J. Exp. Zool. India Vol. 24, No. 1, pp. 315-322, 2021	www.connectjournals.com/jez	*ISSN 0972-0030*
DocID: https://connectjournals.com/03895.2021.24.315		eISSN 0976-1780

FISH DIVERSITY AND GEARS WISE FISH CATH COMPOSTION OF NANAK SAGAR RESERVOIR, UTTARAKHAND, INDIA

Rajesh* and R. N. Ram

College of Fisheries, G.B. Pant University of Agriculture and Technology, Pantnagar - 263 145, India.
*e-mail: rajeshfish100@gmail.com

(Received 17 October 2020, Revised 11 December 2020, Accepted 22 December 2020)

ABSTRACT : The present investigation was carried out to determine fish diversity, fish species, fish catch composition, fishing gear and fishermen's of Nanak Sagar Reservoir, which are situated in between 28° 45'N latitude and 79° 45'E longitude in Distt. Udham Singh Nagar of state Uttrakhand. The study revealed that a total of 41 fish species belonging to 16 families were identified in the reservoir. The maximum 16 fish species were found under Cyprinidae family where as two families Bagridae and Ophiocephalidae represented 4 species each and another family siluridae 2 species, Mastacembelidae 3 species, Centropomidae 2 species and rest 10 families represented 1 species each were recorded. Five different types of fishing gears gillnets, triangular net, drag net, cast net, hooks and line were identified has been widely used in Nanaksagar reservoir. The highest group wise total fish catch was recorded in month of June by all types of gears accordingly for major carps (20795Kg), cat fishes (6131Kg), minor carps (38191Kg) and miscellaneous fishes (12771Kg.) and for uneconomical fishes (25524Kg), respectively. The contributions from the other gears like hooks and line and cast net for catfish catch were insignificant. Triangular net which is locally known as Besar jal shared alone maximum for catch of uneconomical fishes. Two types of fishers were engaged in fishing in the Nanaksagar reservoir. Most of the fishermen's were used gill net, triangular net, hooks and lines where few of them were used cast net for fishing. The maximum 38% of the fishermen had medium size family, 27% had large size family and the rest 35% had small size family. Among the total fishermen 46.4% had primary or higher level education and 41.8% can sign their name, while about 11.8% of them were illiterate.

Key words : Fish diversity, gears, fish catch composition and Nanaksagar.

How to cite : Rajesh and R. N. Ram (2021) Fish diversity and gears wise fish cath composition of Nanak Sagar Reservoir, Uttarakhand, India. *J. Exp. Zool. India* **24**, 315-322. DocID: https://connectjournals.com/03895.2021.24.315

INTRODUCTION

Inland fisheries resources are based on rivers, canals, lakes and reservoirs, which are usually scattered around the national territory and are located in a social, economic and climatic land escapes. Therefore, Inland fisheries are diffuse and diverse, rarely large enough to be scientifically important to warrant exclusive attention at the national level. With the passage of time, the scope of dams has expanded and at present these are constructed for multiple objectives viz. water storage for public supplies, for irrigation reserves, for hydroelectric power, flood control, navigation, recreation, development of fisheries and sport fishing. Aquatic biodiversity is largely responsible for maintaining and supporting overall environmental health. The scale of human impacts on biological diversity has been increasing exponentially primarily because of worldwide patterns of consumptions, trade, agriculture, industrial developments and growth of human population. The maximum biodiversity is exhibited by tropical regions because of climatic uniformity, its suitability for primary and secondary producers and stability of areas. Uttarakhand, the hill state of India has enormous natural inland water resources in the form of rivers (2700 kms), reservoirs (20,000ha), lakes (297 ha) and ponds (> 2000 ha) (Gautama *et al*, 2004). The important reservoirs of the state are Nanaksagar, Dhaura, Baigul, Haripura, Baur, Tumaria and Tehri. Geo-morphological and hydrological salient feature of Nanak Sagar reservoir are as follows: The reservoir was constructed in the year 1962, area of FRL 4662(ha), type of foundation earthen, main feeder rivers joins Devaha and the total catchment's area of 570 Sq.km., total length of the bundh 19.2 km., top width of the dam 6.0 meter and mean depth 3.0 meters. In Nanaksagar reservoir, December to June is the important commercial fishing period and fishermen used selective passive gear and nets to catch the fishes of reservoir. Drag net is mainly used because of the maximum catch efficiency (Joshi, 2011), but the problem with drag net is

trapping of weed fishes. The other fishing gears such as cast nets, scoop nets, long lines and traps are also operated but the catches are insignificant (De Silva, 2009) the gillnet is efficiently in use to catch commercial fishes like major carps, minor carps and catfishes. The present study was conducted to investigate fish diversity; gear practices and fish catch composition in Nanak Sagar reservoir.

