World Journal of Fish and Marine Sciences 10 (3): 24-30, 2018
ISSN 2078-4589

DOI: 10.5829/idosi.wjfms.2018.24.30

Carps (Indian Major Carps and Exotic Carps) Hatchery in Bangladesh, Current Status and Future Prospects: a Review

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Abstract: Carps (*Labeo rohita, Catla catla, Cirrhinus cirrhosis, Labeo calbasu, Hypophthalmichthys molitrix, Ctenoparyngodon idella, Cyprinus carpio var. commonis, Cyprinus carpio var. specularis, Aristicthhys nobolis and Mylopharyngodon piceus*) are the main species for the aquaculture in Bangladesh. About 902 carps hatcheries are present in Bangladesh and their yearly spawn production are 6, 68, 529.00 kg. They are capable of producing the required quantum of fish seed to stock all available water resources in Bangladesh. It is very important to make policy with support services to assure production of quality (disease free, healthy, good looking, same size and shape etc.) fish seed. Lack of any proper fish breeding protocol in the hatcheries results in generation of genetic underclass of carp seeds. It may be occurred poor brood stock management, inter specific hybrids, negative selection, inbreeding depression, hybridization etc. It causes low production of fish and stressed for the interest of fish production and sustainable development of the fisheries resources. There are some ways to solve these problems such as before selecting brood fish for spawning, small size and young fish should be avoided. They should be attained first maturity in their 1 to 2 years. The strains should be collected from various sources and they must be disease free with sound health.

Key words: Carps (Indian Major Carps and Exotic Carps) Hatchery · Present Status · Future Prospect · Hatchery Problems and Managements

INTRODUCTION

Bangladesh is one of the world's leading fish producing countries with a total production of 3.878 million MT in the last fiscal year 2015-16 [1]. In 2015-2016, fisheries sector contribute 3.65% to the national gross domestic product (GDP) and almost one-fourth (23.81%) to the agricultural GDP and 1.97% export earning and 60% of the total protein supply in the diet of the people of Bangladesh [1]. The species mostly cultured in freshwaters and the seed of which being produced are Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigal (*Cirrhinus cirrhosis*), Silver carp (*Hypophthalmichthys molitrix*), Grass carp (*Ctenoparyngodon idella*), Bighead carp (*Aristicthhys nobolis*) etc. species [2]. The availability of fish fry is an essential prerequisite for fish culture. Nowadays fish fry are destroyed due to the degradation of ecological balance, natural resources. So, hatchery is now the main source of fish fry production. The term hatchery is considered in broadest sense as the facilities where fish fry and fingerlings suitable for stocking in growth ponds are produced in artificial manner by the process of induced breeding technique. The main sources of fish fry in Bangladesh are spawn produced in government and private hatcheries and some collected from rivers. In 1980 the total hatchery produced carp fry was estimated at about 22 million [3]. In 1984 hatchery produced carp fry was estimated to be about 249 million, which is more than ten times of 1980 production [4]. From the beginning the natural sources of rivers were the major source of carp seed production in Bangladesh [4]. In 2017, private nurseries produced about

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6, 50, 636 kg hatchling of 5-6 days old while the public sector farms produced about 12, 826 kg hatchling [1]. In view of the economic importance and culture potentials of the fishes the study was done to find out the way to standardize carps hatchery sectors such as broods sources, broods size, maturity periods, broods management, hormone application with dosages, striping processes, fry rearing and feeding, fry price, transportation etc. This study will be helpful to the hatchery owners, fish culturists, farm managers, hatchery operators, production specialists, policy makers and extension workers to run a hatchery effectively and efficiently. It will be also helpful to improve the breed and stock, to improve quality fish fry and increase the fry production rate.

MATERIALS AND METHODS

The study was carried out based on the information through review of related thesis, journals, reports and books. Some practical knowledge was gained through working experience in carps hatcheries (with prepared questionnaire), attending different seminars on carps hatcheries and observing research presentation related with aquaculture and agriculture. The necessary data were collected from internet, different annual statistical yearbooks of Bangladesh, National Fish week compendiums, newspapers, visiting carps hatcheries with different on-going researches and consulting associated consultants and researchers.

