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EFFECT OF STOCKING DENSITY ON GROWTH, SURVIVAL AND PRODUCTION PERFORMANCES OF *CLARIAS BATRACHUS* FRY IN NURSERY HAPA UNDER SEMI-INTENSIVE CULTURE SYSTEM OF RAJSHAHI UNIVERSITY CAMPUS, BANGLADESH

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Abstract

An experiment was conducted to assess the effect of stocking density on growth, survival and production performance of *Clarias batrachus* (Magur) fry using nursery hapa in experimental pond of Dept. of Fisheries, University of Rajshahi. The research was carried out for a period of three months from May to July, 2021 consisting of four treatments each with two replications. A total of eight hapa were prepared using net each having an area of 1.2 × 0.9 × 0.9 m^3. Stocking density was maintained at the rate of 300, 350, 400 and 450 fry/m^3 in T_1, T_2, T_3 and T_4 respectively where the mean initial weight of hatchling was 0.04±0.01 g. Different physico-chemical parameter of water were monitored fortnightly where the mean value of water temperature, water transparency, dissolved oxygen, carbon dioxide, P^H and NH_3-N was observed 28.25±1.18°C, 26.12±0.18 cm, 8.44±0.45 mg/l, 1.78±0.03 mg/l, 6.88±0.04 and 0.007± 0.00 mg/l respectively. Except NH_3-N no significant difference ($p>0.05$) was found among the treatments and all the parameter were in suitable range for fry rearing. Highest mean final weight, weight gain, SGR (%/day), survival rate, along with lower FCR was found in T_1 which was 8.00±0.13 g, 7.96±0.07 g, 5.65±0.00 (%/day) and 91±0.70 (%) respectively followed by T_2, T_3 and T_4 where significant variation ($p<0.05$) was found among them. Maximum net yield (kg/m^3/90 days) was 2.51±0.07 which was obtained from T_3 followed by 2.48±0.02, 2.37±0.02 and 2.20±0.05 in T_4, T_2 and T_1. On the other hand, benefit cost ratio (BCR) was found significantly higher ($p<0.05$) in T_1 (0.73±0.01) than T_2 (0.66 ±0.01), T_3 (0.56±0.00) and T_4 (0.43±0.02). The overall result indicated that a stocking density of 300 fry/m^3 (T_1) could be more profitable for *Clarias batrachus* fry rearing in nursery hapa.

Key words: *Clarias batrachus*, growth, hapa, production performances, stocking density.

Introduction

Success of aquaculture depends on many factors including good quality fry, appropriate feeding, proper water quality management but a great extent on stocking density. Stocking density refers to the numbers of animals that are kept on given unit of area which is very important for getting maximum production from a water body as survival and growth rate of fish depends on it (Backiel and Lecren 1978). Because relatively large number of fish in smaller size of pond could not get more space, food, and dissolved oxygen at the same time. As a result, fish become susceptible to diseases and parasite and prone to mortality which ultimately hamper the total production and farmers face a great economic loss. Aquaculture practice is advancing day by day and different types of hapa is a cage like, rectangular or square net impoundment can be placed in grow out pond, for rearing fry to produce fingerling which reduce the demand for separate nursing pond, ensure the continuous supply of fingerling thus save the additional cost of our farmer. *Clarias batrachus* locally known as Magur is one of the most popular culturable catfish in Bangladesh as well as

