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Water Budgeting of Portable FRP Carp Hatchery for Rohu, *Labeo Rohita* Spawn Production

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ABSTRACT

Water budgeting experiments were conducted in three portable FRP carp hatchery units installed in three different places of Odisha State, India. Induced breeding programmes were conducted for spawn production for seven times in these FRP hatcheries taking rohu, *Labeo rohita* as the test species. Water requirement for one complete cycle of FRP carp hatchery operation was calculated to be 105 - 136.3 m^3, when spawn production ranged between 0.7 and 1.4 million per operation in field condition. It was estimated that the water requirement per 0.1 million spawn production ranged between 8.86 - 15.01 m^3. It was concluded that the water requirement for FRP carp hatchery operation was comparatively more when less quantity of carp spawn produced and was less when more spawn produced.

Keywords*:* Portable FRP carp hatchery, Water budgeting, Rohu breeding, Spawn production.

INTRODUCTION

Fiberglass reinforced plastic (FRP) carp hatchery has taken a significant role in carp seed production in India since 2003 (Mohapatra *et al.,* 2003). In one operation 1.0-1.2 million spawn can be produced by this gadget (Mohapatra *et al.,* 2011a). The system is suitable in field conditions for breeding most of the cultured Asiatic carps. By December, 2014, it has been installed in 26 states and Andaman &Nicobar Island of the country (Mohapatra *et al.,* 2015).

For carp breeding and seed production, supply of good quality water is the most important factor. At the time of induced breeding and egg incubation, definite quantity of water flow is required to maintain dissolve oxygen, centrifugal moment, equilibrium dispersion of egg and hatchling in incubation pool, and purification of incubation pool. Centrifugal movement of water in breeding pool is needed for egg fertilization with milt and also for quick discharge of eggs from breeding pool to the egg collection chamber. Centrifugal movement of water in incubation pool is required for hatching of eggs as well as survivability rate of the hatchlings. Water movement in incubation pool is helpful to eradicate excess ammonia and microbial load from the pool during incubation. The congregating of eggs in the incubation pool can be avoided by proper water circulation. By using the FRP carp hatchery many fishes have been successfully bred in India (Mohapatra *et al*., 2004, 2005, 2007, 2008, 2011a, 2011b, 2013 and 2015). It is very much necessary to budget the water requirement for successful carp seed production in the FRP hatchery.

Taking all of the above factors in to account experiments were conducted in three FRP hatchery units established in three different places of Odisha

to evaluate the water requirement for successful carp breeding operations.

MATERIAL AND METHODS

Experiment site

The experiments were carried out in three FRP carp hatchery units, each one containing breeding pool, hatchling pool and egg collection chamber installed in three places of Odisha, such as, (a) Madhyakhanda Village, Dasapalla Block, Nayagarh District; (b) Kainchakoti Village, Betonati Block, Mayurbhanj District; and (c) Badabisola Village, Kaptipada Block, Mayurbhanj District. Seven times rohu (*Labeo rohita*) breedings were conducted in these FRP hatcheries for water budgeting studies.

FRP carp hatchery

One complete unit of FRP carp hatchery developed by All India Coordinated Research Project on Plasticulture Engineering and Technology (AICRP on PET) centre at ICAR- Central Institute of Freshwater Aquaculture, Bhubaneswar consists of (i) Breeding/ spawning pool (2.15 m diameter, 0.9 m height, 1:22 bottom slope and 3409 liter total volume with operation capacity 2950 liter), (ii) Hatching/ incubation pool (1.4 m diameter, 0.98 m height, 1400 liter total volume and 1200 liter net egg incubation volume with a FRP inner chamber of 0.4 m diameter and 90 cm height covered with nylon bolting cloth to filter the excess water to the drain), (iii) Egg/ spawn collection chamber (1.0 x 0.5 x 0.5 m with water holding capacity 250 liter), and (iv) Water supply lines. The thickness of the walls of the pools varies between 4-6 mm.

