river. In the competition of gillnet design, framed gill net proved to be more efficient than simple gillnet because it can

withstand more disturbance in its position. Fishing monsoon season was the major factor influencing the fish catching efficiency, which reported in Kosi River and Gumati River, as similarly catch per unit effort was higher in the month of July in Kosi River. Nevertheless, cast net, low catch, is a non- selective fishing gear and challenging to operate in deeper sections of the river. The use of cast nets was not significantly beneficial in freshwater fish farming. The efficiency of gillnet was decided through light transparency which influence fish behavior and assumed that fishes are more vulnerability in the river at second half of night during the twilight hours were fishes are more active.

CONCLUSION

This study found that gillnets and cast nets are used for fishing in the Kosi River, Bihar. Gillnet mesh size and depth are determined by the targeted species. Labeo rohita was the most commonly caught fish using gillnets, followed by *Catla catla, Cirrhinus mrigala,* and *Cyprinus carpio*. Carp catches were highest during the monsoon season (June to September), as evidence by the catch per unit effort (CPUE) for these species during that period. Cast nets, with the CPUE of approximately 20-30kg per days, are also used but their effectiveness is limited by the availability of suitable fishing grounds, making them more of a sampling tool. The current state of the Kosi River indicates a scarcity of fish due to the use of undersized mesh nets, overfishing, and poisoning by illegal activities. Therefore, optimizing net mesh sizes and providing fishermen with training and education on responsible fishing practices are crucial for increasing fish populations and improving their livelihoods.

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