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Indian sub- continent. It is a high valued and fast growing aquaculture species with good taste and flavor, high market price, high nutritional value and medicinal quality. 100g of this fish flesh contain 32 g protein, 2 g fat, 0.7 g iron, 172 g calcium and 300 g of phosphorus. This fish is mostly found in ponds, river, beel as well as other derelict and swampy water and fed on fish eggs, insect's larvae and plant material. Both monoculture and polyculture system are suitable for this species which also exhibit satisfactory production performance in drought prone area. The effect of stocking density on growth and survival of some fishes all over the world has been addressed (Sahoo et al. 2004, Pangni et al. 2008, Nwipie et al. 2015, Swamy et al. 2018, Goswami and Ghosh 2022). Several studies regarding the same issue have also been described in our country such as Bostami et al. (2020) on *Cyprinus carpio* var. *spicularis* in Rajshahi; Samad and Imteazzaman (2019) on *Clarias batrachus* fingerling in Rajshahi; Islam et al. (2018) on *Pangasias hypophthalmus* in Noakhali; Mou et al. (2018) on *Mystus vittatus* in Nilphamari; Samad et al. (2017) on *Labeo rohita* in Rajshahi; Chakraborty (2017) on *Bengala elanga* in Saidpur; Chakraborty and Nur (2012) on *Heteropneustes fossilis* in Mymensingh; Hossain et al. (2009) on monosex tilapia in Rajshahi Begum et al. (2008) on *Mystus gulio* in Khulna and Samad et al. (2005) on *C. batrachus* in Mymensingh. This discussion revealed that a little effort has been carried out to know about the effect of stocking density on growth, survival and yield performance of *C. batrachus* fry in Rajshahi region. So the study was under taken to determine the growth, survival and production performance of *C. batrachus* fry under different stocking density and to find out economically viable stocking density for the farmers.

Materials and Methods

Study area and period: The experiment was carried out by setting nursery hapa in research pond of Department of Fisheries, Faculty of Fisheries, University of Rajshahi for a period of 3 months from 1st May to 30th July, 2021. The pond area was about 33 decimal and water depth was about 5 feet.

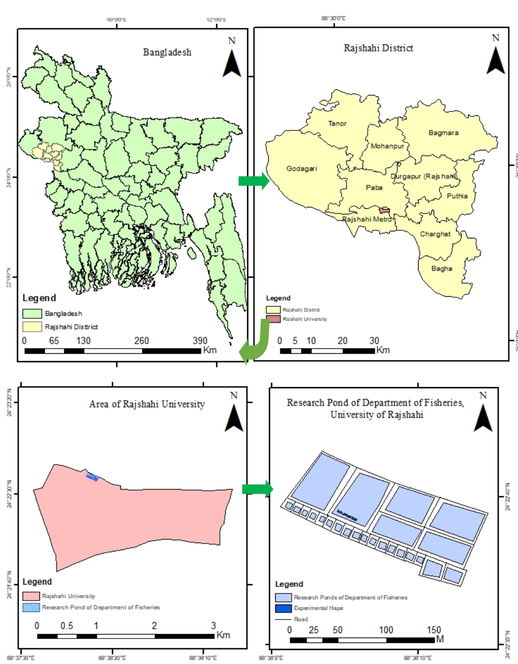

Fig. 1: Map showing the study area.

Experimental design: Four different stocking densities were tested in hapa in pond each with two replications. Each stocking density was considered as treatment. *Clarias batrachus* fry were stocked at the rate of 300, 350, 400 and 450 m^{-3} in T_1, T_2, T_3 and T_4 hapa respectively.

Hapa preparation: A total of eight hapas were prepared using mosquito net and rope where each hapa covering an area of about 1.2 × 0.9 × 0.9 m^3 which was rectangular in shape. Then it was set into a net cages made of iron to prevent the damage of hapa due to crab attack.

Fig 2: Experimental hapa.

Pond preparation: Before releasing fry, aquatic weed was removed manually and the pond treated with rotenone to at a rate of 4.94 kg/ft/ha to remove unwanted fish. After 7 days interval lime was applied at a rate of 250 kg/ha. At first, lime was mixed with water in an aluminum pot then applied by spreading method. Pond was fertilized with cow dung, urea and TSP at a rate of 1200, 25 and 13 kg/ha respectively. A seven days interval was maintained between lime and fertilizer application. As catfish fry are susceptible to viral infection, the research pond was treated with Temsen at a rate of 4.94 kg/ha before releasing fry.

Fig. 3: Application of lime.