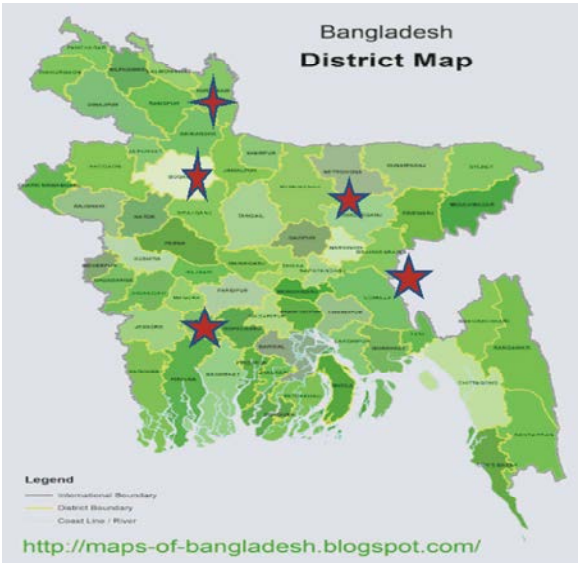

Fig. 1: Location of carp hatcheries in Bangladesh (District wise)

RESULTS AND DISCUSSION

Carps in Bangladesh: Carp are mainly freshwater oily fish species under the family Cyprinidae and are the most important species to aquaculture production in Bangladesh.

Status of Carp Hatchery: Prior to 1990, most carp-seed production was derived from the collection of natural spawn from rivers (Halda, Jamuna, Padma, Meghna, Brahmaputra, Bangali, Teesta, Atrai, Garai, Karatoya, Kopothakho, Kumar, Mahananda). This situation was altered beginning in 1990, when a large number of hatcheries were established in different parts of the country.

A comparison of spawn production from riverine sources and hatcheries from 1988 to 2017 are presented in Table 3. It is estimated that over 902 hatcheries have been established and that they presently contribute about 99.2% of the total spawn production [1] (Table 3). The total hatchery produced spawn, 94.6% is contributed by private hatcheries and about 3.4% comes from public-sector hatcheries [12] (Table 3). Therefore, the private hatcheries appear to play an ever-increasing role in carp production of Bangladesh.

Description of Carp Hatchery Operation: A carp hatchery is generally considered as a facility for producing carp fry and fingerlings suitable for stocking in grow-out ponds. Fry and fingerlings are subsequently sold from the combined hatchery/nursery or from the nursery to the pond owners, either directly or via fry traders. The fry produced from the hatcheries in the area are distributed in most parts of the country. Jessore, Mymensingh, Bogra are the most important fry markets of the country. Fry traders used to come from Khulna, Satkhira, Bagarhat, Barishal, Jhalukati, Comilla, Chandpur, Chuadanga, Dhaka, Borguna, Faridpur, Madaripur, Kushtia, Magura, Naraial, Pabna, Bogura, Rangpur, Nator and other districts of Bangladesh. Sometimes fry and fingerling exported from Bangladesh to Assam, West Bengal and adjacent part of India [14].

Carp Hatchery Components: A carp hatchery complex would generally have different main units.

- The brood-stock units (for rearing & management of carp brood stocks with different size of ponds varying from 0.1 to 1.0 ha)
- Overhead tank (Water contain capacity 50, 000-1, 00, 000 liter)

Table 1: Carp species used in hatcheries for seed production in Bangladesh

Major Groups	Common name	Scientific name
Indian Major Carps	Rohu carp	*Labeo rohita*
	Catla carp	*Catla catla*
	Mrigal carp	*Cirrhinus cirrhosus*
	Kalibaush	*Labeo calbasu*
Exotic Carps	Silver carp	*Hypophthalmichthys molitrix*
	Grass carp	*Ctenoparyngodon idella*
	Common carp	*Cyprinus carpio var. commonis*
	Mirror carp	*Cyprinus carpio var. specularis*
	Bighead carp	*Aristicthhys nobolis*
	Black carp	*Mylopharyngodon piceus*