MATERIALS AND MATHODS

The questionnaire was developed in a logical sequence of that the target group could answer chronologically. For this study a combination of questionnaire interview, Participatory Rural Appraisal (PRA) tool such as Focus Group Discussion (FGD) and interviews with key informants were used for fishermen. To collects data with questionnaire interviews, simple random sampling method was followed by 55 fishermen of the Nanaksagar reservoir. The interview of fishermen was made at home and reservoir sites during fishing. For the present study, the PRA tool such as Focus Group Discussion (FGD) was conducted with fishermen. During the study period, FGD was used to get an overview of particular issues such as existing fish catch composition, fishing gear, mesh size as well as fish biodiversity of reservoir. A total of eight FGD sessions were conducted in the reservoir area where each group consisting of 10 to14 fishermen. The study was carried out during July 2013 to June 2104. All the relevant data and information regarding the major fishing gears used for catch of fishes by different nets collected by physically examinations. Based on data base of Department of Fisheries (FFDA) U.S Nagar, UK and personal interaction and interview with fishing contractors and local fishermen community, total fishes catch and fish population were recorded throughout the investigation periods from landing centers locally known as Machhi Jhala. In present study, the fishes were caught by gill net, drag net, cast net, triangular net, hook and lines and brought to the Department of Fisheries Resource Managment of College of Fisheries, Pantnagar for identification. The fishes were preserved by 5% formalin for the further study. The varieties of fishes caught from the reservoirs were identified following Berg (1947), Day (1878), Jhingran (1991) and Srivastava (2002).

Table 1 : Hydrological and Geomorphological features of Nanaksagar reservoir.

S.No.	Parameters	Nanaksagar
1.	Construction year	1962
2.	Altitude (m)	200
3.	Latitude	28° 45'N
4.	Longitude	79° 45'E
5.	Feeder rivers	Deoha
6.	Area of FRL(ha)	4662
7.	Type of foundation	Earthen
8.	Total length of bundh (km)	19.2
9.	Top width of the dam (m)	6.0
10.	Maximum height of reservoirs (m)	16.50
11.	Mean depth (m)	3.0
12.	Total catchment's area (Sq.km)	570.0
13.	Maximum storage Level (m)	215.19 (706 ft.)
14.	Dead storage level	207.30 M (680 ft.)

Source: Anonymous (1992) and irrigation divison Bareilly.

RESULTS AND DISCUSSION

Groups of Fish catch in Nanaksagar reservoir were observed Indian Major Carps, Cat fishes, Minor carps, miscellaneous and uneconomical fishes shown in Table 2. The gill nets are extensively used for catch of Indian major carps, minor carps and catfishes. In the present investigation, it was observed that the only one type of fishing craft was used and it is a flat timber wooden boat and sides were covered with aluminum sheets and non-mechanized boats manufactured by local professional carpenters. The major fishing gear was gill nets with

Table 2 : Groups of fish species of Nanak Sagar reservoirs.

Groups	Genera/Species catch composition
Major carps	*Catla catla*
	Labeo spp.
	Cirrhinus spp.
	Cyprinus carpio communis
Cat fishes	*Wallago attu*
	Heteropneustes fossilis
	Clarius batrachus
	Mystus spp.
	Channa spp.
Minor carps	*Labeo gonius*
	L. calbasu
	Cirrhinus reba
Miscellaneous	*Xenetedon cancilla,*
	Oreochromis niloticus
	Mastacembalus spp.
	Nemacheilus botia
	Colisa fasciatus
	Notopterus notopterus
Uneconomical fishes	*Gudusia chapra*
	Puntius spp.
	Chanda spp.
	Chela spp.

Table 3 : Fishing gear used in relation to fish catch of Nanaksagar reservoir.

Fishing Gear	Local name	Mesh size	Fish species caught
Gill net	Fansla Jal	75-200 mm	Indian major carps , Minor carps and large cat fishes
Triangular Net	Besar Jal	15-20mm	Weed fishes and specially (*Gudusia chapra)*
Drag Net	Mahajal	60-80 mm	Major carps, Minor carps and cat fishes (all kind of fishes)
Cast Net	Jhumari Jal	20-30 mm	Major & Minor carps, minnows and cat fishes
Hooks and Line	Dori	7-12 No. (100- 300 iron hooks)	Cat fishes, Balm and Murrels

Table 4 : Gear wise catches of Major carps in (kg.) and their percentage in Nanak Sagar reservoir.