Collection and stocking of fry: Seven days old fry (0.04±0.01g) was collected from a private fish seed hatchery Adomdighi, Bogura using plastic bag with proper aeration. The hatchling was counted manually and released in the hapa at the rate of 300, 350, 400 and 450 fry/m^3 in T_1, T_2, T_3 and T_4 respectively.

Periodic fertilization: Cow dung, urea and TSP was applied periodically at the rate of 350 kg/ha, 7 kg/ha, and 5 kg/ha respectively maintaining 7 days interval.

Sampling method: From each hapa, about 5% fish was sampled fortnightly using a scoop net to observe the weight gain, health status and for feed adjustment. After final harvesting survival rate (%) was calculated by counting the fingerling separately.

Water quality parameter: Physico-chemical parameter of water was checked fortnightly in morning between 9-11 am. Water temperature and transparency was recorded by using a centigrade thermometer and a secchi disk respectively. Sub-surface water sample was collected and other chemical parameter of water such as dissolved oxygen, carbon-dioxide, P^H and ammonia were estimated by HACK-kit FF_2.

Growth parameter: Growth performances and survival rate of fry was observed by measuring different growth parameters mentioned below.

- Initial wt (g) = Weight of fish at stock;
- Final wt (g) = Weight of fish at harvest;
- Weight gain = Final wt (g)- Initial weight (g)
- Mean weight gain (g) = Mean final wt (g)- Mean initial wt (g)
- SGR (%/ day)= {(In final fish wt - In initial fish wt)}/Culture period × 100
- FCR= Feed Fed (dry weight) / live weight gain
- Survival rate (%)= {(No. of harvested fish) / (No. of stocked fish)} × 100
- Net production (kg/m^3/90 days) = No. of fish caught × average final weight of fish.

Cost benefit analysis: The entire cost and income from selling fish was kept accurately. Then the cost-benefit analysis under different stocking density was calculated by considering seed, feed and labour cost and earning from selling the fry. Cost benefit ratio was calculated by using the following formula.

CBR = Total income from fish/ Total cost

All types of fixed cost such as expenditure of cage and hapa were not included in total cost, rather running cost was considered.

Statistical analysis:

Statistical analysis of growth, yield performance and water quality parameter was accomplished by using one-way analysis of variance (ANOVA) and significant difference (0.05%) among the mean value was tested by Duncan's multiple range test (DMRT). A computer software SPSS (Statistical Package for Social Science) program was used to perform the statistical analysis.

Results and Discussion

Water quality parameter

Variation in the mean values (Mean±SD) of water quality parameter under different treatment during the study period are demonstrated in Table 1. The mean value of water temperature was found to be ranged from 28.24±1.17 (T_1) to 28.26±1.20°C (T_4). As fish is a cold blooded animal, various physiological process such as respiration, feeding, metabolism, growth, reproduction, rate of detoxification and bioaccumulation are affected by temperature where the optimum range for fish culture is about 25-32°C (Boyd 1988). Water temperature was recorded 26.27±0.47 to 26.49±0.47°C in hapa (Bostami et al. 2020), 28.48±1.37 to 28.66 ±1.42°C in earthen pond (Ahmed at el. 2019), 29.3±1.41 to 31.67 0.47°C in cages (Islam et al. 2018), 30.55±0.54 to 30.69± 0.61°C in pond (Samad et al. 2017) and 29.89±0.87 to 30.05±0.61°C in nursery pond (Monir and Rahman 2015) which is more or less similar with the present findings. This indicated that stocking density has no effect on temperature.

The transparency was found to be ranged from 26.10± 0.14 (T_1) to 26.13± 0.25 (T_4) cm with an average 26.12±0.18 cm. Water transparency is another important factor for pond fish culture which may be affected by siltation, microscopic organisms and suspended organic matter. Water Transparency (cm) was estimated 37.21± 0.12 to 37.88±0.34 in nursery hapa (Bostami et al. 2020), 29.73±2.52 to 43.34 ±3.38 in earthen pond (Ahmed et al. 2019), 35.23 ±2.25 to 35.92±3.25 in net cages (Isalm and Begum 2019) 28.86±1.41 to 30.22± 0.69 in earthen pond (Samad et al. 2017) and 34.50±3.02 to 50.50±5.47 cm in nursery pond (Monir and Rahman 2015) which was higher than the present study. However, it was within optimum level as recommended 25-35 cm by Boid (1988).