Table 2: Number of hatcheries in Bangladesh

Year	No of Hatcheries	Year	No of Hatcheries
2001	631	2008	873
2002	738	2009	854
2003	696	2010	931
2004	756	2011	937
2005	731	2015	964
2006	764	2016	902
2007	860	2017	902

Source: [6-11]

Table 3: Comparative status of spawn production from riverine sources and hatcheries in Bangladesh from 1988-2017 [6, 7, 8, 9, 10, 11, 13]

Year	Riverine Spawn (Kg)	% of Total	Spawn Produced from Hatcheries (Kg)	% of Total	Total Production (Kg)
1988	12, 533	68.8	5, 697	31.2	18, 230
1989	12, 235	73.9	4, 315	26.1	16, 550
1990	5, 128	28.3	13, 014	71.7	18, 142
1991	6, 855	23.6	22, 170	76.4	29, 025
1992	9, 342	22.0	33, 072	78.0	42, 414
1993	4, 913	10.2	43, 047	89.8	47, 960
1994	5, 871	10.7	49, 000	89.3	54.671
1995	9, 144	11.3	72, 000	88.7	81, 144
1996	2, 399	2.0	116, 212	98.0	1, 18, 611
1997	2, 824	2.4	117, 500	97.6	1, 20, 320
1998	2, 885	2.4	118, 100	97.6	1, 20, 982
2001	2683	1.4	187343	98.6	1, 90, 026
2002	1975	0.7	276481	99.3	2, 78, 456
2003	1044	0.3	297781	99.7	2, 98, 825
2004	1577	0.6	345227	99.4	3, 46, 804
2005	2123	0.7	315892	99.3	3, 18, 015
2006	1723	0.4	407827	99.6	4, 09, 550
2007	2061	0.4	457288	99.6	4, 59, 349
2008	1872	0.4	416946	99.6	4, 18, 818
2009	1876	0.4	459804	99.6	4, 61, 680
2010	2203	0.5	459804	99.5	4, 62, 007
2011	4370	0.7	624805	99.3	6, 29, 175
2012	4073	0.7	607400	99.3	6, 11, 473
2013	3326	0.7	487498	99.3	4, 90, 824
2014	2695	0.6	489331	99.4	4, 92, 026
2015	4412	0.8	547549	99.2	5, 51, 961
2016	4819	0.8	609614	99.2	6, 14, 433
2017	5067	0.8	663462	99.2	6, 68, 529

- Aerator (The inflowing water passes through the aeration tower, prior to reaching the reservoir, to remove toxic gases and to dissolve oxygen in the water. It is made out of four to five perforated GI sheets having a 5 cm high border, placed one under the other at 40-50 cm distance. The number of holes on each stage should be adapted to the capacity of the water supply: one hole of 10 mm diameter is enough for 3 liter/minute of water flow. The advantage of this device is the automatic aeration of the water prior to reaching the reservoir, therefore additional aeration equipment is not required)
- Hatching jar (Water contain capacity 250-300 liter, spawn producing capacity 300-500 gm)
- Hatchery building (It is used as a protection from storm, high temperature, other natural calamity, maintain temperature etc.
- Spawning tank (Radii 2.50-3.00 meter, height 1meter)
- Brood fish tank (These should be rectangular shaped tanks, 5 -20 square meters in area and 0.75-1.2 meter in depth. Water depth is maintained at a minimum level, to avoid jumping out by broods. Broods are kept there during hormone treatment and 2 liter/minute of water flow is provided for each kg of broods. The tanks are also used to hold and feed hatchlings, prior to delivery to customers).
- Bottle incubators (The capacity of the incubator is generally 250-300 liters. Water requirement is 5-7% of the total volume per minutes. Egg density can be as high as 2000/liter.)
- Spawning tank and circular incubator (The spawning tanks is safer for the broods, less labor-intensive and it is recommended for commercial hatcheries. Circular incubators are used for incubation of large quantities of eggs/larvae, particularly during the peak season of breeding. The water enters through injectors and circulates horizontally between the inner and outer ring wall. The required speed of water flow is 10 cm/second, to keep the eggs in motion. Therefore, the same quantity of water is needed for incubation of few eggs or for a large quantity. Capacity varies from 300 liters to 10 cubic meters. The density of eggs/larvae in the circular incubator is 500/liter).
- Egg & spawn collection chamber
- The nursery unit (for raising fry from stocked spawn (4 - 5 mm to 25 - 30 mm)
- The rearing unit for raising fry to fingerlings (50 mm and above)
- Store room (It is kept all necessary equipment's to run successful hatchery and stored necessary feeds for fries).
- Water quality parameters unit
- The packing & marketing unit

