

AN INSIGHT TO THE COMMERCIAL FISHES OF RIVER GANGA

ARCHISMAN RAY^a, THANGJAM NIRUPADA CHANU^a, NITISH KUMAR TIWARI^a
AND BASANTA KUMAR DAS^{a*}

Commercial and small scale fisheries both contribute critically towards the development of employment providing food and security. The fishing which earns profit and provides cheapest form of animal protein as food is known as commercial fisheries. India is the leading producer of Inland Fisheries in world. However, potential for riverine fisheries especially of river Ganges is yet to be tapped. River Ganga is revered as Holy Mother Ganges and has been the source of life and livelihood for thousands of years, being mentioned in the oldest scriptures. It is the largest river in India hosting a wide diversity of aquatic habitat and germplasms including varied indigenous fish fauna. Ecologically, the river greatly supports fish species over varied aquatic habitats from both freshwater and brackish water. Rivers are traditional sources of fish for aquaculture and other commercial importance. It is very much true that fishing in commercial has always showed way as a method to attain state power¹. The river supports considerable diversity of commercially important fish species including Indian major carps (*Labeo rohita*, *Labeo catla*, *Cirrhinus mrigala* and *Labeo calbasu*), minor carps (*Labeo bata*, *Labeo fimbriatus*, *Labeo gonius*, *Cirrhinus reba* etc.), catfishes (*Sperata aor*, *Sperata seenghala*, *Wallago attu*, *Rita rita*, *Pangasius pangasius*, *Bagarius bagarius*, *Eutropiichthys vacha*, *Clupisoma garua*, *Mystus* sp. etc.) and several other small indigenous fishes (SIFs) endorsing as the prime fishery of the system fetching good market price. Further assessment revealed that the Ganga River supports substantial percentages of food fish (60.84%), ornamental fish (35.44%) and sports fish (3.70%). Overall, Cyprinidae

the most well represented and commercially important family constituting carps and minnows was recorded in all the freshwater section up to Tribeni in West Bengal. The present study recorded 74 different commercial fish species belonging to 31 families from river Ganga. Cyprinidae was found to be the most species rich (16 spp.) followed by Danionidae (6 spp.), Clupeidae (6 spp.) Bagridae (6 spp) respectively. The detail list commercially important species is represented in Table 1. The present study revealed 74 different commercially valuable species from river Ganga possessing high market value.

These species possess high demand in the market owing to its flavour and taste. Natural recruitment of these fish species in the river is the key behind the table fish production. Natural breeding of carps in the river takes place during south west monsoon seasons from June to August in flooded rivers. The fishes congregate in the shallow areas of the river for gamete expulsions which transform from spawn to further advanced sizes leading to the productions. Majority of the fishes including minor carps, feather backs, catfishes etc. breeds during the monsoon period in the river. Until the advent of the controlled breeding technology in 1957 of Indian Major carps in India, aquaculture was solely confined to the collection of spawn from natural breeding grounds. Again, the entire scenario changed after the further development of eco carp hatchery in 1960 leading to the huge production of carp in the country. However, the drastic decline of major carp catches from the river during the past few decades has created immense pressure on the major chunk of riverine landing. The abstraction of water from those dams and barrages for various uses like the generation of hydroelectricity, agriculture, industrial and urban uses etc., reduced riverine water discharge to a large extent, especially during lean seasons. Reduced and

^a National Mission for Clean Ganga Laboratory, ICAR- Central Inland Fisheries Research Institute, Barrackpore, Kolkata - 700120.

