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Effect of stocking density on survival, growth and production of mud eel, *Monoterus cuchia* (Hamilton) under semi-intensive pond aquaculture

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ABSTRACT

Effect of stocking density on the growth, survival and production of mud eel Monopterus cuchia was tested in three Fish Seed Multiplication Farm of Bangladesh. The experiment was conducted for a rearing period of 240 days in six earthen ponds having an area of 0.14 ha each. The initial length and weight of fingerlings 29.20±1.80 cm and 99.90 g was stocked at 7410 fingerlings ha^{-1} was designated as treatment T_{1}, 9880 fingerlings ha^{-1} as treatment T_2 and 12350 fingerlings ha^{-1} as treatment T_3. Physico-chemical parameters were at the optimum level for culture period. Highest weight gain was observed in treatment T_1 and lowest in treatment T_3. Final length, weight and survival also followed the same trends as weight gain. In treatment T_1 M. cuchia was produced significantly higher specific growth rate than treatment T_2 and T_3. Feed conversion ratio was significantly lower in treatment T_1 followed by treatment T_2 and T_3 in that order. Significantly highest production was produced in treatment T_1 than in treatment T_2 and T_3, respectively. In despite of this, consistently higher net benefits were also found from treatment T_1 than from treatment T_2 and T_3. Overall, highest growth, survival and net benefits of were recorded in treatment T_1 at a density of 7410 fingerlings ha^{-1}. Therefore, of the three stocking densities, 7410 fingerlings ha^{-1} appears to be most suitable stocking density for rearing of M. cuchia in semi intensive mud eel culture system.

***Keywords*:** Cost and return, food conversion ratio, growth, production, stocking density and survival rate

The mud eel, *Monopterous cuchia* (Hamilton) is a fresh water air breathing, swamp mud eel is locally known as cuchia or cuchia, belongs to the family Synbranchidae of the order Synbranchiformes, it commonly occurs in the fresh water of Bangladesh, Pakistan, Northern and Northeastern India and Nepal (Jingran and Talwar, 1991). Once, indigenous mud eel (*Monopterus cuchia*) was abundant throughout the Bangladesh. Plenty in mud-holes in shallow "beels" and 'boro' paddy field particularly in old Sylhet, Mymensingh and Tangail Districts (Rahman, 1989). But now-a-days this fish is hardly found in the open water system. IUCN, Bangladesh (2000) enlisted *M. cuchia* is vulnerable status in country. Due to rough water management policy for irrigation, over exploitation and various ecological changes in its natural habitat; this species is threatened now. The fisheries resources of wetland are under sever threat due to sediment the downstream of the river system which reduces the rate of water flow and changing aquatic ecosystems, human interventions through construction of flood control embankments, drainage structures and sluice gates, conversion of inundated land to cropland and indiscriminate destructive fishing practices and use of pesticides. Pollution from domestic, industrial and agrochemicals wastes and run off have resulted in extinction of a considerable amount of aquatic biota in same stretches of the open water system (Diaster, 1990; Chakraborty and Mirza, 2008).

This fish is exported to many countries of south East Asia and Europe. The tribal people belonging to the Garo, Hajong, Shawtali and Koch-Rajbongshi community believes this fish to be therapeutic one and traditionally use for treatment of various ailments, *viz*., weakness, anemia, asthma, hemorrhoids and diabetes. Direct consumption of fresh blood of the fish is reported to cure weakness, anemia and asthma (Jamir and Lal, 2005; Kakoti *et al*., 2006). Consumption of gall bladder of the fish either fresh or sun dried is believed to have anti-asthmatic and anti-rhinitic properties (Lohani, 2012). Curry prepared by cooking the flesh along with certain herbs or soup prepared from cooking the flesh alone are known to cure anemia, piles and diabetes (Saikia and Ahmed, 2012; Chakravorty and Kalita, 2012). The average protein content per 100 gm of raw flesh is 18.7 gm, while the concentrations of other nutrients are 0.8 gm fats, 2.4 gm carbohydrate and 185 gm calcium (www.mcgill.ca). The caloric value of eel flesh is reported to be as high as 303Kcal.100 gm-1 (Nassar, 1997). 100 gm of fish flesh contains 1400 µgm of Retinol (Vitamin A1), >450 µgm of Dehydroretinol (Vitamin A2) and >3500µgm of Provitamin A11 (www.genderaqua.fish.files). Plasma composition of cuchia fish reported the presence of 3.304-3.745 gm, 67.34-72.46 mg and 224.747-257.027 mg of protein, glucose and triglyceride per 100 ml blood, respectively. Presence of amino acids viz. Alanine, Arginine, Glycine, Histidine, Leucine and Methionine has also been reported from this species (Mishra *et al*., 1977). For such nutritional importance, there is a tremendous demand of cuchia in the international market.

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Eel culture does not necessarily require large bodies of water and specific expensive formulated feed. Due to its dual systems of respiration by the gills and skin this fish can thrive in various adverse conditions such as low oxygen levels, high temperature, shallow water and polluted water. The cuchia culture is not very much popular in our country because of its incredible habitat.

Supplementary feed being the most critical impute, judicious feed management enhances the production performance and reduces the production cost. Several studies have been carried out to evaluate the effect feeding frequency on growth, survival, feed intake, body composition, etc. in different species (Singh and Srivastava, 1984; Chiu *et al*., 1987; Webster et al., 1992; Golden *et al*., 1997; Dwyer *et al*. 1997; Dada *et al*., 2002). However, information on mud eel, M. cuchia is very rare. Development and extension of sustainable mud eel nursery technology can play a positive role to develop a sustainable aquaculture of cuchia production. Considering the importance of this species in nutritional, medicinary, economic and biodiversity point of view, nursery management technology of cuchia should be developed by controlling feeding frequency on growth, survival and feed utilization.

