

Original Research Article

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Carp Seed Production in FRP Hatcheries by Tribal Farmers of Ganjam District, Odisha, India

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ABSTRACT

Induced breeding is a technique to stimulate ripe fish breeders by different inducing agents to breed in captive condition. Four fiberglass reinforced plastic (FRP) carp hatchery units (technology developed by ICAR-CIFA) were supplied, installed and operated in cyclone, Phailin-affected four adopted villages, namely Ambapur and Sindhukhalli in Digapahandi Block, Sujanasahi in Khallikote Block and Daseipur in Sanakhemundi Block of Ganjam District, Odisha for carp seed production. In the established hatchery units induced breeding of Indian major carp, rohu (*Labeo rohita*) was successfully conducted by synthetic hormone 'Ovatide' in the monsoons of 2018 and 2019. Induced breeding programmes were conducted for two times at Ambapur Village and four times at Sindhukhalli Village in 2018; and four times at Ambapur Village, five times at Sindhukhalli Village, three times at Sujanasahi Village and one time at Daseipur Village in 2019. Total 21 lakh rohu spawn (7.5 lakh in Ambapur and 13.5 lakh in Sindhukhalli) and 121 lakh (41 lakh in Ambapur, 49 lakh in Sindhukhalli, 27.5 lakh in Sujanasahi and 3.5 lakh in Daseipur) was harvested in 2018 and 2019, respectively. Spawning was observed after a latency period of 330-420 minutes; fertilization rate was 84.5-95.0% under the temperature range of 26.5-33.2 °C and spawn production was 0.78-1.16 lakh/kg body wt. of female rohu in the field conditions.

Keywords

FRP carp hatchery,
Induced breeding,
Spawn production,
Tribal beneficiaries,
Ganjam District

Article Info

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Introduction

Aquaculture is the booming sector in India providing livelihood to millions of farmers, poverty alleviation and economic development of the poor. The role of aquaculture in providing the much-needed animal protein to the world population is well documented (FAO, 2016). Recognized as a powerful income and employment generator,

aquaculture stimulates growth of a number of subsidiary industries and is a source of cheap and nutritious food, besides being a foreign exchange earner.

Good quality fish seed is the prime and basic need for aquaculture production. Fish seed produced in natural sources of spawning possess uncertainty in availability, quality, mixing of unwanted fish seeds.

The induced breeding of carps in hatcheries helped in production of quality seed under controlled condition and assured supply of stocking material in right time for aquaculture farms. The contributions of several workers starting from hapa breeding to cemented eco-hatchery, and then to portable FRP hatchery have made availability of fish seed easy for aqua-farming. All India Coordinated Research Project on Plasticulture Engineering and Technology (AICRP on PET) Centre at ICAR-CIFA, Bhubaneswar has designed and developed portable fiberglass reinforced plastic (FRP) carp hatchery for the benefit of marginal fish farmers of India (Mohapatra *et al.*, 2003 and 2005).

In the developed FRP carp hatchery in one operation 10-12 kg of female carps and equal quantity of males can be taken for induced breeding programme. In one run, 1.0-1.2 million spawn can be produced from the hatchery, which is sufficient to produce fingerlings for stocking in grow-out ponds of about 30 hectares with stocking density @ 5,000 fingerlings/ha (Mohapatra *et al.*, 2017).

Ganjam District of Odisha State is in 19.4 to 20.17 degree North Latitude and 84.7 to 85.12 degree East Longitude. It covers an area of 8070.60 sq.km. The district experiences normal annual rainfall of 1,444 mm. Agriculture is traditional and main occupation of the inhabitants of the district. Ganjam is considered to be one of the potential aquaculture resources districts of the state in the form of freshwater ponds 11580.0 ha, brackish water 4023.04 ha and for marine fisheries has 60 km coastline.