* Corresponding author: basantakumard@gmail.com

Table 1. Enlisted Commercial Fishes of River Ganga

S1 No.	Fish species	Family	Common name	Vernacular name	Commercial importance	Max. length recorded (mm)	IUCN
1.	<i>Ailia coila</i> (Hamilton, 1822)	Aillidae	Gangetic Ailia	Sutri/Batansi/ Kajri	Food fish	174	Near threatened
2.	<i>Amblypharyngodon mola</i> (Hamilton, 1822)	Danionidae	Mola carplet	Dawai/Mourala	Food/Ornamental fish	83	Least concern
3.	<i>Anabas testudineus</i> (Bloch, 1792)	Anabantidae	Climbing perch	Kawai/Koi	Food fish/ Ornamental fish	137	Least concern
4.	<i>Anodontostoma chacunda</i> (Hamilton, 1822)	Clupeidae	Chacunda gizzard shad	Nona Khoira	Food fish	209	Least concern
5.	<i>Arius arius</i> (Hamilton, 1822)	Ariidae	Threadfin sea catfish	Kata mach	Food fish	253	Least concern
6.	<i>Bagarius bagarius</i> (Hamilton, 1822)	Sisoridae	Giant River Gooch	Gostha/Bagar	Food fish	534	Near threatened
7.	<i>Bangana dero</i> (Hamilton, 1822)	Cyprinidae	Kalaban	Bangan	Food fish	430	Least concern
8.	<i>Botia lohachata</i> (Chaudhuri, 1912)	Botiidae	Reticulate loach	Chitora/Nacta/ Puia/Bagha	Ornamental fish	116	Not evaluated
9.	<i>Cabdio morar</i> (Hamilton, 1822)	Danionidae	Morari	Harda/chalwa/ piyali	Food/Ornamental fish	152	Least concern
10.	<i>Channa marulius</i> (Hamilton, 1822)	Channidae	Great snakehead	Saur/ Gojal	Food fish	355	Least concern
11.	<i>Channa punctata</i> (Bloch, 1793)	Channidae	Spotted snakehead	Sauri/ Lata	Food fish	225	Least concern
12.	<i>Channa striata</i> (Bloch, 1793)	Channidae	Striped snakehead	Sauri/ Shol		247	Least concern
13.	<i>Chitala chitala</i> (Hamilton, 1822)	Notopteridae	Clown knifefish	Moi/Chital	Food fish/ Ornamental fish	570	Near threatened
14.	<i>Cirrhinus mrigala</i> (Hamilton, 1822)	Cyprinidae	Mrigala	Naini/ Mrigal	Food fish	175	Least concern
15.	<i>Cirrhinus reba</i> (Hamilton, 1822)	Cyprinidae	Reba carp	Rewah/Rai bata	Food fish	224	Least concern
16.	<i>Clarias magur</i> (Hamilton, 1822)	Clariidae	Magur	Magur	Food fish	163	Endangered
17.	<i>Clupisoma garua</i> (Hamilton, 1822)	Aillidae	Garua batcha	Gharua/Gorcha	Food fish	342	Least concern
18.	<i>Coilia dussumieri</i> (Hamilton, 1822)	Engraulidae	Goldspotted grenadier anchovy	Amadi	Food fish	195	Least concern
19.	<i>Corica soborna</i> (Hamilton, 1822)	Clupeidae	Ganges river sprat	Maya/Sona Khorke	Food fish	56	Least concern
20.	<i>Eleutheronema tetradactylum</i> (Shaw, 1804)	Polynemidae	Four Finger threadfin	Chakle/Gurjali	Food fish	255	Not evaluated
21.	<i>Escualosa thoracata</i> (Valenciennes, 1847)	Clupeidae	White sardine	Gang mouti	Food fish	97	Least concern
22.	<i>Eutropiichthys murius</i> (Hamilton, 1822)	Aillidae	Muria vacha	Murevacha/ Megni	Food fish	189	Not evaluated
23.	<i>Eutropiichthys vacha</i> (Hamilton, 1822)	Aillidae	Vacha	Vacha/ Batchwa	Food fish	274	Least concern
24.	<i>Gagata cenia</i> (Hamilton, 1822)	Sisoridae	Indian Gagata	Kukri/Baghwa	Ornamental fish	107	Least concern