The breeding pool and incubation pool have different roles in carp breeding operation. During experiment, carp broods were transported from the rearing pond to the breeding pool for conditioning followed by injection of synthetic hormone and kept there for spawning. After spawning the eggs were collected in the egg collection chamber with the help of a hapa and released in the incubation pool for incubation. The spawn were collected from the incubation pool through the spawn collecting chamber on 4th day from spawning.

Rohu breeding in FRP carp hatchery

Activities in the breeding pool

Rohu breeders were selected male to female in 1:1 ratio in number and weight for breeding programme. Sex wise total weight of the breeder was calculated by a spring balance. They were transported from the rearing pond site to the breeding pool through a hammock or career tank filled with water. As per requirement the breeders were conditioned for acclimatization in the pool. After that the synthetic hormone (Ovaprim) was injected to the breeders @ 0.2 ml per kg body weight of male and 0.5 ml per kg body weight of female for induced spawning. Breeders were kept in breeding pool and the water shower was opened for sprinkling the water on it. After 4 hours of injection, shower was closed, and inlet and outlet pipes of the pool were opened for circular moment of water. The outlet pipe was opened in to a hapa fitted in the egg collection tank. Eggs were collected in the hapa of the egg collection chamber and removed from there by the help of mug and bucket.

Activities in the incubation pool

The collected fertilized eggs were stocked in the incubation pool till the production of spawn. Water shower of the pool was closed till the eggs hatched out as hatchlings. Hatchlings were kept in the pool till the egg sacs were absorbed by themselves. This absoption of egg sac takes approximately 60-72 hours. After the egg sac is absorbed the hatchling became the spawn and collected through the spawn collection chamber using a hapa. Total harvested spawn was calculated by using a standard measured cup.

Estimation of water requirement in FRP carp hatchery

Water flow was calculated by a ten-liter bucket and stopwatch. The empty bucket was kept under the pipe for collection of water and the initial and final times for filling up of the bucket were recorded. The maximum care was taken during the process of estimation. Triplicate samplings were done and the average was noted for the water quantity estimation. Water requirement estimation was carried out separately for breeding pool and incubation pool, and then added together for finding out the total requirement of water for the FRP carp hatchery.

Water requirement in breeding pool

Water requirement in FRP breeding pool was calculated by adding the initial loading of water in it, during conditioning of fish, showering of water after injection of fish, water flow through duck-mouths and during egg collection. The duration (in minute) and speed of water flow during breeding operation was carried out according to the local condition and total weight of the fish used.

Water requirement in incubation pool

Water requirement in FRP incubation pool was calculated by adding the initial loading of water in it, initial showering, flow before eggs hatch out and flow through the duck-mouths.

RESULTS AND DISCUSSION

The water budget of the FRP carp hatchery unit for a breeding operation was calculated based on the water requirement data recorded from the breeding and hatching pools for the respective operations. The data of water budgeting of FRP carp hatchery operations at Madhyakhanda Village, Daspalla Block are mentioned in Tables 1 and 2; Kainchakoti Village, Betonati Block in Table 3; and Badabisola Village, Kaptipada Block in Tables 4 to 7.

Breeding pool

The water requirement of breeding pool during rohu breeding operation varied between 11,895 liter (11.9 m^3) and 20,330 liter (20.3 m^3) (Tables 1a-7a). The breeding pools were initially filled full in four operations (Tables 1a, 4a, 5a and 7a); half in two operations (Tables 2a and 3a); and one-third in one operation (Table 6a) of its total volume for conditioning of brood fish. Spawn production from breeders conditioned with full water in breeding pool with total body weight 13.8 and 17.5 kg was found to be 1.0 – 1.4 million per operation (Tables 1a, 4a, 5a and 7a). Those breeders kept in half filled water in breeding pool during conditioning gave the spawn production of 0.8 million spawn from 24.9 kg breeder and 0.7 million spawn from 14.7 kg breeder (Tables 2a and 3a). This poor production of spawn (0.8 million from 24.9 kg) may be attributed to the breeding operation that was conducted at the time of end of the breeding season (24 August 2011) and over stocking of breeders in the FRP hatchery. But the second operation of half-filled water was shown within normal production *i.e.,* 1.0 million spawn from 10 kg female. One operation (Table 6a) was conducted by filling 1/3rd of water as initial fill in the breeding pool and the result was 0.8 million spawn. By alternating the initial water filling of breeding pool, one can save 1500-2000 liter of water.