Groups	Gears	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total (Kg.)	%
Major carps	Gill net	542.0	485.0	388.0	543.0	290.0	685.0	9621.0	12554.0	49.04
	Triangular Net	115.0	104.0	74.0	87.0	130.0	76.0	1134.0	1720.0	6.72
	Drag net	203.0	170.0	126.0	137.0	158.0	312.0	9700.0	10806.0	42.21
	Hooks and Line	NC	NC	NC	NC	NC	NC	NC	0	0
	Cast net	GNO	GNO	GNO	GNO	GNO	178.0	340.0	518.0	2.02
Total		860.0	759.0	588.0	767.0	578.0	1251.0	20795.0	25598.0	100

Table 5 : Gear wise catches of Cat fishes in (kg.) and their percentage in Nanak Sagar reservoir.

Groups	Gears	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total (Kg.)	%
Cat fishes	Gill net	876.0	743.0	614.0	775.0	907.0	1093.0	2768.0	7776.0	54.99
	Triangular Net	90.0	85.0	78.0	108.0	116.0	184.0	232.0	893.0	6.32
	Drag net	106.0	184.0	112.0	183.0	297.0	424.0	2405.0	3711.0	26.24
	Hooks and Line	143.0	GNO	GNO	132.0	124.0	428.0	410.0	1237.0	8.75
	Cast net	GNO	GNO	GNO	GNO	GNO	207.0	316.0	523.0	3.70
Total		1215.0	1012.0	804.0	1198.0	1444.0	2336.0	6131.0	14140.0	100

Table 6 : Gear wise catches of Minor carps in (kg.) and their percentage in Nanak Sagar reservoir.

Groups	Gears	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total (Kg.)	%
Minor carps	Gill net	3460.0	6938.0	6425.0	6040.0	2150.0	1620.0	16965.0	43598.0	56.11
	Triangular Net	235.0	471.0	739.0	473.0	502.0	1039.0	3054.0	6513.0	8.38
	Drag net	1954.0	1745.0	1624.0	1095.0	1040.0	1602.0	17824.0	26884.0	34.60
	Hooks and Line	NC	NC	NC	NC	NC	NC	NC	0	0
	Cast Net	GNO	GNO	GNO	GNO	GNO	363.0	348.0	711	0.91
Total		5649.0	9154.0	8788.0	7608.0	3692.0	4624.0	38191.0	77706.0	100

different mesh size locally called as 4 to 12 Angura jal, which are actual measured in terms of mesh size (75 - 200 mm) operated in Nanaksagar reservoir. The triangular net, locally known as besar jal with mesh size ranged 15-20 mm. These nets are mainly operated in reservoirs for catch of uneconomical fishes (especially *Gudusia chapra*). Drag net locally known as mahajal was having mesh size ranged from 60-80 mm., this net was generally operated by 15-20 fishermen for catch of all kind of fishes. Cast net (mesh size 20-30 mm) and Hook and line (7-12 No. with 100-300 iron hooks) are locally known as Jhumari jal and kanta (dori) respectively used for catch of cat fishes (Table 3). The commonly used gears are Gill net (fansla jal), Drag net (Mahajal), Triangular net (Besar jal), hooks and line (dori). The length of boat is ranged from 4- 6 m and width 1-2 m. (Kumar and Kumar, 2013) investigated in Dhaura reservoir that the length of the boat is about 7-11 meters and width is about 1-2 meter and gill net is most common fishing gear used by the fishermen. Wooden boats are used for fishing in a number of reservoirs, especially in the North India. Flat-bottom, locally fabricated boats ranging in length from 3 to 7 m are used in Hirakund, Malampuzha, Gobindsagar, Gandhisagar and Rihand (De Silva, 2009). A plank-built, flat-bottom canoe of 2-3 m in length is the most popular fishing craft of Gandhisagar. Dugout canoes, carved out