Average concentration of dissolved oxygen was found 5.44±0.45 mg/l. Dissolved oxygen (DO) is a basic requirement for aquaculture species and may be affected by water temperature, respiration and level of organic matter which should be 5-8 mg/l (Boyd 1988) for a productive pond. Dissolved oxygen content was recorded 4.49±0.09 to 4.73±0.04 in nursery hapa (Bostami et al. 2020), 4.81± 0.45 to 4.75±0.34 in net cages (Islam and Begum 2019), 5.10±0.44 to 5.50±0.27 in earthen pond (Ahmed et al. 2019), 3.07±0.28 to 6.08 ±0.33 in nursery pond (Monir and Rahman 2015) and 6.02±1.41 to 6.33±1.02 in nursery pond (Begum et al. 2008) which agree with the present findings and was in suitable condition for fry rearing.

CO_2 concentration was more or less similar in different treatment where the variation was recorded 1.77± 0.02 (T_1) to 1.78± 0.03 mg/l (T1, T_2 and T_4) with an average 1.78± 0.03 mg/l. CO_2 is another component of water where a range from 1-2 mg/l is tolerable in a productive pond (Boyd 1988). Carbon dioxide content (mg/l) was recorded 2.98± 0.007 to 3.31±0.21 in earthen pond (Samad et al. 2017) and 8.34 to 8.85 in earthen pond (Hossain et al. 2009) which was higher than the present study.

During the trial, p^H fluctuation was very slight where the mean value was calculated 6.80 0.04 (T_1) to 6.95± 0.04 (T_1). The p^H of water is its hydrogen ion concentration (H+) and indicative to its fertility or potential productivity where a range from 6.5 to 9 is generally regarded as suitable for fish and shrimp (Boyd, 1998). P^H was recorded 7.40±0.04 to 7.51±0.03 (Bostami et al. 2020) in nursery hapa, 7.3 to 7.5 in net cages (Islam and Begum 2019), 7.16±0.46 to 7.20 to 0.43 in earthen pond (Ahmed et al. 2019), 7.8±0.04 to 8.15± 0.21 in earthen pond (Islam et al. 2018) and 7.72 0.04 to 7.82 007 in earthen pond (Samad et al. 2017) which was slightly higher than the P^H of experimental pond.

The mean value of NH_3-N (mg/l) was recorded 0.08±0.01 in T_4 followed by 0.07±0.01, 0.0±60.00 and 0.05± 0.00 in T_3, T_2 and T_1 respectively. Ammonia is the initial product of the decomposition of nitrogenous organic waste, respiration and excess can cause gill damage, reduce the oxygen carrying capacity of blood and affect osmoregulation. Suitable range of ammonia nitrogen is 0-1 mg/l (Alim 2005). Ammonia nitrogen was recorded 0.11±0.02 to 0.13±0.03 in net cages (Islam and Begum, 2019), 0.11±0.02 to 0.13± 0.01 in earthen pond (Samad et al. 2017), 0.01± 0.01 to 0.05 ±0.02 in nursery pond 0.18 ±0.07 to 0.20 ±0.08 in earthen pond (Hossain et al. 2017) which was higher than the present findings. But Monir and Rahman (2015) recorded p^H 0.01± 0.01 to 0.05± 0.02 in nursery pond which is lower than the present findings. Here a proportional relation was found between stocking density and ammonia concentration where stocking density significantly influences the ammonia concentration of each hapa. All water quality parameters were in favorable condition for fry nursing during the experimental period and no significant difference was found among the treatments except NH_3-N.

Table 1. Mean values ($\bar{x}$±SD) of water quality parameter under different treatment.