Pictorial View of Carp Hatchery in Bangladesh

Table 3: Sources of spawn in the nursery and of brood stock in the hatchery as reported in the case study [15].

Nursery			Hatchery		
Source of Spawn	Number	%	Source of Bloodstock	Number	%
Hatchery	127	72.6	Other farmers	43	41.3
Wild caught (river)	24	13.7	Own grown	17	16.3
Own grown	22	12.6	Wild caught (river)		
Other farmers	1	0.5	Trader	12	11.5
Trader	1	0.5	Government hatchery	6	5.8
			Other private hatchery	3	2.9
			Other source	6	5.8

Table 4: Water quality parameters requirements for carp hatchery in Bangladesh

Parameters	Range
Water temperature	20-29°C
DO (Dissolve Oxygen)	5-8 mg/L
pH	7.0-8.5
Hardness	>25 ppm
Alkalinity	>40 ppm
Dissolved Iron	<2.0 ppm
Carbon dioxide	<15 ppm
Ammonia, Hydrogen sulfate, Methane	00 ppm
Total dissolve solids	<1ppt (1000 ppm)

Sources: [16]

Table 5: Hormone treatment to the carp broodstock

Species	Sex	First dose (for each kg)	Interval (hours)	Second dose (for each kg)	Ovulation (hours dose after Second)
Rui	Female	PG 2 mg	6.0	PG 6 mg	4-6
	Male	-	-	PG 2 mg	
Catla	Female	PG 1-2 mg	6.0	PG 5-6 mg	5-6
	Male	-	-	PG 1-2 mg	
Mrigal	Female	PG 1-1.5 mg	6.0	PG 5-6 mg	4-6
	Male	-	-	PG 1-1.5 mg	
Calbasu	Female	PG 1-1.5 mg	6.0	PG 4-5 mg	5-6
	Male	-	-	PG 1.5-2 mg	
Silver carp	Female	PG 2 mg	6.0-9.0	PG 6 mg	6-8
		HCG 200-250 IU	9.0-12	HCG 500 IU+ PG 3 mg	
	Male	-		PG 2 mg	
Grass carp	Female	PG 1.5- 2.0 mg	6.8-8.0	PG 4-6 mg	5-7
	Male			PG 2 mg	
Bighead carp	Female	PG 2 mg	6.0-9.0	PG 6 mg	6-8
		HCG 200-250 IU	9.0-12	HCG 500 IU+ PG 3 mg	
	Male	-		PG 2 mg	
Common carp/	Female	PG 1 mg	6	PG 4mg	6
Mirror carp	Male	-	-	PG 2 mg	

Source: [5]

Table 6: Average price of spawn, fry and fingerlings in hatcheries and nurseries 16.

