Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(5): 1077-1084

Received: 05-07-2018
Accepted: 06-08-2018

Uday Singh Majhi
Department of Fisheries Resource Management, College of Fisheries, G. B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India

AK Upadhyay
Department of Fisheries Resource Management, College of Fisheries, G. B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India

Shubham Varshney
ICAR- Central Institute of Fisheries Education, Mumbai, Maharashtra, India

Correspondence
Uday Singh Majhi
Department of Fisheries Resource Management, College of Fisheries, G. B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India

Study of fish catch composition data and fishing methods from the Baigul reservoir of distt-Udham Singh Nagar, Uttarakhand

Uday Singh Majhi, AK Upadhyay and Shubham Varshney

Abstract
The present study was undertaken to collect baseline data on the ecological features and fish and fisheries in Baigul reservoir located in the Tarai region of Uttarakhand. The data on fish community, fecundity, physico-chemical parameters, phytoplankton *etc.* were recorded at fortnightly intervals in the lentic and lotic zones of the reservoir. The fish fauna was comprised of major carps, cat fishes, minor carps and large populations of trash fishes. A total of 36 species of fish belonging to 13 families were identified in the reservoir and it was quantified that the fishery of the reservoir, belonging to group B_2 and group B_3 was most dominant in all three years. During the study period total fish yield of Baigul reservoir was 1,86,314 kg in the year 2014-15(69.18 kg/ha/year) from its total water area of 2693 hectare. Fish catch trend for the previous three years indicated the annual production of 2,00883 kg, 1,58204 kg, 1,86314 kg respectively for the years of 2012-13, 2013-14, and 2014-15. The average fish production from the Baigul reservoir for the three years was found to be 1, 81800 kg. The investigation also revealed that the maximum gain in length and weight was found to occur during spring season and summer months between the months of March to June. The spawning was found to occur in the monsoon months from June to September with the peak time in the months of July and August having two peaks of maximum. In Baigul reservoir the employment of gill net was most common. The contractors employed mostly the traditional gears and crafts for fishing. The fishing was performed from gill net, triangular net, hook and line, cast net and dragnet

Keywords: Reservoir, production, catch, gill net, economy

Introduction
The fisheries sector contributes to the national income, exports, food and nutritional security and employment generation. As per the estimates of the Central Statistical Organization of the Government of India, the total fish production during 2011-12 was 8.67 million tonnes with a contribution of 5.30 million tonnes from inland sector and 3.37 million tonnes from marine sector respectively. In same year fisheries sector contributed 4.47 per cent to the agricultural GDP and 0.78 per cent to the total GDP (DAHD&F, 2013) [1]. During 2013-14, the volume of fish and fishery products exported from India was 98,3756tonnes worth 30, 213.26crores and during 2013-14 for the first time export earnings have crossed USD 5 Billion (MPEDA, 2014) [5]. While considering the resources Inland sector of India comprises 29,000 km of river, 3.15 million ha area of reservoirs, 0.2 million ha area of flood plain wetlands, 0.72 million ha area of upland lakes, 2.25million ha area of tanks (Sugunan, 1995) [10]. Among the said inland resources, rivers and reservoirs contribute considerably to the inland fish production. In the event of confiding and considering the reality of water abstraction from the major rivers, in fact if properly managed and expressed, the reservoirs would be the principal source of fish production for India in future. The reservoirs can play a vital role in increasing fish production of the country, provided these vast resources are developed for fisheries on the scientific lines. Reservoirs are not only one of the most potential fishery resources for future fisheries development but will play pivotal role man power resources development and management for generating the source from employment of India Vass (2002) [11].
Fish production through capture from rivers, however, has already declined by ten-fold. Therefore, reservoirs offer a great scope for further enhancement of inland fish production of the country. The feasibility of using reservoirs for fisheries was conceived globally early in the twentieth century. As a result, a number of pioneering studies with regard to fisheries of impounded waters were initiated in India by Raj (1941) [7], Sugunan (1980) [9], Jhingran (1989)