Water quality parameter	Treatment				P-value	Comments
	T_1 (300/m^3)	T_2 (350/m^3)	T_3 (400/m^3)	T_4 (450/m^3)		
Temperature (°C)	$24.84±1.17^a$	$28.15±1.18^a$	$28.25±1.18^a$	$28.26±1.20^a$	0.24	No need for post hoc test
Transparency (cm)	$26.10±0.14^b$	$26.12±0.15^{ab}$	$26.12±0.16^{ab}$	$26.13±0.25^a$	0.06	Do
DO (mg/l)	$5.45±0.45^a$	$5.44±0.46^{ab}$	$5.44±0.46^{ab}$	$5.43±0.44^b$	0.06	Do
CO_2 (mg/l)	$1.78±0.03^a$	$1.77±0.02^a$	$1.78±0.03^a$	$1.78±003^a$	0.12	Do
pH	$6.95±0.04^a$	$6.93±0.04^a$	$6.85±0.04^a$	$6.80±0.04^a$	0.22	Do
NH_3-N (mg/l)	$0.05±0.00^a$	$0.06±0.00^a$	$0.07±0.01^a$	$0.08±0.01^a$	0.02	Post hoc test was done to compare the mean

*Value in the same row with different superscripts is significantly different ($p<0.05$).

Growth parameter: Variation in the mean values (Mean±SD) of growth parameter, survival rate, and production of *Clarias batrachus* fry after 90 days of rearing in nursery hapa are presented in Table 2. Mean weight gain was found to be varied from 6.85± 0.18 to 7.96±0.07 g. Here maximum weight gain was observed in T_1 and minimum in T_4. The mean weight gain was recorded 14.82±0.15 to 17.95 ±0.17 for *Cyprinus carpio* var. *spicularis* fry (Bostami et al. 2020); 21.78± 015 to 29.14±0.25 for *Clarias batrachus* fingerling (Samad and Imteazzaman 2019); 0.09±0.06 to 0.20±0.87 for *Pangasius hypophthalmus* fry (Islam et al. 2018) for a period of 45 days; 2.57±0.71 to 7.14±0.10 for *Mystus vittatus* fry (Mou et al. 2018) for 50 days; and 27.70±3.44 to 43.90±3.05 for *Heteropneustes fossilis* fingerling (Charaborty and Nur 2012) for period of 100 days. Here, all the value was higher than the present findings except the weight gain of *Pangasius hypophthalmus* and *Mystus vittatus.* This difference may be due to variation in culture species, initial weight, culture period, experimental condition, stocking density, feed and temperature.

Specific growth rate was estimated 5.65±0.00, 5.62± 0.01, 5.50 ±0.00 and 5.58±0.02 (%/day) in T_1, T_2, T_3 and T_4 respectively for 90 days. Here, highest value was found in T_1 whereas lowest value was found in T_3. The SGR is a coefficient that measures the percentage increase in fish weight per day which expressed as (%/ day). Specific growth rate was evaluated 6.67±0.02 to 6.82±0.05 for *Cyprinus carpio* var *spicularis* fry (Bostami et al. 2020); 2.85±0.19 to 3.29±0.15 for *Oreochromis mossambicus* fry (Islam and Begum 2019); 0.44±0.03 to 0.92±0.08 *Pangasius hypophthalmus* fry (Islam et al. 2018); 2.63±0.03 to 3.14±0.04 1.34±0.01 to 1.58±0.01 for *Clarias batrachus* fingerling (Samad and Imteazzaman 2019), 2.63±0.03 to 3.14±0.04 for *Heteropneustes fossilis* fingerling (Charaborty and Nur 2012) and 6.52 to 7.45 for *Clarias batrachus* fry (Samad et al. 2005). Here the specific growth rate of *Clarias batrachus* and *Cyprinus carpio* var *spicularis* fry resemble the present findings but the rest were lower than the mean value. It is higher for the fingerling at early stage of life cycle and low for adult fishes.