Sl No.	Fish species	Family	Common name	Vernacular name	Commercial importance	Max. length recorded (mm)	IUCN
25.	<i>Glossogobius giuris</i> (Hamilton, 1822)	Gobiidae	Tank goby	Bulla/AashBele	Food fish	211	Least concern
26.	<i>Gonialosa manmina</i> (Hamilton, 1822)	Clupeidae	Ganges river gizzard shad	Suia/Chapra/Korti	Food fish	120	Least concern
27.	<i>Gudusia chapra</i> (Hamilton, 1822)	Clupeidae	Indian river shad	Suia/Chapra/Korti	Food fish	146	Least concern
28.	<i>Harpadon nehereus</i> (Hamilton, 1822)	Synodontidae	Bombay Duck	Lote	Food fish	260	Near threatened
29.	<i>Heteropneustes fossilis</i> (Bloch, 1794)	Heteropneustidae	Asian Stinging catfish	Singhi	Food/Ornamental fish	224	Least concern
30.	<i>Ilisha megaloptera</i> (Swainson, 1838)	Pristigasteridae	Big eye ilisha	Dhela	Food fish	548	Least concern
31.	<i>Johnius coitor</i> (Hamilton, 1822)	Sciaenidae	Amphidromous croaker	Pathri/Phala/Bhola	Food fish	152	Least concern
32.	<i>Labeo bata</i> (Hamilton, 1822)	Cyprinidae	Bata	Bata	Food fish	278	Least concern
33.	<i>Labeo calbasu</i> (Hamilton, 1822)	Cyprinidae	Kalbasu	Keronchi/Kalbasu	Food fish	660	Least concern
34.	<i>Labeo catla</i> (Hamilton, 1822)	Cyprinidae	Katla	Bhakur/Katla	Food fish	970	Least concern
35.	<i>Labeo dyocheilus</i> (McClelland, 1839)	Cyprinidae	Brahmaputra Labeo		Food fish	257	Least concern
36.	<i>Labeo gonius</i> (Hamilton, 1822)	Cyprinidae	Kuria Labeo	Batki/Goni	Food fish	200	Least concern
37.	<i>Labeo rohita</i> (Hamilton, 1822)	Cyprinidae	Rohu	Rehu/Rui	Food fish	920	Least concern
38.	<i>Lates calcarifer</i> (Hamilton, 1822)	Latidae	Asian Seabass	Bhetki	Food fish	249	Least concern
39.	<i>Macrogathus pancalus</i> (Hamilton, 1822)	Mastacembelidae	striped spiny eel	Patgonji/Pakal	Food fish/Ornamental fish	190	Least concern
40.	<i>Mastacembelus armatus</i> (Lacepède, 1800)	Mastacembelidae	Tire-track spiny eel	Bami/Ged/Baam	Food fish/Ornamental fish	620	Least concern
41.	<i>Mystus cavasius</i> (Hamilton, 1822)	Bagridae	Gangetic mystus	Palva/Bajha/Gulshatengra	Food/Ornamental fish	209	Least concern
42.	<i>Mystus gulio</i> (Hamilton, 1822)	Bagridae	Long whiskers catfish	Nona tengra	Food fish	196	Least concern
43.	<i>Mystus vittatus</i> (Bloch, 1794)	Bagridae	Stripped dwarf catfish	Katinna/Deshitengra	Food fish	201	Least concern
44.	<i>Nandus nandus</i> (Hamilton, 1822)	Nandidae	Gangetic leaf fish	Bheda/Nadosh	Food fish/Ornamental fish	104	Least concern
45.	<i>Notopterus notopterus</i> (Pallas, 1796)	Notopteridae	Silver bronze featherback	Dhutta/Patra/Moi/Folui	Food fish/Ornamental fish	270	Least concern
46.	<i>Odontamblyopus rubicundus</i> (Hamilton, 1822)	Gobiidae	Rubicunduseel-goby	Lal chengo	Food fish	266	Least concern
47.	<i>Ompok bimaculatus</i> (Bloch, 1794)	Siluridae	Butter catfish	Pabdah	Food/Ornamental fish	211	Near threatened
48.	<i>Ompok pabda</i> (Hamilton, 1822)	Siluridae	Butter catfish	Pabdah	Food/Ornamental fish	192	Near threatened
49.	<i>Opsarius barna</i> (Hamilton, 1822)	Danionidae	Barnabaril	Chal	Food/Sport fish	174	Least concern