[4] etc. in certain major reservoirs of the country which has augmented fish harvest and caused habitat amelioration as well. Most of the country's reservoirs are located in drastically different agro-climatic conditions and therefore their limnological characteristics are different. On account of this fact, it becomes essential to characterize the ecological parameters of different water bodies, so that the lack of information on these aspects does not constitute an important bottle neck in the development of reservoirs. Reservoir are classified into small (<1000 ha), medium (above 1000 to 5000 ha) and large (>5000 ha) based on their area. It has been estimated that India has 19,134 small reservoirs with a total water surface area of 14, 85,557 ha, 180 medium reservoir with 5, 27,541 ha and 56 large reservoirs with 11, 40,268 ha. Thus, the country has 19, 370 reservoirs covering 31, 53, 366 ha. The average fish production of different categories of reservoirs has been estimated for small, medium and large reservoir as 50, 12.3 production potential and 11.5 kg/ha/year respectively (Sugunan, 1995) [10]. Although many reservoir ecosystems have been recognized for their great potential for fisheries, their average fish production is frustrating low (20.13kg/ha/year) (Desai, 2006) [2]. These underutilized aquatic resources offer immense scope for generating additional national income in the order of more than Rs. 100 crores per year and providing additional employment through fishing, handling transport, marketing and ancillary industries (Srivastava and Reddy, 1983) [8].

Uttarakhand, the hill state of India has only fresh water resources having river and tributaries (2,686 km.) reservoirs (20,075 ha) and flood plain (628 ha) which have 64 species in Garhwal region and 31 fish species in Kumaon region. The important reservoirs of Uttarakhand are the Nanaksagar, Sardasagar,Baigul, Tumaria, Dhaura, Baur, Haripura and Tehri. These reservoirs are mainly used for irrigation, hydroelectric power generation and fisheries (Gautam *et al.*, 2004) [4]. Among these reservoirs, Baigul reservoir which is situated at about 35 kms from the place of study centre: collage of fisheries Pantnagar is taken as a case study for the present investigation.

The present assessment of on-going fisheries activities was meticulously undertaken which included comprehensively information about the fishing methods and the fish catch trend from previous years.

Material and methods

Baigul Reservoir

Experimental site

The site chosen for the experiment for all the interventions of sampling and as a case study intending the improvement was Baigul reservoir. The dam was constructed in the year 1967 across Sukhi River originally from Shivalik hills of the Himalayas and a tributary of river Ganga, mainly to irrigate the agricultural farming of the lower Tarai region of the state of Uttarakhand. The fisheries activity of the dam began in 1973. The spread of the reservoir is about 2995km and the catchment area of 305 km^2.

Data of fish catch

In order to assess the production trend the catch data of the said reservoir of the last three years was obtained from the state fisheries department.

Fish composition

The fish harvesting methods employed for fishing from the Baigul reservoir was vitally monitored to take into consideration the potential of the harvest. The harvested fishes from the reservoir were classified into 5 categories according to the Uttarakhand Fisheries Development Corporation (UFDC, Dehradun). These were Group A, Group B_1, Group B_2, Group B_3, Group C; the Group Wise detail are shown in Table 1.

Table 1: The list of fish catches composition and these respective groups

SI. No.	Groups	Species
(A)	Major carps	*Labeo rohita, L. calbasu, Catla catla* and *Cirrhinus mrigala*
(B_1)	Cat fishes	*Mystus tengara* and *Channa striatus*
(B_2)	Minor carps	*Labeo gogonius*, and *Notopterus notopterus*
(B_3)	Miscellaneous	*Heteropneustes fossilis, Nandus nandus* and *Mastacembelus armatus* etc.
(C)	Weed fishes	*Gudusia chapra* etc.

(**Sources;** Uttarakhand Fisheries Development Corporation, Dehradun)

Fishing methods used

The fish harvesting methods employed for fishing from the reservoir was vitally monitored to take into consideration the potential of harvest from each gear employed viz.; Gill net, Triangular net, Hook & Line, Cast net, Drag net etc.

Results and discussion

The Baigul reservoir since having the total water spread area 2693 hectare and less than 5000 hectare comes under the category of medium class reservoir. According to Sugunan (1995) [10]. The production potential of medium reservoirs in earlier times was average about12.3 kg/ha/year. The current production trend of the reservoir was thus found be much above this land mark. However considering with the passage of time the introduction of research work done and management measure to improve the production potential for medium class of reservoir at present rate was estimated to be around a minimum of 75 kg/ha/year. Therefore in context of potential the present level production from the reservoir was found to be comparatively low.