These resources are very much suitable for pond culture, reservoir fisheries and shrimp culture purposes. It can provide an excellent opportunity to develop pisciculture for increasing fish production, thus, to meet the growing demand of the people as well as play

a significant role for providing employment opportunity to the rural poor. The main factor of rural development is to utilize productively the available resources in local areas. The ponds, tanks and small reservoirs available in villages are often remain unutilized and underutilized due to various reasons, such as, lack of technical knowledge, lack of investment and support for inputs, marketing system, etc. In most of the villages, available water bodies are owned, controlled and managed by the village development communities (VDC) or self-help groups (SHG) or panchayats, and the benefits from aquaculture are shared among the community members (Mohapatra and Barik, 2018a).

Hence, sustained efforts are needed to transfer many aquaculture technologies to a large number of farmers for visible impact (Mohapatra and Barik, 2018b). Here the study was focused on socio-economic development of tribal communities of four adopted villages, namely Ambapur and Sindhukhali in Digapahandi Block; Daseipur in Sanakhemundi Block; and Sujanasahi in Khallikote Block of Ganjam District, Odisha and one proven technology developed by ICAR-CIFA *i.e.*, FRP carp hatchery for quality seed production was demonstrated to the farmers of the area.

The study was conducted under the Department of Science and Technology (DST), Govt. of India sponsored project for that area during 2017-20. The tribal farmers of the area were educated on various aspects of brood fish management, carp seed production, FRP hatchery operation and seed rearing up to the size for stocking in grow-out ponds in their areas.

During the study period, the water bodies of the area were examined and feasibility of their utility for carp seed production was also found out by regular visits of the team.

Materials and Methods

Study area

The present work was carried out in four adopted villages, namely Ambapur and Sindhukhali in Digapahandi Block; Daseipur in Sanakhemundi Block; and Sujanasahi in Khallikote Block of Ganjam District, Odisha. The location of blocks in the district map is shown in Figure 1. Total 156 (SC-9, ST-118, OBC-28, General-1) beneficiaries having 10.2 ha pond (14 nos) area were adopted in the study. Total 5 Self Help Groups, namely *Maa Grama Devati SHG* and *Maa Bankeswari SHG* in Ambapur Village; *Maa Matiapalli Mahila Swayam Sahayak Sangha* in Sindhukhali Village; *Maa Chandeswari Primary Fisheries Development Union* in Sujanasahi Village and *Maa Behera Patra SHG* in Daseipur Village were engaged in the study. Most of the farmers are under educated and their primary occupation is paddy cultivation, bamboo craft work and daily wages. Their average annual family income varies between INR 26,000 and INR 35,000.

FRP hatchery unit

Portable fiberglass reinforced plastic (FRP) carp hatchery unit of production capacity 1.0-1.2 million spawn per operation in four days consisting of four parts *i.e.*, spawning pool, incubation pool, egg/spawn collection tank and overhead water storage tank of capacity 2,000 litter was installed and operated in each adopted village. Thus, four FRP hatchery units were supplied to the district in the monsoons of 2018 and 2019.

Brood stock

Matured brood stocks of Indian major carp, *viz.*, rohu (*Labeo rohita*) free from diseases and any kind of abnormalities were selected for the breeding programmes from the brood

stock-cum-grow-out ponds of the villages. The brood fishes were reared as per available scientific practices and selection of the broods for breeding operations were done based on their maturity and weight.

Inducing agent

'*Ovatide*', an indigenous, cost-effective hormonal formulation developed by Mumbai-based pharmaceutical company, M/s Hemmo Pharma was used for the breeding programmes. *Ovatide* has been successfully tested for ovulation of several fishes, including *Labeo rohita*, *Labeo calbasu*, *Cirrhinus mrigala*, *Catla catla* and *Clarias batrachus* in India (CIFE, 1997). The *Ovatide* is easy to store at room temperature, simple to use and less expensive.