of palm trees are used in Yerrakalava reservoir. The gill net was the most favored fishing gear employed in Nanak Sagar reservoir. It was made of nylon twine and was about 50 -100 m long and 1.5 - 4 m wide. Mostly different mesh sized gill nets *viz*. 75-100 mm and 100-200 mm were used for catching different groups of fishes like minor carps, major carps and catfishes (Table 3). The net is vertically suspended in surface water along with traditional floats i.e. thermacol and sometime bisleri and aquafina waste empty plastic bottle in the forenoon and gilled fish catch hauled subsequently in the early morning with the help of boats which is locally known as kishti. Pravin *et al* (1998) were investigated in Gujarat where, Seer fish gillnets was operated as surface drift; column drift and bottom drift nets. Thomas and Hridayanathan (2006) reported that the seer fish gillnets of Kerala was operated in surface or column depending on the swimming layer of the fish during different seasons. Thomas *et al* (2005) were reported that mesh size ranging from 40 to 140 mm, 60 to 150 mm and 70 to 140 mm were common in seer fish gillnets in Gujarat, Andhra Pradesh and Kerala, respectively. Krishnamurthy *et al* (1994) pointed out that in Mettur and Krishnaraja sagar reservoir, where large sized carps and cat fishes form a regular fishery production, the use of bigger meshed nets (mesh size above 50 mm) is justified. Joshi (2012) recorded that Indian major carps are decline in the reservoir of Nanaksagar. However, in reservoir like Tungabhadra where indigenous fishes fauna in comprised mainly of minor carps, the choice of nets had to be 38 mm mesh size and even less. Nayar *et al* (1969) determined 53 mm mesh size suitable for fishing for *Labeo calbasu* in Govind sagar reservoir. Sulochan *et al* (1968) found 75 mm mesh size suitable for *Catla catla* in the Hirakund reservoir.

The present study revealed that gill nets are effectively employed for the catch of major carps, minor carps and cat fishes. Therefore, the gill nets having mesh size 75mm to 150 mm are more efficient according to habitats and occurrence of fish species in Nanaksagar reservoir. Gill net with mesh size of 40, 50 and 60 mm mesh size bar nets was found to be more effective for commercial fishing in Tungabhadra, Hirakund and Govindsagar reservoirs (David and Rajgopal, 1978). Gillnets owing to their simplicity in design, construction and operation and low investment, remain as the most popular gear especially in the traditional sector T. G. *et al* (2012). The net was made of polyamide (PA) multifilament twins of varying specification according to the mesh size used *viz* .bigger the mesh size, thicker the twine. Drag net (100- 300 m length and 3- 6 m width) is generally used in summer season when water level is low. The triangular nets made of bamboo pieces of about 7-8 m size and the length of net varied from 15 - 18 m. Generally, 15-20 mm mesh sizes are used in this net. Hook and line is another gear commonly operated in this reservoir during post monsoon and summer months. These lines were made of long strings of cotton or silk tied with 100- 300 iron hooks. The common baits used on the hooks comprised of weed fishes recorded during the present investigation in Nanak Sagar reservoir. Kumar and Kumar (2013) have investigated one wooden craft and four different kinds of gears (Gill net, cast net, scoop net, hook and line) in Dhaura reservoir of Uttarakhand. De Silva (2009) has reported the size of gill nets are varies from 50 x 2 m with a head rope and floats and footrope with or without sinkers. About 77% of the catch is entangled and the rest is gilled. Dragnets (shore seine) are also used in some reservoirs, especially for catching catfishes and weed fishes. In Uttar Pradesh and Madhya Pradesh, the dragnets are called 'Mahajal'. The other fishing gears such as cast nets, scoop nets, long lines and traps are also operated but the catches are insignificant. The presence of underwater obstacles restricts the use of active gear in reservoirs and the choice is often limited to passive gear such as gillnets. Although, a number of other fishing gear such as long lines, hand lines, pole and line, cast nets, Dip nets, are in use, their contribution to the total catch is very insignificant. Among major gear wise monthly fish catch contribution of Nanaksagar reservoir, the Gill net shared maximum catch of major carps 49.04% followed by drag net 42.21% (Table 4 and Fig. 2). Gill net contribution was also maximum 54.99 % for catch of cat fishes followed by Drag net 26.24%, the contributions from other gears like Triangular net, Hooks and line and cast net for catch of cat fishes were minimal (6.32%, 8.75% and 3.7%) respectively (Table 5 and Fig. 3). Gill net contributed 56.11% for minor carps and 41.01% for miscellaneous fish catches (Tables 6 and 7 & Figs. 4 & 5). Catch of uneconomical fishes by triangular net shared maximum catch contribution 61.33% followed by drag net 37.57% (Table 8 & Fig. 6). Drag net is mostly used due to its maximum fish capture efficiency in the Nanaksagar reservoir during summer period. It is evident from the (Fig. 1) that the harvest of major carps was found maximum in the month of June and this might be due to low water level in the reservoir resulting in the intrusion of gears at a greater depth. However, there was no significant change noticed in the catch quantity for major carps from December to May. It was also observed that the harvest of uneconomical fish was maximum in extreme weather conditions viz.