Baigul reservoir is important among the reservoirs existing in the Tarai regionwhich forms the major hub for the fisheries activity for the state of Uttarakhand. The fish catch trend for the previous three years indicated the annual production of 2,00883kg, 1, 58204 kg, 1, 86314 kg respectively for the years of 2012-13, 2013-14, and 2014-15.

This aptly indicates wide annual fluctuation of fish landing from the reservoir. The details of year wise fish production from the reservoir are reproduced in Table 2:

Table 2: Month wise and year wise fish production (kg) of Baigul reservoir (2012-2013, 2013-2014 and 2014-2015)

	Months								
	November	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**Total**
2012-13	12370	26407	63034	14558	15599	15142	15846	37927	200883
2013-14	15232	25402	28984	21245	14037	12496	17751	23056	158203
2014-15	2819	51226	79006	18608	7600	8368	10263	8424	186314
Months wise average	10140.33	34345	57008	18137	12412	12002	14620	23135.66	181800

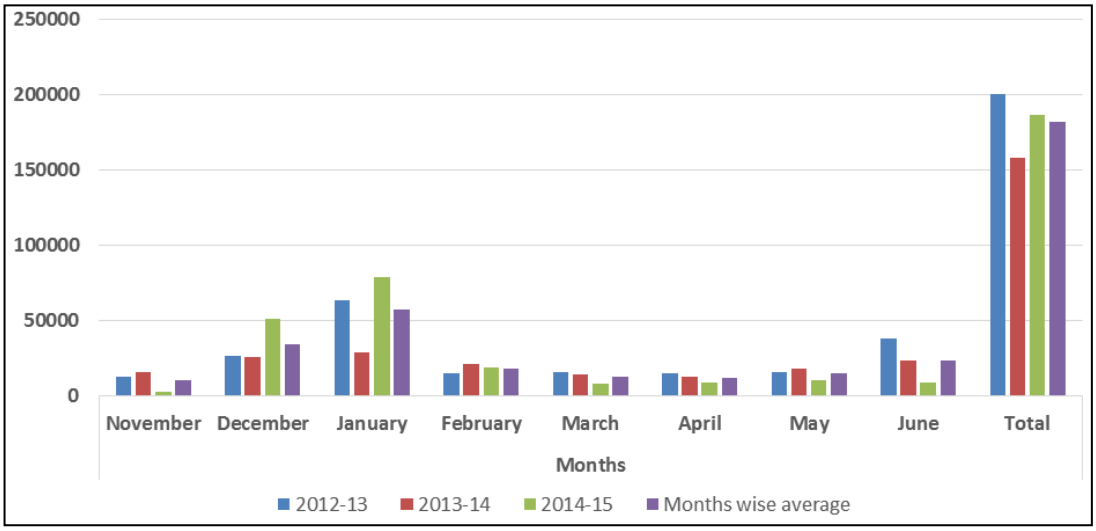

Fig 1: Month wise and year wise fish production (kg) of Baigul reservoir (2012-2013, 2013-2014 and 2014-2015)

The fishing seasons from the reservoir extends from October to June. The month wise landing of fish for the reservoir for all these three years has also shown a remarkable disparity and fluctuation. The fish production was lowest with the beginning of the fishing season in the month of October-November. The fishing was intensified with the highest production in the month of January. There after the production got sedately reduced in the months from February to May. However, within the months from February to May the fish landing in all the three years have shown the fluctuation. The fish production again got increased in the month of June except in the year 2014-2015. The month wise average fish landing has shown such fluctuating trend in the month of January and minimum from the month of November. The great fluctuation were also seen within the same months of data of fish production

The average fish production from the Baigul reservoir for the three years was found to be 1,81800kg this production seems to reasonably less than the expectations. The per hectare fish production of the reservoir for these years was found to be highest of 74.59 kg/ha in the year 2012-13, followed by 58.74 kg/ha in 2013-14 and 69.18 kg/ha for the year 2014-15.

Fish fauna of the reservoir

The fish fauna has been studied during the present investigation revealed rich assemblage of both naturally occurring and stocked fish species, indicating that the Baigul reservoir harbor a rich and variety of fish fauna.