Sl No.	Fish species	Family	Common name	Vernacular name	Commercial importance	Max. length recorded (mm)	IUCN
50.	<i>Opsarius bendelisis</i> (Hamilton, 1807)	Danionidae	Indian Hill Trout	Ral	Food/Sport fish	180	Least concern
51.	<i>Osteobrama cotio</i> (Hamilton, 1807)	Cyprinidae	Cotio	Gurdi/Gurdah/Koti	Food/Ornamental fish	105	Least concern
52.	<i>Otolithoides pama</i> (Hamilton, 1822)	Sciaenidae	Gangetic sciaenid	Bhola	Food fish	367	Least concern
53.	<i>Pangasius pangasius</i> (Hamilton, 1822)	Siluridae	Pangas catfish	Pangash	Food fish	487	Least concern
54.	<i>Pethia conchonius</i> (Hamilton, 1822)	Cyprinidae	Rosy barb	Moni Puti	Food/Ornamental fish	89	Least concern
55.	<i>Planiliza parsia</i> (Hamilton, 1822)	Mugilidae	Goldspot mullet	Parshey	Food fish	118	Not evaluated
56.	<i>Polynemus paradiseus</i> (Linnaeus, 1758)	Polynemidae	Paradise threadfin	Topshey	Food fish	204	Least concern
57.	<i>Puntius sophore</i> (Hamilton, 1822)	Cyprinidae	Spot-fin swamp barb	Bhur/Lal puti	Food/Ornamental fish	109	Least concern
58.	<i>Rasbora daniconius</i> (Hamilton, 1822)	Danionidae	Slender Rasbora	Gulaba/Darki	Ornamental fish	91	Least concern
59.	<i>Rhinomugil corsula</i> (Hamilton, 1822)	Mugilidae	Corsula mullet	Aduar/Korshula	Food fish	194	Least concern
60.	<i>Rita rita</i> (Hamilton, 1822)	Bagridae	Rita	Belagra/Kunkuna/Ritah	Food/ Sport fish	552	Least concern
61.	<i>Salmostoma bacaila</i> (Hamilton, 1822)	Danionidae	Large razorbelly minnow	Pocha/Chelwa/Chela	Food fish	134	Least concern
62.	<i>Scatophagus argus</i> (Linnaeus, 1766)	Scatophagidae	Spotted scat	Pairachanda/pairatoli	Ornamental fish	272	Least concern
63.	<i>Schizothorax richardsonii</i> (Gray, 1832)	Cyprinidae	Snow trout	Asela	Sport fish	380	Vulnerable
64.	<i>Setipinna phasa</i> (Hamilton, 1822)	Engraulidae	Gangetic hairfin anchovy	Phasa/Phasia	Food fish	246	Least concern
65.	<i>Setipinna tenuifilis</i> (Valenciennes, 1848)	Engraulidae	Common hairfin anchovy	Phasa/Phasia	Food fish	201	Least concern
66.	<i>Sperata aor</i> (Hamilton, 1822)	Bagridae	Long-whiskered catfish	Degar/Tengra/Aarh	Food/Sport fish	718	Least concern
67.	<i>Sperata seenghala</i> (Sykes, 1839)	Bagridae	Giant river catfish	Degar/Tengra/Aarh	Food/Sport fish	690	Least concern
68.	<i>Systomus sarana</i> (Hamilton, 1822)	Cyprinidae	Olive barb	Trai/Sorputih	Food/Sport fish	296	Least concern
69.	<i>Tariqilabeo latius</i> (Hamilton, 1822)	Cyprinidae	Gangetic latia	Sehri/Baryain/Bata	Food fish	91	Least concern
70.	<i>Tenualosa ilisha</i> (Hamilton, 1822)	Clupeidae	Hilsa shad	Ilish/Hilsa	Food fish	450	Least concern
71.	<i>Tor putitora</i> (Hamilton, 1822)	Cyprinidae	Golden Mahseer	Mahseer	Food/Sport fish	499	Endangered
72.	<i>Trichogaster fasciata</i> (Bloch & Schneider, 1801)	Osphronemidae	Banded gourami	Khasso/Dholaiya/Kholshe	Ornamental fish	97	Least concern
73.	<i>Wallago attu</i> (Bloch & Schneider, 1801)	Siluridae	Freshwater shark	Barari/Lachi/Parin/Boal	Food/Sport fish	890	Vulnerable
74.	<i>Xenentodon cancila</i> (Hamilton, 1822)	Belonidae	Freshwater garfish	Nauwa/Alwali/Kakila/Kakle	Food fish/ Ornamental fish	252	Least concern