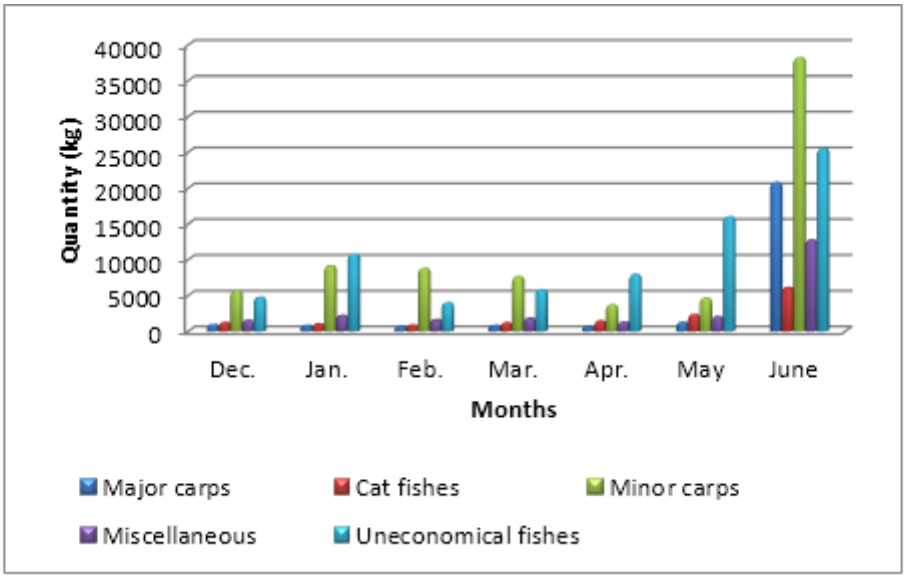

Fig. 1 : Major group wise catch of fishes in Nanak Sagar reservoir.

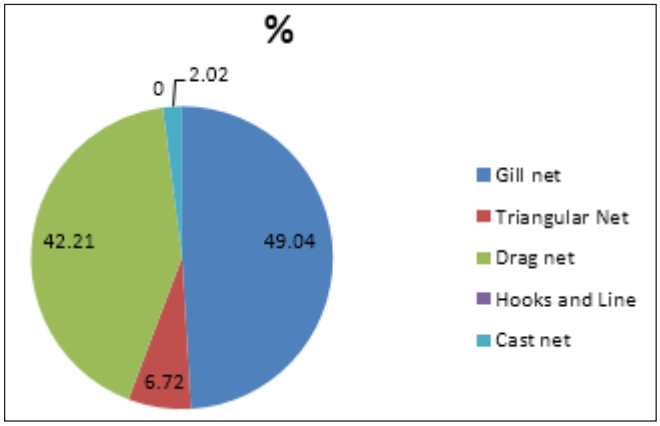

Fig. 2 : Gear wise percentage catch contribution of Major carps.

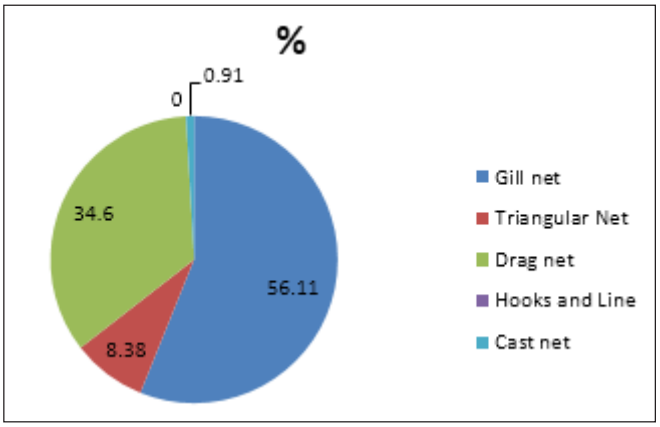

Fig. 4 : Gear wise percentage catch contribution of Minor carps.

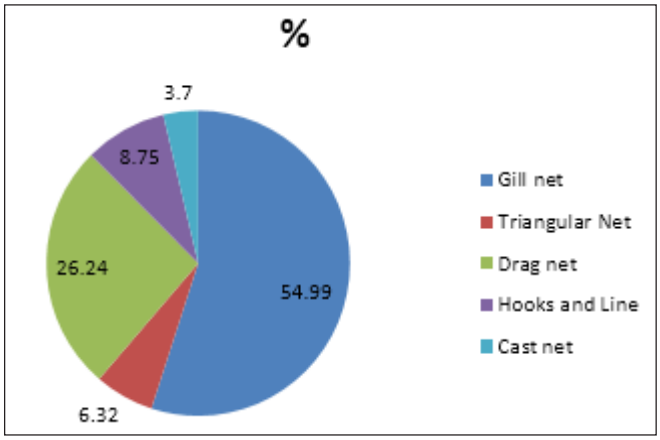

Fig. 3 : Gear wise percentage catch contribution of Cat fishes.