Obtained survival rate was 91.00±0.70 (T_1), 88±0.70 (T_2), 83.00±0.00 % (T_3) and 79.00±0.00 (T_4). Maximum survival rate was observed in lowest stocking density (T_1) which was 91.00±0.70 %. On the contrary, T_4 provide minimum survival rate which was 79.00±0.00 % with highest stocking density. Survival rate is the percentage of cultured organisms in a study or treatment group still alive for a given period of time which may be affected by species, species age and size, stocking density, culture condition etc. Bostami et al. (2020) found a survival rate (%) of about 42.99±1.37 to 56.47±6.94 for *Cyprinus carpio* var. *spicularis* fry rearing in hapa condition which was lower than the present findings. Besides these, survival rate was recorded 93.0±5.12% for *Oreochromis mossambicus* fry (Islam and Begum 2019); 89.75±2.40 to 92±2.41% for *Clarias batrachus* fingerling (Samad and Imteazzaman 2019); 81±4.20 to 95±3.02% for *Pangasius hypophthalmus* fry (Islam et al. 2018); 70.77±3.41 to 90.76±2.07% for *Heteropneustes fossilis* fingerling (Charaborty and Nur 2012); 70.34 ±5.71 to 89.25± 5.41% for *Mystus gulio* (Begum et al. 2008); and 84 to 90 % for *Clarias batrachus* fry (Samad et al. 2005) which agree the present findings. *Clarias batrachus* is a hardy species that shows a relatively higher survival rate inspite of its small size, age, though negative relationship was found between stocking density survival rate.

FCR was calculated as 1.94±0.01, 2.06±0.02, 2.20±0.07 and 2.15±0.03 in T_1, T_2, T_3 and T_4 respectively. Lowest FCR was found in T_1 whereas highest FCR was found in T_4. FCR (Feed Conversion Ratio) is the conventional measure of livestock production efficiency which is defined as the weight of feed intake divided by weight gained by the cultured organism where the lower the FCR value; the higher the efficiency. The FCR value was found to be ranged from 1.46±0.08 to 2.30± 0.16 for *Oreochromis mossambicus* fry (Islam and Begum 2019); 1.75±0.21 to 3.20 ±0.14 for for *Mystus vittatus* fry (Mou et al. 2018); 1.93± 0.23 to 3.05±0.13 for *Pangasius hypophthalmus* fry (Islam et al. 2018); and 1.90 ±0.04 to 2.8±0.06 *Heteropneustes fossilis* fingerling (Charaborty and Nur 2012) which resemble the present finding. On the other hand, FCR value was recorded 1.51±0.02 to 1.83±0.03 for *Labeo bata* (Ahmed et al. 2019) and 1.73 to 2.04 for *Pangasius sutchi* (Azimudin et al. 1999) which was lower than the present findings. This difference may be due to species variation, types and quality of feed, stocking and it was found that the higher the stocking density the lower the FCR.

Final production of the cultured fish was 2.20±0.05, 2.37±0.02, 2.51±0.07 and 2.48± 0.02 kg/m^3/90 days in in T_1, T_2, T_3 and T_4 respectively. Here T_3 provide highest production followed by T4, T_2 and T_1. Yield is the standard measurement of the amount of aquaculture production harvested per unit of water body within a given period of time. Net production was found 1498.2±345.2 to 1786.28±295.4 kg/ha for *Clarias batrachus* fingerling in earthen pond (Samad and Imteazzaman 2019), 13.44±1.88 to 13.77±1.15 kg/m^3 for *Oreochromis mossambicus* fry (Islam and Begum 2019), 2132±29.78 to 2322.38 ±55.20 kg/ha for *Labeo bata* (Ahmed et al. 2019), 10042.56±5.44 to 22175.60 ±7.35 kg/ha for *Heteropneustes fossilis* fingerling in pond (Charaborty and Nur 2012), 1370 ±60 to 1535 ±71 kg/ha *Pangasius sutchi* (Azimuddin et al. 1999). Post Hoc test was done to compare the mean where significant difference ($p<0.05$) was found among the treatments and control in case of all the growth parameter.