The fish composition mainly including major carps, cat fishes, minor carps and the large quantum of trash fishes, taxonomically about 36 species belonging to 13 families were found, which mainly including Clupidae, Notopteridae, Cyprinidae, Siluridae, Channidae and Bagridae. The major identified fish species from the fish fauna included *Labe orohita*, *Catla catla*, *L. calbasu*, *L. gonius*, *Puntius sp.*, *Cirrhinus mirgla*, *C. reba*, *Mystus tengara*, *M. seenghala*, *Nandus nandus*, *Gudusia chapra*. *Notopterus notopterus*, *Wallago attu*, *Xenentodon cancila* and *Mabtacembelus armatuse* etc. the detailed list of fish composition from the reservoir is given in Table3:

Table 3: Fish fauna of the Baigul reservoir

S. No.	**Families**	**Species**	**Local name**	**Abundance**
1	Clupideae	*Gudusia chapra*	Suhia	A
2	Notopteridae	*Notopterus notopterus*	Patra	A
		N. chitala	Moya	S
3	Cyprinidae	*Cyprinus carpio*	Common carp	L
		Tor tor	Mahaseer	S
		B. bendelisis	Bhola	S
		Puntius sophore	Sidhari	L
		P. sarana	Sidhari	M
		Cirrhinus mrigala	Mrigal/Nain	M
		C. reba	Raia	M
		Labeo gonius	Kursa	A
		L. bata	Bata	L
		L. rohita	Rohu	L
		L. calbasu	Karaunch	M

		Oxygaste rbacaila	Chilwa	L
		Catla catla	Katla	L
4	Bagridae	*Mystus seenghala*	Dariaitengar	L
		M. cavasius	Sutahawatengara	L
		M. vittatus	Tengara	S
		M.oar	Dariaitengar	S
		M. tengara	Tengara	M
5	Heteropneustidae	*Heteropneustus fossilis*	Singhi	L
6	Siluridae	*Ompak pabda*	Pabda	M
		Wallago attu	Padhani/Lanchi	S
7	Claridae	*Clarias batrachus*	Magur	L
8	Belonidae	*Xenentodon cancila*	Kauwa	M
9	Channidae	*Channa gachua*	Changa	M
		C. marulius	Saur	A
		C. punctatus	Girai	A
		C. striatus	Saur	A
10	Anabantidae	*Colisa fasciatus*	Khosti	S
11	Centropomidae	*Chanda ranga*	Chanari	M
12	Nandidae	*Nandus nandus*	Dhebari	M
13	Mastacembelidae	*Mastacembelus armatus*	Baam	M
		M. pancalus	Malga/Patya	L
		M. aculeatus	Malga/Patya	L

(Sources: Poonam, 2006)
A = Most abundant, M = Moderately abundant, L = Less abundant, S = Seasonally

Based on the commercial validity the fish fauna from the reservoir was categorised into given groups, group A comprised of the major carps which included *Labeo rohita, L. calbasu, Catla catla and Cirrhinus mrigala*. The group B_1 included the cat fishes represented by *Mystus tengara and Channa striatus, Wallago attu* etc. the B_2 group comprised of the minor carps such as *Labeo gonius, and Notopterus notopterus.* The group B_3 included the miscellaneous other fishes having species wise composition of *Heteropneustes fossilis, Nandusnandus and Mastacembelus armatus, Pungacious, Tor tor etc.* The last C Group formed by the weed fishes comprising of *Gudusia chapra, Puntius, Oxygastus sp., etc.*

Group wise production details of fish catch composition
The details of Group wise landing of fish for the years, 2012-13, 2013-14 and 2014-15 is given in Table 4-6:

Table 4: Total catch composition (in Kg) in Baigulreservoir 2012-2013

Months	A Class	B_1 Class	B_2 Class	B_3 class	C Class	Total
November	629	483	8690	1585	983	12370
December	986	816	6820	16840	945	26407
January	1322	842	14650	44400	1820	63034
February	1379	759	10720	870	830	14558
March	1188	661	12740	0	1010	15599
April	418	254	13470	0	1000	15142
May	1219	517	12900	0	1210	15846
June	6561	1051	17680	0	12635	37927
Total	13702	5383	97670	63695	20433	200883
%	6.82	2.67	48.62	31.7	10.17	100