It was found that when conditioning time of breeder was increased up to 40 minutes, the water requirement increased by 200 liter through showering. More quantity of water used in breeding pool was at the time of spawning, *i.e.,* flow through the duck-mouths and egg collection. If the duration of egg collection is decreased, the water requirement also reduced in breeding pool.

Hatching/ incubation pool

The water requirement for hatching pool operation was varied from 11,895 liter (11.9 m^3) to 20,330 liter (20.3 m^3) (Tables 1b-7b). At the time of egg stocking, the hatching pool was filled one-third

Table 1(a): Water requirement in FRP breeding pool on 25.06.11 at Madhyakhanda Village, Nayagarh District, Odisha

Sl No.	Operational activity	Duration	Water flow in l/min	Total water consumption (l)
1	Initial loading of water in breeding pool	-	-	2950
2	Conditioning of fish in breeding pool	30 min	6.0	180
3	Showering of water after injection of fish	4 hr	5.0	1200
4	Water flow through duck-mouths	1 hr 20 min	80.0	6400
5	Egg collection	2 hr 30 min	64.0	9600
	Total			20,330

Table 1(b): Water requirement in FRP hatching pool during 25.06.11 - 28.06.11 at Madhyakhanda Village, Nayagarh District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (l)
1	Initial loading of water in hatching pool	-	-	1200
2	Initial showering and flow before eggs hatch out	16 hr	28.0	26,880
3	Water flow through duck-mouths	60 hr	21.0	75,600
Total	1,03,680			

Total water requirement= 20,330 + 1,03,680 =1,24,010 liter (124 m^3)
Spawn harvested: 1.4 million
Water requirement for 0.1 million spawn production = 8,857.85 liter (8.86 m^3)

Table 2(a): Water requirement in FRP breeding pool on 24.08.11 at Madhyakhanda Village, Nayagarh District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in breeding pool	-	-	1475
2	Conditioning of fish in breeding pool	40 min	9.66	386.4
3	Showering of water after injection of fish	3 hr 30 min	6.2	1302
4	Water flow through duck-mouths	1 hr	55.0	3300
5	Egg collection	2 hr	64.7	7764
Total	14,227.4			

Table 2(b): Water requirement in FRP hatching pool during 24.08.11 – 27.08.11 at Madhyakhanda Village, Nayagarh District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in hatching pool	-	-	400
2	Initial showering and flow before eggs hatch out	13 hr 30 min	27.0	21,870
3	Water flow through duck-mouths	61 hr	20.0	73,200
Total	95,470			

Total water requirement = 14,227.4+ 95,470 = 1,09697.4 liter (109.7 m^3)
Spawn harvested: 0. 8 million
Water requirement for 0.1 million spawn production = 13712.18 liter (13.7 m^3)

Table 3(a): Water requirement in FRP breeding pool on 26.07.11at Kainchakoti Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in breeding pool	-	-	1475
2	Conditioning of fish in breeding pool	30 min	5.0	150
3	Showering of water after injection of fish	4 hr	5.0	1200
4	Water flow through duck-mouths	1 hr 15 min	70.0	5250
5	Egg collection	1 hr 50 min	63.0	6930
Total	15,005			