Breeding programme

Four FRP carp hatchery units were operated in Digapahandi, Sanakhemundi and Khallikote Blocks of Ganjam District in July-August of 2018 and 2019. Hatchery operations were followed as per the guidelines given by Mohapatra *et al.*, (2017). Brooders sexes were identified based on morphological characters like swollen abdomen, pinkish vent and smooth pectoral fin in female; and rough pectoral fin in male. The brooders were carefully transferred from ponds to the FRP hatchery avoiding much handling and conditioned for one hour in the spawning pool prior to administration of inducing agent. Male brooders were injected with *Ovatide* @ 0.2 ml/kg and female brooders 0.5 ml/kg body weight, intra-peritoneally in a single dose. The injected fishes were released in the spawning pool for egg laying. The brood fishes were removed from the breeding/spawning pool with the help of a scoop net after spawning. Water circulation was maintained as per recommendations of Mohanty *et al.*, (2009)

and Mohapatra *et al.*, (2017). The fertilized eggs were kept in the incubation pool for the next 72 hrs. The breeding/spawning pool was disinfected by sprinkling 5.0 ppm potassium permanganate solution at an interval of two hours.

% of fertilization per female was calculated with the following formula:

$$\text{Fertilization} = \frac{\text{No. of fertilized eggs}}{\text{Total No. of egg counted}} \times 100$$

Latency period (time from injection to egg release), effective spawning period (time from first egg release to the end of egg release), hatching time, total spawn production per operation and spawn production per kg body weight of female fish were determined.

Water quality parameters

The water quality parameters of the pond (inlet water to hatchery unit) were analysed as per standard laboratory procedures bringing water samples to ICAR- CIFA. The physico-chemical parameters studied were water temperature (°C), dissolved oxygen (mg/l), pH, total alkalinity (mg/l), total hardness (mg/l) and water transparency (cm) in every hatchery operation period by standard laboratory procedures of APHA (1989).

Results and Discussion

Carp breeding operation

Fiberglass reinforced plastic (FRP) hatchery units were established in farmer's field at Ambapur and Sindhukhali Villages under Digapahandi Block; Sujanasahi Village under Khallikote Block and Daseipur Village under Sanakhemundi Block, Ganjam District. Rohu, *L.rohita* as test fish with single injection of Ovatide was successfully induced to spawn in established FRP carp hatchery units during

monsoons of 2018 and 2019. *Ovatide* is the cheaper hormone and 70% more economical as compared to *Ovaprim* (Bhatti and Qureshi, 2000). The *Ovatide* suppresses the *Ovaprim* use giving an equal result of seed production in hatcheries. Pandey *et al.*, (2002) found the fertilization rate of 95-100% and hatching success 90-98% in *L. rohita* at a water temperature of 28-31°C using hormone *Ovatide*. Dhawan and Kaur (2004) used *Ovatide* and *Ovaprim* for induced breeding of Indian carps. They found that *Ovaprim* was more effective than *Ovatide* in breeding induction in *C. catla*; however, in *L. rohita* and *C. mrigala*, *Ovatide* resulted in high fecundity and fertilization rate. Khan *et al.*, (2006) stated that *Ovatide* was better than *Ovaprim-C* in induced spawning, fecundity, hatching and fertilization of *L. rohita*. Effective spawning period of catla was calculated to be 53.3 minutes, rohu 62 minutes and mrigala 40 minutes.

Results of the breeding trials are summarized in Tables 1 and 2. Total 21 lakh (7.5 lakh Ambapur Village and 13.5 lakh Sindhukhali Village) and 121 lakh (41 lakh Ambapur Village, 49 lakh Sindhukhali Village, 27.5 lakh Sujanasahi Village and 3.5 lakh Daseipur Village) rohu spawn was harvested in 2018 and 2019, respectively. In the monsoon of 2018, two FRP carp hatchery units were operated for two and four times in Ambapur and Sindhukhali Villages, respectively.

Similarly in the monsoon of 2019, four FRP carp hatchery units were operated for four, five, three and one times in Ambapur, Sindhukhali, Sujanasahi and Daseipur Villages, respectively. The fertilization rate was recorded 85-95% in monsoon of 2018 in two villages and 84.5-95% in monsoon of 2019 in four village sites. In two monsoons, highest fertilization rate 95% of rohu was recorded in Ambapur and Sindhukhali Village.