Table 5: Total catch composition (in Kg) in Baigulreservoir 2013-2014

Months	A Class	B_1 Class	B_2 Class	B_3 class	C Class	Total
November	616	651	9920	3295	750	15232
December	798	1045	10158	12750	651	25402
January	1103	694	9270	17185	732	28984
February	664	768	9510	9885	418	21245
March	581	787	11250	955	464	14037
April	451	553	10440	675	377	12496
May	945	912	15050	390	454	17751
June	1979	1213	17490	384	1990	23056
Total	7137	6623	93088	45519	5836	158203
%	4.51	4.18	58.84	28.77	3.68	100

Table 6: Total catch composition data (in Kg) in Baigulreservoir 2014-2015

Months	A Class	B_1 Class	B_2 Class	B_3 class	C Classs	Total
November	171	48	570	1980	50	2819
December	3487	1194	6250	39810	485	51226
January	2176	744	2880	72890	316	79006
February	1347	652	4000	12210	399	18608
March	1663	928	4039	370	600	7600
April	1500	568	6000	0	300	8368
May	1700	1035	6028	0	1500	10263
June	1583	892	5021	0	928	8424
Total	13627	6061	34788	127260	4578	186314
%	7.31	3.25	18.67	68.3	2.45	100

Group A

The catch composition of group A fishes for the three years varied between the highest of 6561 kg obtained in the month of June 2012-2013 and the lowest catch 171 kg obtained in the month of November 2014-2015. Month wise in the respective years, the highest catch of 6561 kg was landed in the month of June 2012-2013; for the year2013-2014 also the highest catch of 3487 kg was harvested in the month of December. This was great variation in all the three years into the month wise landing of this group from the months of November to June. Thus the remarkable fluctuation in month wise production was recorded for this group in all the three years. The percentage contrib0ution of this group to the year wise, total fish landing was found to be at 6.82%, 4.5% and highest of 7.13% for respective years of 2012 -2013, 2013-2014 and 2014-2015.

Group B_1

The share in production by this category fishes for the three years varied between the highest of 1213 kg obtained in the month of June 2013-2014 and lowest catch of 48 kg obtained in the month of November 2014-2015. Month wise in the respective years, the highest catch of 1213 kg was landed in the month of June 2013-2014, for the year 2014-2015 also highest catch of 1194 kg was harvested in the month of December and the year of 2012-2013 also highest catch recorded 1051 kg in the month of June. This was great variation in all three years in to the month wise landing of this group from the month of November to June. Thus the remarkable fluctuation in month wise production was recorded for this group in all three years. The percentage contribution of this group to the year wise, total fish landing was found to be at 2.67%, 4.18%, and 3.25% for respective years of 2012 -2013, 2013-2014 and 2014-2015.

Group B_2

The catch composition of group B_2 fishes for the three years varied between the highest of 17680 kg obtained in the month of June 2012-2013 and lowest catch 570 kg obtained in the month of November 2014-2015. Month wise in the respective years, the highest catch of 17680 kg was landed in the month of June 2012-2013; for the year 2013-2014 also the highest catch of 17490 kg was harvested in the month of June and the year of 2014-2015 also the highest catch was recorded 6028 kg in the month of May. This was great variation in all the three years into the month wise landing of this group from the months of November to June. Thus the remarkable fluctuation in month wise production was recorded for this group in all the three years. The percentage contribution of this group to the year wise, total fish landing was found to be at 48.62%, 58.84% and 18.671% for respective years of 2012 -2013, 2013-2014 and 2014-2015.

Group B_3

The catch composition of group B_3 fishes for the three years varied between the highest of 72890 kg obtained in the month of January 2014-2015 and lowest catch 370 kg obtained in the month of March 2014-2015. Month wise in the respective years, the highest catch of 72890 kg was landed in the month of January 2014-2015; for the year 2013-2014 also the highest catch of 17185 kg was harvested in the month of January and the year of 2012-2013 also the highest catch was recorded 44400 kg in the month of January. This was great variation in all the three years into the month wise landing of this group from the months of November to June. Thus the remarkable fluctuation in month wise production was recorded for this group in all the three years. The percentage contribution of this group to the year wise, total fish landing was found to be at 31.70%, 28.77% and the highest 68.30% for respective years of 2012 -2013, 2013-2014 and 2014-2015.