Table 3(b): Water requirement in FRP hatching pool during 26.07.11 – 29.07.11at Kainchakoti Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in hatching pool	-	-	600
2	Initial showering and flow before eggs hatch out	15 hr 30 min	26.5	24,645
3	Water flow through duck-mouths	60 hr	18.0	64,800
Total				90,045

Total water requirement = 15,005 + 90,045 = 1,05,050 liter (105.0 m^3)
Spawn harvested: 0.7 million
Water requirement for 0.1 million spawn production = 15,007.2 liter (15.0 m^3)

Table 4(a): Water requirement in FRP breeding pool on 30.06.11 at Badabisola Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in breeding pool	-	-	2950
2	Conditioning of fish in breeding pool	25 min	7.0	175
3	Showering of water after injection of fish	3 hr 30 min	5.0	1050
4	Water flow through duck-mouths	1 hr 15 min	72.0	5400
5	Egg collection	1 hr 40 min	61.5	6150
Total				15,725

Table 4(b): Water requirement in FRP hatching pool during 30.06.11 – 03.07.11 at Badabisola Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration in l/min	Water flow	Total water consumption (liter)
1	Initial loading of water in hatching pool	-	-	1200
2	Initial showering and flow before eggs hatch out	13 hr	28.0	21,840
3	Water flow through duck-mouths	68 hr	22.0	89,760
Total				1,12,800

Total water requirement = 15,725 + 1,12,800 = 1,28,525(128.5 m^3)
Spawn harvested: 1.1 million
Water requirement for 0.1 million spawn production = 11,684.1 (11.7 m^3)

Table 5(a): Water requirement in FRP breeding pool on 30.06.11 at Badabisola Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in breeding pool	-	-	2950
2	Conditioning of fish in breeding pool	35 min	5.0	175
3	Showering of water after injection of fish	4 hr 25 min	5.0	1325
4	Water flow through duck-mouths	1 hr 20 min	72.0	5760
5	Egg collection	1 hr 30 min	63.0	5670
Total				15,880

Table 5(b): Water requirement in FRP hatching pool during 30.06.11 – 03.07.11 at Badabisola Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in hatching pool	-	-	1200
2	Initial showering and flow before eggs hatch out	15 hr	26.0	23,400
3	Water flow through duck-mouths	71 hr	22.5	95,850
Total				1,20,450

Total water requirement = 15,880 + 1,20,450 = 1,36,330 liter (136.3 m^3)
Spawn harvested: 1.3 million
Water requirement for 0.1 million spawn production = 10,486.9 liter (10.5 m^3)

in two operations (Tables 2b and 5b), half in one experiment (Table 3b) and full in four experiments (Table 1b, 4b, 5b and 7b). Hatching pool initially filled with 1/3rd and half of water saved 600-800 liter water without damaging eggs.

The rohu fish breeding was carried out 7 times in three places. In each operation weight of breeders was varied. The total weight of breeder (male and female) was taken from 10.3 kg to 24.9 kg. The rohu spawn was harvested between 0.7 million to 1.4 million per operation. Total water used in one operation was estimated between 1,04,995 liter and 1,36,330 liter. Accordingly water used to produce 0.1 million spawn was ranged from 8,857.85 liter to 15,007.20 liter.

Table 6(a): Water requirement in FRP breeding pool on 23.07.11 at Badabisola Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in breeding pool	-	-	1000
2	Conditioning of fish in breeding pool	10 min	5	50
3	Showering of water after injection of fish	4 hr	6	1440
4	Water flow through duck-mouths	1 hr 5 min	79	5135
5	Egg collection	1 hr 10 min	61	4270
Total	11,895			

Table 6(b): Water requirement in FRP hatching pool during 24.07.11-27.07.11 at Badabisola Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in hatching pool	-	-	400
2	Initial showering and flow before eggs hatch out	12 hr	22.0	15,840
3	Water flow through duck-mouth	61 hr	21.0	76,860
Total				93,100