Time duration 690-895 minutes for completion of egg hatching was recorded in these experiments. In 2018 spawn production was 0.9 lakh/kg female body weights for Sindhukhali Village and 0.892 lakh/kg female body weights for Ambapur Village. In 2019 highest spawn production was 1.14 lakh/kg female body weights for Sujanasahi Village followed by 1.08 lakh/kg female body weights for Sindhukhali Village, 1.07 lakh/kg female body weights for Ambapur Village and 1.06 lakh/kg female body weights for Daseipur Village.

Mohapatra *et al.*, (2016) had conducted induced breeding of IMC in FRP carp hatchery at Puranapradhan Village of Baliana Block, Khordha District, Odisha. During breeding season of 2015 the hatchery was used for induce breeding of Indian major carps (IMC) *i.e.*, rohu and mrigal for 19 times (*viz.*, rohu 11 times and mrigal 8 times). Total 198 lakh spawn was produced (*i.e.*, rohu 125 lakh and mrigal 73 lakh).

Spawning fecundity was found to be 1.3-1.82 and 1.25-1.58 lakh egg/kg female body weight of rohu and mrigal, respectively. Percentage of fertilized eggs during spawning was calculated to be 90-100% for both species. Spawn production per kg female body weight was found to be 1.23-1.55 lakh/kg for rohu and 1.09-1.4 lakh/kg for mrigal and percentage of spawn survival from fertilized egg ranged 90- 97.17% in rohu and 87.3- 94.74% in mrigal.

Similarly the FRP carp hatchery was installed and operated at Subarnapur Village of Gop Block, Puri District, Odisha during monsoon months of 2015 (Mohapatra *et al.*, 2015). Ten trials of induced breeding of three IMC, *L. rohita* (4 times), *C. catla* (4 times) and *C. mrigala* (2 times) were conducted during monsoon season of 2014. A total of 92.0 lakh spawn (carp seed) was produced (rohu 42

lakh, catla 30 lakh and mrigal 20 lakh). Spawning fecundity of rohu, mrigala and catla was found to be 1.43-1.72; 1.41-1.54 and 1.15-1.23 lakh egg/kg female body weight respectively. Percentage of fertilized eggs during spawning was found to be 90-95%. Spawn production per kg female body weight (lakh) was found 1.07-1.36 lakh/kg female body weight of rohu, 1.17-1.36 lakh/kg female body weight of mrigal and 0.9-0.95 lakh/kg female body weight of catla. Further to compare the findings of present study, the study of Chakrabarti *et al.*, (2016) may be taken to consideration.

One unit of FRP carp hatchery was installed and operated at Bali Island, Sunderban, West Bengal during 2014-15. In the hatchery operation, spawning fecundity of rohu was found to be 0.88-1.0 lakh, catla 0.95 lakh and bata 1.1-1.3 lakh egg/kg bodyweight of female fish. Hatching time was found more or less similar in rohu 920-970 minutes, catla 965 minutes and bata 940-990 minutes. Spawn survival percentage from egg release was calculated to be 85.5-92.5 in rohu, 84.5 in catla and 86.5-90 in bata. Spawn production per kg female body weight was found similar for all the experimented fishes *i.e.* rohu 0.74-0.88 lakh, bata 0.86-1.2 lakh and catla 0.66 lakh.

One FRP carp hatchery was established and operated in farmer's field at N.B. Pokhria Village under Bisoi Block, Mayurbhanj District, Odisha from 4 July, 2016 (Mohapatra *et al.*, 2018c). Induced breedings of Indian major carps (catla, rohu, & mrigal) were conducted in the established hatchery using synthetic hormone 'Ovatide' for 1, 3 and 6 times in the monsoons of 2016, 2017 and 2018, respectively. Total 7.0 lakh (rohu), 20.0 lakh (rohu 10.0, mrigal 3.0, and catla 7.0) and 48.5 lakh (rohu 28.5, mrigal 5.0, and catla 15.0) lakh spawn was harvested in 2016, 2017 and 2018, respectively showing a

positive trend as the farmer is getting experienced year after year. Under the temperature range of 27-34⁰C, spawning was observed after a latency period of 342-400 minutes (5.7-6.7 hours); fertilization rate recorded was 91.7-97.5% and spawn production was 1.02-1.18 lakh/kg body wt. of female in IMC. Highest fertilization rate

(97.5%) was recorded in mrigal followed by rohu (92%) and catla (91.7%). Effective spawning period was 62, 53.3 and 40 minutes for rohu, catla and mrigal respectively. The present study was in agreement with the studies conducted by different authors using the FRP carp hatchery for IMC breeding purposes.