Group C

The catch composition of group C fishes for the three years varied between the highest of 12635 kg obtained in the month of June 2012-2013 and lowest catch 50 kg obtained in the month of November 2014-2015. Month wise in the respective years, the highest catch of 12635 kg was landed in the month of June 2012-2013; for the year 2013-2014 also the highest catch of 11990 kg was harvested in the month of June and the year of 2014-2015 also the highest catch was recorded 1500 kg in the month of May. This was great variation in all the three years into the month wise landing of this group from the months of November to June. Thus the remarkable fluctuation in month wise production was recorded for this group in all the three years. The percentage contribution of this group to the year wise, total fish landing was found to be at 10.17%, 3.68% and 2.45% for respective years of 2012 -2013, 2013-2014 and 2014-2015.

The month wise average landing have indicated that the highest production of fish was obtained in the month of January, followed by the month of December the fish catch however declined from March to May to have another peak of high production in the month of June for all the three years.

Table 7: All three years average months wise and class wise of fish production (in kg) of Baigul reservoir (2012-2013, 2013-2014 and 2014-2015)

	A Class	B Class	B2 Class	B3 Class	C Class	Total
November	472	394	6393.33	2286.66	594.33	10140.33
December	1757	1018.33	7742.66	23133.33	693.66	34345
January	1533.66	760	8933.33	44825	956	57008
February	1130	726.33	8076.66	7655	549	18137
March	1144	792	9343	441.66	691.33	12412
April	789.66	458.33	9970	225	959	12002
May	1288	821.33	11326	130	1054.66	14620
June	3374.33	1052	13397	128	5184.33	23135.6
Total	11488.66	6022.33	75182	78824.66	10282.33	181800

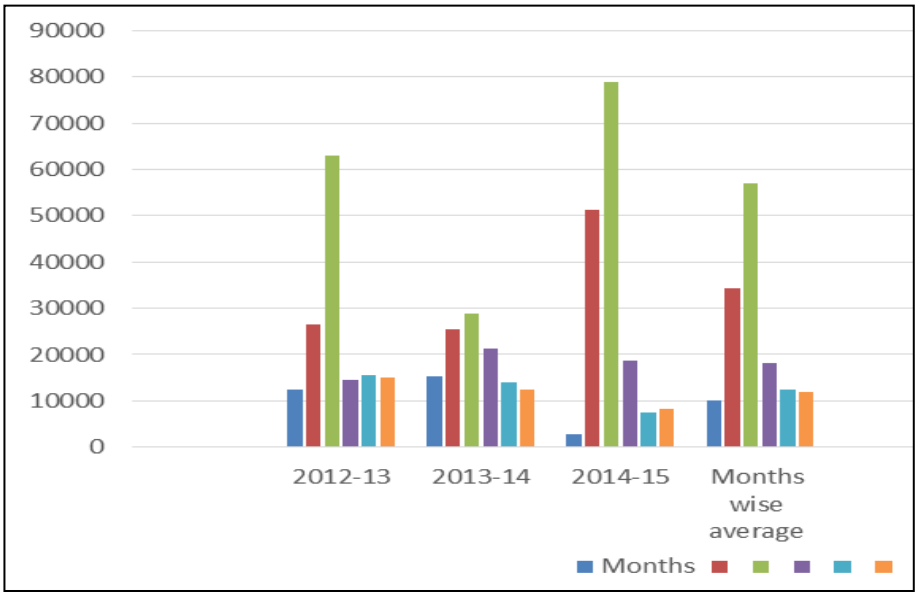

Fig 2: Class wise of fish production (in kg) of Baigul reservoir (2012-2013, 2013-2014 and 2014-2015)

The critical analysis of group wise production for the three years for the have indicated highest landing of B_3 category represented by the miscellaneous fish group with the average production of 78824 Kg, followed by group B_2 formed mainly by minor carps with the average production of 75182 Kg. The group A for major carps ranked 3rd with the average landing of 11488Kg, The group C for weed fishes and B_1 for cat fishes 0ccupied 4th and 5th places with the average fish harvest of 10282 Kg and 6022 Kg respectively.

The group wise monthly landing have shown that the landing B_3 Category was highly over overwhelming for the months of December and January with the average production 23133 Kg and 44825 Kg respectively when it was highest. In the months of November and February it ranked 2nd in production. The production of this group (B_3) was remarkably poor and insignificant and occupied 5th place from March onward to the end of fishing season in June.

The most prominent group in terms quality and quantity was group B_2 represented by minor carps.

This group was next to B_3 only in the months of December and January but was leading producer in the months of November and February till the end of fishing season in June when it occupied the topmost 1st position.