Total water requirement = 11,895+93,100 = 1,04,995 liter (105 m^3)
Spawn harvested: 0.8 million
Water requirement for 0.1 million spawn production = 13,124 liter (13.1m^3)

Table 7(a): Water requirement in FRP breeding pool on 01.08.11 at Badabisola Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in breeding pool	-	-	2950
2	Conditioning of fish in breeding pool	30 min	8	240
3	Showering of water after injection of fish	4 hr 20 min	6	1560
4	Water flow through duck-mouths	1 hr 10 min	82	5740
5	Egg collection	1 hr 20 min	63	5040
Total				15,530

Table 7(b): Water requirement in FRP hatching pool during 01.08.11-04.08.11 at Badabisola Village, Mayurbhanj District, Odisha

Sl. No.	Operational activity	Duration	Water flow in l/min	Total water consumption (liter)
1	Initial loading of water in hatching pool	-	-	1200
2	Initial showering and flow before eggs hatch out	13 hr 30 min	26.0	21,060
3	Water flow through duck-mouth	66 hr	22.0	87,120
Total				1,09,380

Total water requirement = 15,530 + 1,09,380 = 1,24,910 liter (124.9 m^3)
Spawn harvested: 1.0 million
Water requirement for 0.1 million spawn production = 12,491 liter (12.5 m^3)

Table 8: Water requirement for rohu breeding in FRP carp hatchery

Experiment	Total weight of Male and Female breeder (kg)	Spawn harvested (million)	Total water used during operation (liter)	Water used to produce 0.1 million spawn production (liter)
1	14.4	1.4	1,24,010	8,857.85
2	24.9	0.8	1,09,697	13,712.18
3	14.7	0.7	1,05,050	15,007.20
4	17.1	1.1	1,28,525	11,684.10
5	17.5	1.3	1,36,330	10,486.90
6	10.3	0.8	1,04,995	13,124.00
7	13.8	1	1,24,910	12,491.00
Average	16.1±4.55	1.01±2.7	1,19,073.9± 12438.74	12,194.75± 2060.59

According to Mohanty *et al*., 2009 the water requirement for 0.1 million rohu spawn production in FRP carp hatchery in the research farm of ICAR-CIFA, Bhubaneswar was 9 m^3. The present result of water requirement for 0.1 million spawn production in farmer's field ranged between 8.86 m^3 to 15.01 m^3 which is in accordance of the report of Mohanty *et al*., 2009. The water requirement was inversely proportional to the quantity of rohu spawn production (Table 8). In the operation where more spawn produced (1.4 million), water requirement calculated to be less, *i.e*., 8.86 m^3 for production of 0.1 million spawn. But the highest water consumption 15.01 m^3 was found where spawn production was less. In the above 7 breeding operations of rohu, average spawn production was found 1.0 million and water consumption per 0.1 million spawn production was 12.26 m^3, which was little more than Mohanty *et.al*, 2009, because that experiment was conducted at ICAR-CIFA research station and in peak monsoon season, but the current experiment was carried out in farmers' field and in fag end of the season.

In ICAR, 2011 it was mentioned that the water requirement for 4 million spawn production in eco-carp hatchery (cemented) facilitated with 2 incubation pools of size 2.4 m dia, and 1.2 m height, 1.0 m water depth is 8.7 m^3 per lakh spawn production. It consumed less water than the FRP carp hatchery because of its higher production capacity.

CONCLUSION

For induced carp breeding in hatchery, seed rearing and grow out production in ponds, supply of good quality water is the most important factor. In the this experiment the water requirement for one complete cycle of FRP carp hatchery operation was calculated to be to be 105 - 136.3 m^3, when spawn production ranged between 0.7 and 1.4 million per operation. It was estimated that the water requirement per 0.1 million spawn production ranged between 8.86 - 15.01 m^3. The water requirement for FRP carp hatchery operation was found to be more when less quantity of carp spawn produced and less when more spawn produced.

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