Table.1 IMC breeding in FRP carp hatchery at Ambapur and Digapahandi Villages under Digapahandi Block of Ganjam District, Odisha in 2018 monsoon

Block	Digapahandi							
	Ambapur			Sindhukhali				
Village	Rohu			Rohu				
Species	Rohu			Rohu				
Trials	1	2	Total (T)/ Average (A)	1	2	3	4	Total (T)/ Average (A)
Year	2018	2018		2018	2018	2018	2018	
Number of male breeders	3	3	6 (T)	3	4	3	2	12 (T)
Number of female breeders	3	3	6 (T)	3	4	3	2	12 (T)
Total weight of male breeder (kg)	3.8	4.5	8.3 (T)	3.9	4.5	3.8	2.5	14.7 (T)
Total weight of female breeder (kg)	4	4.4	8.4 (T)	4	4.5	3.9	2.6	15(T)
Time of first egg release after hormone injection (min.) (latency period) (A)	360	370	365 (A)	340	330	360	370	350 (A)
Completion time of egg release from time of injection (in minute) (B)	390	405	397.5 (A)	400	400	420	410	407.5 (A)
Effective spawning period (B-A) (minute)	30	35	32.5 (A)	60	70	60	40	57.5 (A)
Egg released (lakh approx.)	4	4.5	8.5 (T)	4	4.8	4	2.5	15.3 (T)
Fertilization rate of egg (%)	90	90	90 (A)	90	95	90	85	90 (A)
Time of first hatchling observed from spawning (minute)	710	690	700 (A)	720	700	740	690	712.5 (A)
Spawn recovered (lakh)	3.5	4	7.5 (T)	3.5	4.5	3.5	2	13.5 (T)
Spawn production (lakh/kg body weight of female)	0.875	0.909	0.892 (A)	0.875	1.0	0.897	0.78	0.9 (A)

Table.2 IMC breeding in FRP carp hatchery at four villages under Digapahandi, Khallikote and Sanakhemundi Blocks of Ganjam District, Odisha in 2019 monsoon

Block	Digapahandi						Khalikote						Sanakhemundi				
Village	Sindhukhali			Ambapur			Sujansahi			Daseipur							
Species	Rohu						Rohu						Rohu				
Year	2019						2019						2019				
Trials	1	2	3	4	5	(T)/(A)	1	2	3	4	(T)/(A)	1	2	3	(T)/(A)	1	(T)/(A)
Number of male breeders	6	5	5	7	4	27 (T)	5	6	5	5	21 (T)	5	5	4	14 (T)	3	3 (T)
Number of female breeders	6	5	5	7	4	27 (T)	5	6	5	5	21 (T)	5	5	4	14 (T)	3	3 (T)
Total weight of male breeder (kg)	10.5	8	10	12	7.5	48 (T)	10	12	10	9.5	41.5 (T)	9.2	9.5	6.3	25 (T)	4	4(T)
Total weight of female breeder (kg)	10	8	9	11	7	45 (T)	10	11	9	8	38 (T)	9	9	6	24 (T)	3.3	3.3 (T)
Time of first egg release after hormone injection (min.) (latency period) (A)	360	340	330	360	370	352 (A)	370	360	350	365	361 (A)	365	360	370	365 (A)	360	360 (A)
Completion time of egg release from time of injection (in minute) (B)	390	400	400	420	410	404 (A)	405	390	390	400	396 (A)	410	400	410	407 (A)	390	390 (A)
Effective spawning period (B-A) (minute)	30	60	70	60	40	52 (A)	35	30	40	35	35 (A)	45	40	40	42 (A)	30	30 (A)
Egg released (lakh approx.)	12.5	9.5	11	13	8.5	54.5 (T)	12	13.5	10.5	9.5	45.5 (T)	11.5	11	7.5	30 (T)	4	4 (T)
Fertilization rate of egg (%)	92	84.5	91	92.5	88.5	90 (A)	92	85.5	90.5	95	90.5 (A)	91.5	91	93.5	91.5 (A)	87.5	87.5 (A)
Time of first hatchling observed from spawning (minute)	720	700	740	690	700	710 (A)	710	690	720	700	705 (A)	710	720	690	707 (A)	710	710 (A)
Spawn recovered (lakh)	11.5	8	10	12	7.5	49 (T)	11	11.5	9.5	9	41 (T)	10.5	10	7	27.5 (T)	3.5	3.5 (T)
Spawn production (lakh/kg body weight of female)	1.15	1	1.11	1.09	1.07	1.08 (A)	1.10	1.04	1.05	1.12	1.07 (A)	1.16	1.11	1.16	1.14 (A)	1.06	1.06 (T)