The group A represented by major carps was handsome in landing the months of March and May when it ranked 2nd while in rest of the months the production was fairly good to occupy the 3rd position.

Even though the B_1represented by catfishes quality wise very important considering its commercial validity. Its production from the reservoir comparatively low except for the month march when it occupied the 3rd position with the average production of 792 kg it ranked for most of the months at 4th and 5th position.

The harvesting pattern also has shown that the C group which mostly includes trash fishes occupied the rank between the 2nd and 5th places. It also indicated that the average production of for all the three years of this group each about 10282 kg, this is substantial loss from the reservoir considering the catch of this group of fishes goes as gross wastage without any viable utilization. It must therefore be earned endeavor to reduce this loss upgrade the provisions for effect in utilization of the trash fishes and their reduction in to the development of byproducts of multifarious utility.

Fishing methods

The fishing methods not only have direct impact on fish productivity from natural water bodies but also it influences the availability of fish stock for the exploitation in future. The fishing methods, fishing efforts and fishing frequency have direct bearing on the quantum of catch in hand also determines what is left for future. The rational fishing practice is to use such gears whose capture capacity for adult fishes is more however under no circumstances should effect the stock in future by preventing in the process the small, juvenile and pre-spawners from the harvest. The term of maximum sustainable yield should always be adhered which ensures. The maximum sustainable productivity of fish for longer duration of time but prevents overexploitation of stock from the site of the water body. The fishing frequency should be executed at the level of fishing effort which is required to be

below than the level of fishing effort needed for the maximum sustainable yield, so that the stock is not completely or overexploited and some portion of stock is left in lieu which would further multiply thus ensure high productivity in the subsequent years. There also be some duration of cooling time or non-fishing days especially during the spawning time of fishes so that the brooders are safe to follow breeding, spawning and adding in quantum of fish stock for future.

The Baigul reservoir is leased out to contractor for fishing for the duration of five years. The management of the reservoir is therefore under the complete command of the contractor. The fishing was followed from the month of October to the start of June every year and in the monsoon month the fishing was abandoned up to the end of September every year.

Fishing gears

The contractors employed mostly the traditional gears and crafts for fishing. The fishing was performed from gill net (fanslajal), triangular net (fattajal), hook and line (dori), cast net (ghagariajal), dragnet (chattijal or mahajal) etc.

Table 8: Class wise and gear wise fish production of Baigul reservoir in year 2014-15

Months	A Class	B_1 Class	B_2 Class	B_3 Class	C Class	Total
Gill net	9538.9	3636.6	34788		4578	52541.5
Triangular net	2725.4	-	-	127260	-	129985.4
Hook and line	1362.7	2424.4	-	-	-	3787.1
Cast net	-	-	-	-	-	-
Drag net	-	-	-	-	-	-
Total	13627	6061	34788	127260	4578	186314

Gill net

Gill net is highly versatile gear and also species specific to perform the targeted fishing. The gear can be erected of virtually in upright manner and fixed at any point for stationary fishing; it can also be used as mobile gear by handing one end of the net secured to the boat and mandevoured along the length of the water body.

In the Baigul reservoir the employed of gill net was most common. The net usually is made up of nylonchord and mostly 3 type of mesh size viz: 15×15 mm, 45×45 mm and 75×75 mm for catching minor carps, major carps catfishes etc. the top of the net is made up of series of floats whereas the sinkers are secured to the bottom edge of the gear. The net thus vertically stands in upright manner with the help of one end secured to the boat to perform fishing at different location of the water body. The fishes mostly caught by this gear are *Labeo sp.*, *Catla catla*, *Mystus seenghala*, *M. tengra*, *M. vittatus* and *Wallago attu* etc. The group wise harvest by the gear indicated 100% of capture for B_2 and C groups, while group A and group B_1 accounted for 70% and 60% respectively. The gear was able to constitute about 28.2% of share to the total quantum of harvest obtained from the reservoir.

Triangular net

The use of this gear is mostly used for the harvest for A and B_3 groups. Triangular nets are conical in shape and made of bamboo pieces of about 1.2×1.2 ×2.0 m size. The length of the net may also vary between 1.0 and 2.5 m. The posterior end of the net where the catch is collected is known as 'Bhog'. In the operation of this net the fishermen dip the front edge of the net in shallow water and capture small prawns and weed fishes like Puntius sp. and Channa sp. The mesh sizes of 5×5 mm to 5×10 mm are recommendable for capturing commercially important fish species. If the net is to be used in deeper waters, a small boat is of great help.