regulated flow often helps in the deposition of heavier sand particles on the river bed causing large-scale sandification, the formation of islands in the main course of the river and an overall decrease of the river depth. This again results in recurrent heavy floods during monsoon seasons when released water from barrage and dams often crosses the river boundary to submerge large catchment areas. During lean seasons, organic pollution load from a point and non-point sources like discharges from drains of cities and towns, run-off with low water quality from tributaries further deteriorate the river water. This type of ecological degradation of the river caused by anthropogenic loading and man-made hindrances resulted in a noticeable decline in overall fish spawn, total fish production as well as productivity of the river in the recent past. Therefore, to reassess the present fish availability in the stretch, investigations were undertaken by ICAR-Central Inland Fisheries Research Institute with the support of the National Mission for Clean Ganga. Periodical sampling in different sites covering different states were investigated for the purpose. The study highlights the current status, distribution and availability of few economically important fish species of few economically important fish distribution and availability species.

Status of Fish Production in River Ganga

Historically, middle stretch of the river Ganga has always been the chief fish production source from years. Gradual decline in valuable major carp occurrence has increased the abundance of small sized species. Miscellaneous fish groups have increased manifolds from Buxar to Bhagalpur stretch as evident from the present data. Significant decrease in major carp production is evident from Prayagraj region of Ganga where the landing came down from 35.82 t to 5.97 t during the period of 1981-90 to 2016-19. Impact on migratory species like Hilsa (*T. ilisha*) is tremendous. Previously, Hilsa fishery was the mainstay at Buxar stretch of Ganga during 1960's contributing 33.48% (22.35). However, the stock gradually got diminished after 1980's once Farakka barrage was commissioned. Post Farakka barrage has resulted sudden drop in catch of prized Hilsa from 160 to 9 kg km⁻¹ in the middle stretches of Ganges. The fishing practice as of now depends mainly on catfishes and other miscellaneous groups. Hilsa abundance could be noticed below Farakka. In case of Patna, drastic decline in major carp landings was noticed from 1960's (23.35 t; 21.48%) to 2016-19 (2.16t; 7.88%). Interestingly, rise in miscellaneous fish group was noticed during the same period. During the present study, reduced catches of major carp was observed at Bhagalpur

9.90% (1.98 t) compared to previous records of 20.18% (18.66 t) in 1980's. The pattern of annual fish landings was found similar when compared to previous reports from the site. Higher appearances of small sized catfishes (*C. garua*, *E. vacha*, *A. coila* etc.) have significant effect on the total production. The group exhibited increasing trend in all of the sites studied with a range of 29-43%.