	Price (Taka and Dollar)						
Category	Average (Taka)	Average (US Dollar)	Maximum (Taka)	Maximum (US Dollar)	Minimum (Taka)	Minimum (US Dollar)	Standard Deviation (Taka)
Spawn (Taka/Kg)	1154	13.85	1700	20.40	750	9.00	204
Early fry (Taka/1000)	21	0.25	50	0.60	10	0.12	8
Fry (Taka/1000)	112	1.34	1000	12.00	40	0.48	95
Fingerlings (Taka/1000)	1147	13.76	3000	36	50	0.60	734

Note: 1 Bangladeshi Taka equals to 0.012 US Dollar

Induced Breeding: For producing large quantity of fish fry at a same time, induced breeding techniques are applied in the hatcheries. Mainly two types of inducing agents *viz*. pituitary gland (PG) and the human chorionic gonadotropin (HCG) were used for induced breeding practices in hatcheries. PG was used for all fishes except the silver and bighead carps where HCG was used.

Economics of Hatchery and Nursery Production: Fish spawn is generally sold by weight (kg), while fry and fingerlings are sold by number (thousands) in our country. Average prices for spawn, fry and fingerlings are shown in Table 6. Although there were variations in the price for different fish species, the information on average price was collected ignoring this species-wise variation.

Future Prospects: Fish is an essential daily food item for the people of Bangladesh with 166, 368, 149 population. For this reason, demand for fish is increasing with the increasing of population. Aquaculture has been given importance in Bangladesh. It has great a contribution for export earning, generation of employment for the rural

sector and supply of animal protein for the population. Aquaculture is now fully dependent on the hatchery produced seed. The good quality of fish seed is highly essential for an effective development of aquaculture. But it has been claimed that the hatchery produced fry are not of good quality. Special attention should be paid to improve the quality of seed production. In this regard, live brood and cryogenic gene banks need to be established. The Government in collaboration with private hatchery entrepreneurs should take necessary steps to establish carps brood banks in different parts of the country.

In the carp fish sanctuaries, there are some activities should be followed such as to check broods health, maintain water quality parameters, to know their food and feeding habit, to remove predatory animals, to save environment from pollution etc. It should be banned catching or killing of broods and fry during breeding season. In this situation, alternate employment for fishermen during breeding season should be arranged. The Government should need inter-departmental co-ordination to minimize the damage of fish habitats. It should be provided necessary training on brood stock management, breeding technology, nursery technology, disease control etc. to hatchery and nursery operators, farm managers and fish farmers. It should be further extended through awareness building of private hatchery operators and fish farmers. The Government should impose rules strictly to the both Government and private hatchery operators for maintaining proper protocol of induced breeding, selective breeding, line crossing, hybridization, nursery management etc. so that fish seed production does not contaminate. The Government field laboratories should be established for testing the quality of fish of different hatcheries locally and regionally. Trading networks should be developed by the government and other developing partners so the carp fish farmers can get their actual benefit. A live gene bank initially for the IMC (Indian Major Carp, viz. Rohu, Catla, Mrigal etc.) should be established to supply pure gene strains of these indigenous carps and Government may support establishing such facilities in different parts of country.

ACKNOWLEDGEMENT

The authors are thankful and grateful to BFRI scientists, Department of Fisheries, the hatchery owners, managers, fishery officers, staffs etc. for their kind help to supply data and information related to the hatcheries.

CONCLUSION

The brood fish is the most important component of hatchery operation. For induced breeding of carp species we should be followed some criteria such as an optimum age and weight, good health of brood fishes, small size and young fish should be avoided, collected from various sources etc. The pure seeds of indigenous carps shall gradually disappear from the culture system due to cross breeding, negative selection, hybridization, improper brood stock management etc. All these causes may occur the low fish production in Bangladesh. All of them lack of quality fish seeds are very serious. Only quality brood fish can produces quality seeds. If we want to produce quality brood fishes, we should be followed i) Detail information's on pedigree of brood stock; ii) Identify to use a proper marking system; iii) Parents have to be originated from two different sources; iv) Inbreeding in any fish farm should be handled carefully or avoided; v) Individual fish with poor health conditions or anatomical abnormalities should be rejected.

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