*T= Total and A= Average

Table.3 Physico-chemical properties of hatchery inlet water in Ganjam District

Water quality parameter	Ambapur	Sindhukhali	Sujanasahi	Daseipur
Water temperature (°C)	29.2-32.6	28.2-31.6	26.5-31.3	26.9-33.2
Dissolved oxygen (mg/l)	3.5-5.3	3.2-5.5	3.4-5.6	3.0-5.5
pH	6.60-8.20	6.49-8.48	6.9-7.8	7.21-7.92
Total alkalinity (mg/l)	52-74	67-84	66-87	72-92
Total hardness (mg/l)	57-87	57-85	54-73	75-95
Water transparency (cm)	9.5-12.4	7.3-14.47	5.7-12.5	6.5-12.9

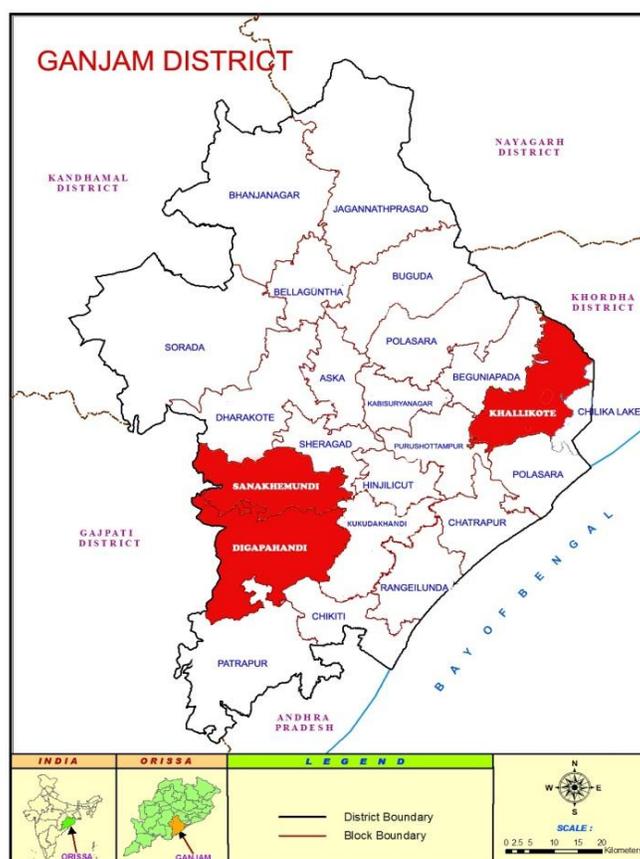


Fig.1 Study area location in Ganjam District

Physico-chemical properties of inlet water to hatchery

Physico-chemical parameters of the inlet water to hatchery from pond during different breeding operations were analysed. The range of water temperatures, pH, dissolved oxygen, total alkalinity, total hardness and transparency were analysed and recorded, and

presented in Table 3. The water quality required for hatchery operation for IMC seed production is 24-29 °C temperature, 6.5-8.5 pH, 5.0-6.0 mg/l dissolved oxygen and less than 150 mg/l total alkalinity (Gupta *et al.*, 2008). The water parameters recorded during the present breeding programmes were found within the range for hatchery operation of IMC.

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