The contribution of fish species towards commercial fisheries has always estimated through landings. Previous studies on natural hydrological cycle of the river have highlighted the striking impact on the river integrity caused by severe anthropogenic loading, irrigation activities and manmade blockades. The impact is more noticeable on the prized indigenous fish fauna of the river like Indian Major Carps which have been reduced to a great extent as evident from decline in spawn availability compared to other fish stocks. Indiscriminate exploitation, pollution impacts and aquaculture needs may be attributed to the decreased production. Besides, lowered precipitation, water restriction, deformed river bed has constituted change in water flow and turbidity in peak breeding seasons resulting in collapse of overall natural stock recruitments. The emergence and invasion of exotic species like common carp and tilapia has also added up to the rising trend in the overall production. On the other hand, landing pattern from the middle stretches of the river, exhibited shifting from major carps and large catfishes to catfishes, minor cyprinids, shads, croakers and spiny eels during the period of 1950s and 1960s indicating changing pattern of fish assemblage structure.

Abundance of Major Commercial Fish Groups

The overall fish composition as obtained from river Ganga was mainly divided into ten major groups (Table 2). The carps included major, medium and minor fish representatives; the catfish included large and small sized catfish groups; the miscellaneous included fish species of lesser economic importance, growth rate and opportunistic ones and lastly the exotics. Based on this, the total fish species as obtained in the present investigation from respective centres of river Ganga have been categorized and their catch percentage has been calculated at each centre as well as in the entire stretch. In the present study, Bijour and Narora recorded the highest number of species (107 and 95 each) followed by Farakka, Prayagraj (Allahabad), Kanpur and rest. Diamond Harbour and Godakhali recorded the least number of species (38 and 33 respectively). In the upstream zones of Haridwar, Bijour and Narora the carps shared more or less equal amounts (54%, 24 % and 23 % respectively) in comparison to catfish

and miscellaneous groups. However, the trend declined to further middle and downstream reaches where a major decline in the carps and a considerable increase in miscellaneous fish groups were noticed. In the centres viz. Varanasi, Patna, Bhagalpur, Balagarh and Tribeni, the major carp had a sharp decline (22, 22, 23, 18 and 15) % respectively in comparison to miscellaneous fish groups (27, 31, 23, 52 and 58), respectively. The lower trend of fish production of the major fish groups in the river Ganges is believed to be the recruitment failure due to decreased runoff, alteration in flow, turbidity of the natural spawning habitat and climate change.

As assessed during the present study, harvesting and marketing of commercial fishes result in enormous employment and revenue generation among the youths and people associated. Most of the fishes caught from river Ganga is sold in local whole sale fish markets except few species like Hilsa and other commercially important estuarine species which are sold in different parts of the country via local auctions. With rise in demand, the supply chain from river is gradually narrowing. In case of inland fisheries, selling of commercial fishes in retail markets is complicated after a hardship of overnight fishing. It is very much evident that, small scale riverine fisheries lead to better quality catches but less in prices. Therefore, development of strategies is essential for small scale fish marketing. However, in terms of profitability, few of the fish groups pose significant higher valuation and share significant high return. Catfish under the family Bagridae, Siluridae, Sisoridae and Schilbidae exhibit important commercial significance in river Ganga²⁻⁴. They form the second most dominant group in terms of total fish landings⁵ contributing about 21-24%^{5,6}. Large catfishes like 'Long whiskered Catfish', 'Rita', 'Vacha' and 'Garua' has good market value in Uttar Pradesh and Bihar stretch of river Ganga. These catfishes possess an approximate market value of Rs. 400-450 per kilogram during peak landing period. A sizeable quantity of small catfishes comprising of *Mystus* sp. and *Ailia coila* are also harvested from river Ganga which may go up to Rs. 350-400 per kilogram. Riverine freshwater catfishes like *C. garua*, *E.vacha* is widely known for its rich taste, nutritional aspect and high market value⁷, thus making it commercially valuable. The Indian Shad, Hilsa (*Tenualosa ilisha*) is highly appreciated food fish of river Ganges and is widely preferred among locals. Unfortunately, after the construction of Farakka barrage, the migratory shad is restricted below the Farakka in West Bengal. This lucrative commercial fish earns a major income source in Hooghly