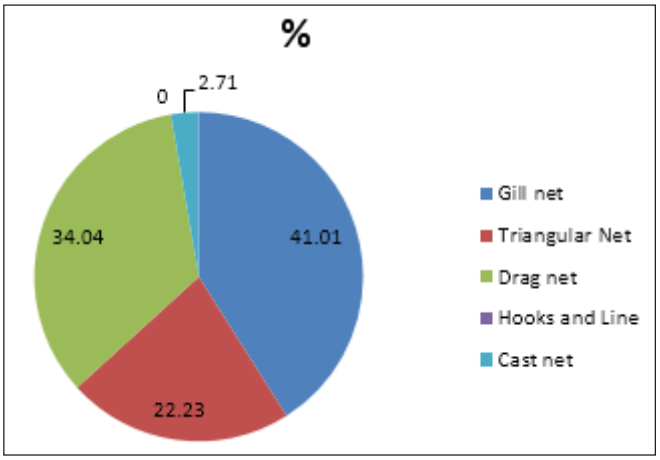

Fig. 5 : Gear wise percentage catch contribution of Miscellaneous fishes.

January and May-June (Fig. 1). Minor carps contributed maximum catch in month of June 38191kg. (Fig. 1). During the study, a total of 41 fish species belonging to 16 families were identified out of which in Cyprinidae, 16 species where as in Clupeidae 1 species, Notopteridae 1 species, Bagaridae 4 species, Saccobranchidae 1 species, Ophiocephalidae 4 species, Siluridae 2 species, Claridae 1 species, Mastacembelidae 3 species, Belonidae 1 species, Anabantidae 1 species, Gobiidae 1 species, Centropomidae 2 species, Nandidae 1 species, Cobitidae 1 species an Cichilidae 1 species were identified in

Table 7 : Gear wise catches of Miscellaneous fishes in (kg.) and their percentage in Nanak Sagar reservoir.

Groups	Gears	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total (Kg.)	%
Miscellaneous	Gill net	812.0	938.0	595.0	764.0	374.0	755.0	5369.0	9607.0	41.01
	Triangular Net	276.0	347.0	428.0	453.0	560.0	433.0	2711.0	5208.0	22.23
	Drag net	454.0	960.0	632.0	650.0	351.0	620.0	4308.0	7975.0	34.04
	Hooks and Line	NC	NC	NC	NC	NC	NC	NC	0	0
	Cast net	GNO	GNO	GNO	GNO	GNO	252.0	383.0	635.0	2.71
Total		1542.0	2245.0	1655.0	1867.0	1285.0	2060.0	12771.0	23425.0	100

Table 8 : Gear wise distribution of catches of Uneconomical fishes in (kg.) in Nanak Sagar reservoir.

Groups	Gears	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total (Kg.)	%
Uneconomical fishes	Gill nets	NC	NC	NC	NC	NC	NC	NC	0	0
	Triangular Net	3197.0	6498.0	2319.0	2854.0	5208.0	9720.0	16058.0	45854.0	61.33
	Drag net	1578.0	4245.0	1680.0	2956.0	2720.0	5942.0	8970.0	28091.0	37.57
	Hooks and Line	NC	NC	NC	NC	NC	NC	NC	0	0
	Cast net	GNO	GNO	GNO	GNO	GNO	325.0	496.0	821.0	1.10
Total (Kg.)		4775.0	10743.0	3999.0	5810.0	7928.0	15987.0	25524.0	74766.0	100

***Sources:** Based on data base of Department of Fisheries (FFDA U.S.Nagar), UK and personal interaction and interview with fishing contractors and locally engaged fisherman community of Nanak Sagar reservoir **NC:** No caught, **GNO**: Gear not operated.