Table 2. Mean values ($\bar{x}$±SD) of growth parameter, survival rate, and production of *Clarias batrachus* fry after 90 days of rearing in nursery hapa.

Growth parameters	Treatment				P-value	Comment
	T_1 (300/m^3)	T_2 (350/m^3)	T_3 (400/m^3)	T_4 (450/m^3)		
Mean initial weight (g)	0.04±0.01	0.04±0.01	0.04±0.01	0.04±0.01	-	-
Mean final weight (g)	8.00±0.13^a	7.70±0.16^b	7.48±0.16^b	6.89 ±0.18^c	0.00	Post Hoc test was performed
Weight gain (g)	7.96±0.07^a	7.66±0.08^b	7.44±0.09^b	6.85±0.04^c	0.00	Do
SGR (% /day)	5.65±0.00^a	5.61±0.01^b	5.58±0.02^b	5.50 ±0.00^c	0.00	Do
Survival (%)	91±0.70^a	88±0.70^a	83±0.00^b	79±0.00^c	0.00	Do
Yield (kg/m3/90 days)	2.20±0.05^c	2.37±0.02^a	2.51±0.07^b	2.48±0.02^a	0.01	Do
FCR	1.94±0.01^d	2.06±0.02^c	2.15±0.03^b	2.20±0.07^a	0.01	Do

*Value in the same row with different superscripts is significantly different ($p<0.05$).

Economic benefits:

Economics of *Clarias batrachus* fry after 90 days rearing in nursery hapa was presented in Table 3. Benefit cost ratio (BCR) was varied from 0.43±0.02 (T_1) to 0.73±0.01 (T_3) kg/ m^3/3 months where stocking density of fry was 300 and 450 fry per m^3 respectively. Price of fingerling was related with size which was 800 Tk./kg (size- 8g) in T_1; 770 Tk./kg (size- 7.72g) in T_2; 750 Tk./kg (size-7.48g) in T_3; and 700 Tk./kg (size-6.89) in T_4. BCR was found 1:0.67 to 1:1.05 for *Clarias batrachus* fingerling in earthen pond (Samad and Imteazzaman 2019) for a period of 90 days and 1.72±0.005 to 1.97±0.004 for *Cyprinus carpio* var. *spicularis* fry (Bostami et al. 2020) which were higher than the present findings.

Table 3. Economical benefits of *Clarias batrachus* fry rearing in nursery hapa under semi-intensive culture system.

Item cost	Treatment				P-value	Comments
	T_1 (300/m^3)	T_2 (350/m^3)	T_3 (400/m^3)	T_4 (450/m^3)		
Feed	541±2.12^c	612±2.82^b	681±1.41^a	684±0.70^a	0.00	Post hoc test was performed
Seed	120±0.00	140±0.00	160±0.00	180±0.00	-	Do
Labor cost (BDT/m^3)	350± 0.00	350±0.00	350±0.00	350±0.00	-	Do
Total cost (BDT/m^3)	1011±2.12^d	1102±2.82^c	1191±1.41^b	1215±0.70^a	0.00	Do
Total return (BDT/m^3)	1750±14.14^b	1835±14.14^a	1866±21.21^a	1748±16.97^b	0.00	Do
Net benefit	739±0.12^a	733±11.31^a	676±19.78^b	533±20.50^c	0.00	Do
BCR (benefit cost ratio)	0.73±0.01^a	0.66±0.01^b	0.56±0.11^d	0.43±0.02^c	0.00	Do

*Value in the same row with different superscripts is significantly different ($p<0.05$).

Conclusion

After analyzing the growth parameter, net production and BCR ratio, it can be remarked that a stocking density of 300 fry/m^3 might be suggested as the most suitable stocking density for *Clarias batrachus* fry rearing in nursery hapa under semi intensive culture system. By applying this stocking density our farmer will be expected to produce more fingerlings at a time which ensure the proper utilization of the pond and finally they will be economically benefitted.

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