The triangular net accounted for the maximum 100% harvest for B_3 group which accounts for the maximum production of fishes from the reservoir. This was followed by the harvest of group A which accounted for 20% of harvest from the gear the utility of the gear was highest so profound that it shared about 69.76% to the total production of the fish obtained from the reservoir from the collection use of all gears.

Hook and Line fishing

Hooks and line is another important fishing gear commonly operated in Baigul reservoir during post monsoon and summer months when the transparency of water is low. This device is usually used to harvest cat fishes and murrels. Lines are made of long cords of cotton or waste silk tied with 100 to 200 country made iron hooks. The common baits used on the hooks comprise trash fishes, small prawns, earthworms *etc*.

Hook and line accounted for 40% of fish catch for B_1 group for the capture catfishes mainly. The group A for major carps shared 10% of harvest from the gear. The total share the gear for the harvest was 2.03% from the harvest obtained collection from the use of all gears.

Cast net

The use of cast net was not common; it was employed in the shallower water of the reservoir and swampy, marshy areas nearby to the reservoir.

This net is circular in shape, which opens like an umbrella. The bottom rope of thenet, fitted along its opening, is usually fastened with a number of weights which facilitate an easy suspension of the net in the water. The recommended mesh size of the net is 5×5 cm to 8×8 cm. The fisherman throws the net towards such a manner that it falls over the water body in a circular fashion. The net suspends easily in water due to the presence of attached weights. Subsequently, the fishermen haul the net by slowly pulling the string and closing its circumference. The gear is mostly use for the capture of *Labeo spp.*, *Catla sp.*, *Cirrhinus*spp., *Mystus*spp., *Wallagoattu.* However, the harvest from the gear is very poor and found to be insignificant.

Drag net

The use of drag net is also very less. The gear is very large and can be spread horizontally covering wide area. However, considering the vast area of water body and the depth offered the limitation in the operational use of the gear in the reservoir.

Drag net is very large in size which horizontally covers an enormous area in length (350 to 400 m) and width (3 to 4 m). One large and two small boats with 24-30 fishermen form one operational unit. The mesh size of the net is about 1x1 mm. The head rope of this net is supported by a strong cord and is provided with a large number of wooden or plastic floats,

whereas the food rope is tied with a number of sinkers to keep the net suspended in water in vertical position. The operational principle involves handing over one end of the net to one party of fishermen standing on the reservoir bank. The net is then spread out in water in the semicircular fashion with the help of boats to encircle the fish shoal from all directions. The operational boats then turn to hand over the other end of the net to the second party of fishermen standing at another distant place on the shore. The net is operated in the month of May and June to catch the fishes like *Heteropneustes fossilis,* Channa sp.*, Mastacembelus* sp.*, Chanda* sp.*, Puntius* sp. *etc*. The harvest from the gear was so insignificant to find manuscript mentioning in the present.

Conclusions

The general trend of the month wise fish catch from the reservoir suggested that in all the three years the fish landing was higher in the month of January, with the second high peak in the production in the month of June except 2014-15.The production in the months of December and February were found to be at a moderate level. In the month of March and April the production decline and risen again in the month of May culminating into the second-high peak of production in June except 2014-15. The production was minimum at the start of fishing season in November for the years 2012-13 and 2014-15, while for the year 2013-14 the minimum production was observed in the month of April.

The general trend of the month wise fish catch from the reservoir suggested that in all the three years the fish landing was maximum in the month of January, with the second high peak in the production in the month of June except 2014-15.The production in the months of December and February were found to be at a moderate level. In the month of March and April the production decline and risen again in the month of May culminating into the second-high peak of production in June except 2014-15. The production was minimum at the start of fishing season in November for the years 2012-13 and 2014-15, while for the year 2013-14 the minimum production was observed in the month of April.

The present finding clearly indicates that the gill net was responsible for the harvest of commercially major important fishes. Therefore, for the purpose of harvesting it proved to be the most important and vital gear for the Baigul reservoir. The harvest was maximum by the employment of triangular net, but the gill net was the most prominent gear for the capturing of large quality fishes of commercial importance from the reservoir.

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