Nanaksagar reservoir were stated in Table 9. De Silva and Amarasinghe (2009) informed that in India, the fish species contributing to the fisheries of the reservoirs located in the upper reaches of the rivers of Ganga system are mahseer *viz*. *Tor putitora*, *T. mosal*, *T. tor*; the katli, *Acrossocheilus hexagonolepis*; the snow trout, *Schizothorax plagiostomus*, medium carps, *Labeo dero* and *L. pangusia* and the goonch, *Bagarius bagarius*. The reservoirs located in the middle and lower reaches of the rivers harbour the Indian major carps, *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala* and *Labeo calbasu* and other carps such as *Labeo gonius*, *L. bata*, *L. boga*, *L. boggut*, *Puntius sarana* and *Chagunius chagunio*. The major catfish species contributing to the fisheries of the reservoirs of the Ganga river system are *Wallago attu*, *Silonia silondia*, *Pangasius pangasius*, *Rita rita*, *Aorichthys aor*, *A. seenghala* etc. Smaller catfishes represented in these reservoirs are *Clupisoma garua*, *Eutropiichthys vacha*, *Mystus cavasius*, *Ompok bimaculatus* etc. Pathani and Joshi (2007) have extensively studied Ichthyo-fauna diversity and fisheries of Nanaksagar reservoirs. The formation of reservoirs has adversely affected the indigenous fish stocks of the mahseer, *Labeo dero* and *L. dyocheilus* of the Himalayan streams. The presence of *Oreochromis niloticus* in family *Cichilidae* was recorded first time in Nanaksgar reservoir, which was not reported in any other research works on Nanaksagar reservoir. Mostly the fishing techniques used by the fishermen are traditional therefore,

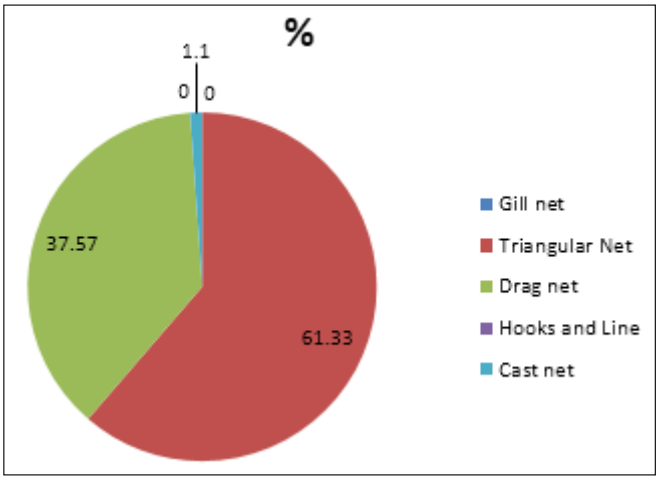

Fig. 6 : Gear wise percentage catch contribution of uneconomical fishes.

need of awareness and training programme regarding modern fishing techniques. Further, reservoir management authority should aware the local contractors and fishermen's for the use of modern fishing equipments .The documented information, technical characteristics and operation of gear and fish diversity of Nanaksagar reservoir in tarai region of Uttrakhand, would serves as base line data which would help in the process of technological invention and managements for well being. The present investigation revealed that the long term studies on fish diversity, fishing gears and catch composition are much essential to know the changes in the biodiversity for better and sustainable reservoir

Table 9 : Fish diversity of Nanaksagar reservoirs.

S. No.	Family	Genus / species	Local name
1.	**Cyprinidae**	*Catla catla* (Ham.)	Bhakur
		Labeo rohita (Ham.)	Rohu
		Cirrhinus mrigala (Ham.)	Nain
		Cirrhinus reba (Ham.)	Raiya
		Cyprinus carpio communis (Linn.)	Common carp
		L. gonius (Ham.)	Khursa
		L. calbasu (Ham.)	Karaunch
		L.Bata	Bata
		Puntius sarana (Ham.)	Puthia
		P. ticto (Ham.)	Bhoor
		P. sophore (Ham.)	Sidhari / Bhoor
		P. chola (Ham.)	Sidhari / Bhoor
		Rasbora daniconius (Ham.)	Dendua
		Osteobrama cotio (Ham.)	Katair /Maya
		Danio devario (Ham.)	Patukari
		Oxygaster bacaila (Ham.)	Chelwa
2.	**Clupeidae**	*Gudusia chapra* (Ham.)	Suhia
3.	**Notopteridae**	*Notopterus notopterus* (Pallas.)	Patra
4.	**Bagridae**	*Mystus tengara* (Ham.)	Tenger
		M. vittatus (Bloch)	Tengara
		M. seenghala (Sykes)/*Sperata seenghala*	Keral /Tenger
		M. cavasius (Ham.)	Tengara
5.	**Saccobranchidae**	*Heteropneustes fossilis* (Bloch)	Singhi
6.	**Ophiocephalidae**	*Channa striatus* (Ham.)	Shaul
		C. gachua (Ham.)	Chanaga
		C. marulius (Ham.)	Saur
		C. punctatus (Bleeker)	Girai
7.	**Siluridae**	*Wallago attu* (Ham.)	Lachi
		Ompok pabo (Ham.)	Papda
8.	**Clariidae**	*Clarius batrachus* (Linn.)	Mangur
9.	**Mastacembelidae**	*Mastacembelus puncalus* (Ham.)	Baam
		Macrognathus aculeatus (Bloch)	Baam
		Mastacembalus armatus (Lacepede)	Baam
10.	**Belonidae**	*Xenentodon cancila* (Ham.)	Kauwa
11.	**Anabantidae**	*Colisa fasciatus* (Bloch & Schn.)	Kharda
12.	**Gobiidae**	*Glossogobius giuris* (Ham.)	Gobi
13.	**Centropomidae**	*Chanda nama* (Ham.)	Gurda
		Chanda ranga (Ham.)	Gurda
14.	**Nandidae**	*Nandus nandus* (Ham.)	Godhi
15.	**Cobitidae**	*Nemacheilus botia* (Ham.)	Nakti
16.	**Cichilidae**	*Oreochromis niloticus*	Tilapia