estuaries where the price of the species (more than 1 Kg) attains around 1500-1800 per kilogram during peak season. Importance of minor, medium and major carps in river Ganga is widely known. In present investigation it is observed that freshwater Gangetic Indian Major Carps (Catla, Rohu and Mrigal) are the major food fish for selective section of local people. These fish posses' long history and form the backbone of Gangetic fish production. The demand of wild Gangetic Indian Major Carps is high as it is rich in taste and flavour however the supply remains limited round the year. The Gangetic carp price reaches up to Rs 300-450 per kilogram for large sized. The average selling price of minor carps comprising of Bata (*Cirrhinus reba*) and *Puntius* sp. etc. was observed to be Rs. 180-300 per kilogram and Rs 100-150 per kilogram respectively. In present study it was recorded that, daily supply of Gangetic fish in local market depends on the variation in catches.

Table 2. Distribution of Major Fish Groups in River Ganga

Major Groups	Upper Stretch (Harsil-Haridwar)	Middle Stretch (Bijnour-Bhagalpur)	Lower Stretch (Farakka-Fraserganj)
Mahseer	1	0	0
Trout	1	0	0
Major carp	0	3	3
Other carps	5	12	10
Large Cat fish	0	5	5
Small Cat fish	4	10	10
Shads	0	3	6
Total species (stretch wise)	11	33	34

Thus, the proportion and overall contribution of carps (major, medium and medium) reduced considerably in most of the stretched of river Ganga and constituted about 2.3% of the catch and a rapid increase of the miscellaneous or trash fish group (43%). However, catfish groups did not vary much and constituted a uniform catch % in almost all the centres. With the advancement of fishing methods and technology, the fishing pressure as also increased considerably. Nevertheless, the study suggests that extensive programmes on sustainable exploitation of fish stocks and conservation related to Gangetic biodiversity should be embarked. Furthermore, with recent attention and policies on blue economy empowered by Government of India, the industries related to fishing based on river Ganga can also be developed in assistance with the

stakeholders which in turn will add up to raising of national economy. □

Reference

1. C. Finley. The industrialization of commercial fishing, 1930–2016. In Oxford Research Encyclopedia of Environmental Science. (2016).
2. K. S. Misra, An aid to the identification of the common commercial fishes of India and Pakistan. *Rec.Indian Mus.* 57, 1-4 (1959).
3. A.G.K. Menon, A check list of fishes of the Himalayan and the Indo-Gangetic plains, Special Publications, *J. Inland Fish. Soc. India.*,1, 1-136 (1974).
4. V.G. Jhingran. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi, India. (1975).
5. D.K. De, The river Ganga-environment and fishery. In: Course Manual, Summer School on Ecology, fisheries and fish stock assessment in Indian River. ICAR-Central Inland Fisheries Research Institute, Barrackpore, West Bengal, India, (1999).
6. U. K. Sarkar, A. K. Pathak, R. K. Sinha, K. Sivakumar and A. K. Pandian, A. Pandey, V.K. Dubey, W. S. Lakra. Freshwater fish biodiversity in the River Ganga (India): Changing pattern, threats and conservation perspectives. *Rev. Fish Biol. Fish.* 22(1). 251-272. doi: 10.1007/s11160-011-9218-6 (2012).
7. M.F. Hasan, A.H. Molla, M.S. Ahsan, M.T. Alam. Physicochemical properties and fatty acids distribution pattern in lipids of *Eutropiichthys vacha* Hamilton Buchanan (Family Schilbeidae). *Pak. J. Biol. Sci.*,5(6). 696-698 (2002).