fisheries management.

ACKNOWLEDGEMENTS

The authors are grateful to the authorities of university, Dean PGS, Prof. & HoD, Department of Fisheries Resource Management and Dean College of Fisheries for granting permission and his constant encouragement and valuable guidance in carrying out the study. The help rendered by local fishermen, fishing contractors Mr. A.P. Singh and Deptt. of Fisheries, Uttarakhand is duly acknowledged.

REFERENCES

Anonymous (1992) E.E., Irrigation division Bareilly, letter No. 1713, dated: 17.07.1992

Berg L S (1947) Classification of fishes both recent and fossil, (English and Russian), Traveaux Follett's Michigem Bookstore, 87- 517 p.

David A and Rajgopal K V (1978) Experimental fishing and observation on commercial fishing methods. *Proc. Ecology and fisheries of fresh water reservoir*, Nov. 27-29 CIFRI, Barrackpore: 503-516.

Day Francis (1878) *The fishes of India.* William Dawson & Sons Ltd., London. 703 p.

De Silva S S and Amarasinghe U S (2009) Status of reservoir fisheries in five Asian countries. NACA Monograph No. 2. Network of Aquaculture Centers in Asia-Pacific, Bangkok, Thailand. 113p.

Gautam P L, Sharma A P and Mishra A (2004) Uttaranchal ke matsyki vikas hetu nitigat dishayen. Jaladhi, Central Institute of Fisheries Technology, Cochin. 20-26.

Jhingran V G (1991) *Fish and fisheries of India*. Hindustan Publishing Corporation, India., 727 p.

Joshi Pramod (2011) Fishes catch statistics in relation to nets and gear used. *J. Exp. Zool. India* **14**(2), 591-593.

Joshi P (2012) Species wise composition of some food fishes. *J. Exp. Sci.* **3**(1), 08-09.

Kazi T G, Mohite A S and Jadhav R R (2012) Design and technical specifications of Seer Fish Gillnets of Ratnagiri, Maharashtra. *Fish. Technol*. **49**, 28-31.

Krishnamurthy K N, Govind B V and Bhatnagar G K (1994) Experimental gill net fishing in Tungabhadra reservoir. *Indian J. Fish.* **11**, 465-479.

Kumar V and Kumar K (2013) A Preliminary Study on Fishing Craft and Gears in Dhaura Reservoir, Uttarakhand, India. *Int. Research J. Biol. Sci.* **2**(8), 76-78

Nayar S, Gopalan M, Sahahul Hameed and Verghese M D (1969) Experimental fishing in Gandhisagar reservoir Madyapradesh. *Proc. Symp. Ecology of Reservoir*, CIFRI Barrackpore.

Pathani S S and Joshi P (2007) Ichthyo-fauna and fishery in Nanaksagar reservoir of Uttarakhand State, India. *Aquacult*. **8**(2), 191–197.

Pravin P, Remesan M P and Mathai P G (1998) Gillnet fishing, In: Advances and Priorities in Fisheries Technology (Balachandran K K, Iyer T S G, Madhavan P, Joseph J, Perigreen P A, Raghunath M R and Varghese M D eds), pp 170-176, *Society of Fisheries Technologists* (India), Cochin.

Srivastava Gopalji (2002) *Fishes of UP & Bihar* (Fourth edition). Vishwavidyalaya Prakashan, Varanasi, 207 p.

Sulochanan P, George V C and Naidu R M (1968) Experimental fishing in Hirakund reservoir Orissa (1965-67). *Fish Tech*. **5**, 81-95.

Thomas S N, Meenakumari B, Pravin P and Mathai G (2005) Gillnets of Marine Fisheries of India, Monograph, 45p, Agricultural Technology Information centre, Central Institute of Fisheries Technology, Cochin.

Thomas S N and Hridayanathan C (2006) Design and general characteristics of marine gillnets of Kerala. *Fish. Technol*. **43**, 17-36.