Success in fish culture depends on a good knowledge of nutritional and environmental requirement of the larvae in the open aquatic ecosystem (Mollah, 1985). To maintain this fish population as well as its conservation and rehabilitation, development of suitable culture technology for *M. cuchia* is very essential. Growth, survival and production in ponds depend on stocking density, habitat development and supplementary feeds. The present experiment has been undertaken to develop a practical and economically viable methodology for mass growth and production of *M. cuchia* under semi intensive pond aquaculture system in Bangladesh.

MATERIALS AND METHODS

On the basis of geographical and biological point of view Fish Seed Multiplication Farm (FSMF) of Sadar, Netrokona; Fulpur, Mymensingh and Nimgachi, Sirajgonj was selected for semi intensive culture of mud eel, *M. cuchia*.

The research has been carried out at the six ponds of Fish Seed Multiplication Farm Sadar, Netrokona; Fulpur, Mymensingh and Nimgachi, Sirajgonj FSMF with an area of 0.13 ha. The study area was designed FSMF of Sadar, Netrokona as a treatment T_1 and ponds FSMF of Fulpur, Mymensingh as a treatment T_2 and ponds FSMF of Nimgachi, Sirajgonj as a treatment T_3 (Fig. 1-3). The experiment was conducted for a period of 240 days from March to October, 2016.

A safety shelter for cuchia was developed by installing bamboo root, plastic pipe, aquatic vegetation and necessary objects in the area of the habitat. Mud-compost hips were developed for natural shelter of cuchia step by step in the suitable place of habitat. The size of the mud-compost hip was 3.0 m× 2.0 m ×1.5 m. To prevent the escaping of cuchia, pala siding work by dram sheet was set up on the dyke of every pond. Two sides of the every pond were developed by four layers. First layer was filled with 80% clay and 20% loamy which will be 100cm in density, second layer was covered with compost (cowdung, straw and water hyacinth as per requirement, lime 6.0 kg, urea 3kg and TSP 6.0 kg); third layer was filled with 5-7 days dry banana leaf of 2cm and fourth layer was filled as same as first layer. Lastly top layer was placed by clay on a slope with one end. The two sides was developed upto dyke level arranging by this way. The upper of the pond side was covered with grass for shelter and protection.

Quicklime ($CaCO_3$, 247 kg ha^{-1}) has been spread over the only pond bottom and liming also during the experimental period. Seven days subsequent to liming, the ponds was manured with organic manure (cowdung @ 2470 kg ha^{-1}).

The water bodies were stocked at a density of 7410, 9880 and 12350 fingerlings ha^{-1} with an initial length and weight of 29.20±8.98 cm and 99.90±1.80 g in the treatment T_1 (FSMF Sadar, Netrokona), T_2 (FSMF Fhulpur) and T_3 (FSMF, Nimgachi). The stocking densities have been employed with two replicates in every treatment. The catch statistics were maintained based on fortnightly sampling. Before stocking, the total length and body weight of the fishes was recorded individually with the help of a measuring scale and a sensitive portable balance (Model HL 400 EX).

In order to meet up the increasing dietary demand, different types of live feeds were used to achieve targeted production (Table 1). Cuchia consume fry of carp or tilapia, dry fish, earthworm, tadpole, and apple snail of paddy field. Cuchia is nocturnal fish. It likes to feed at night. The feeds were supplied in a tray or plastic pipe 2.5 inch diameter and put it in the bottom of the water. Varmi compost was set up in every pond site (Fig. 4).

Proximate composition of the feeds was analyzed according to AOAC (1995) method, nitrogen free extract (NFE) by subtraction (Castell and Tiews, 1980). Proximate composition (% dry matter) of the supplementary feeds (crude protein, crude lipid, crude fiber, ash and nitrogen-free extract) of dry fish or fishmeal was 32.31%, 7.70%, 10.17%, 19.18% and

Fig. 1: Fish seed multiplication Farm Sadar, Netrokona

Fig. 2: Fish seed multiplication Farm Phulpur, Mymensingh

Fig. 3: Fish seed multiplication Farm Nimgachi, Sirajgonj

Fig. 4: Production of earth warm from vermicompost

Fig. 5: Sampling of cuchia fish by traping method

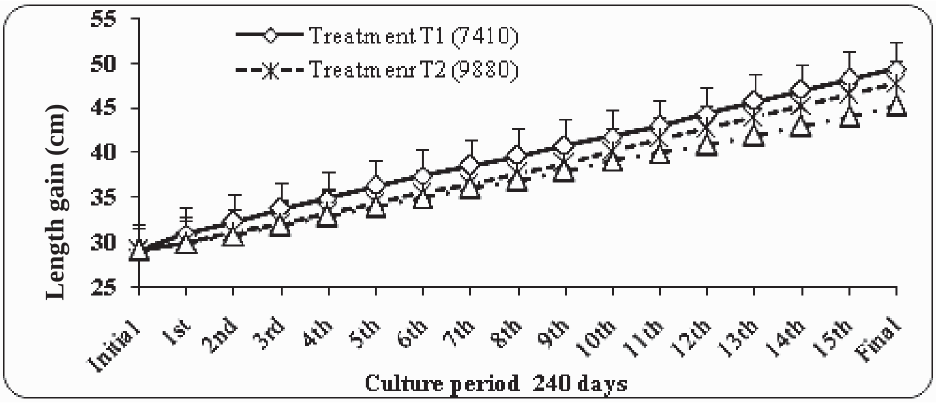

Fig 6: Fortnightly mean length (cm) gain of Cuchia, *Monopterous cuchia* under three treatments during 240 days study

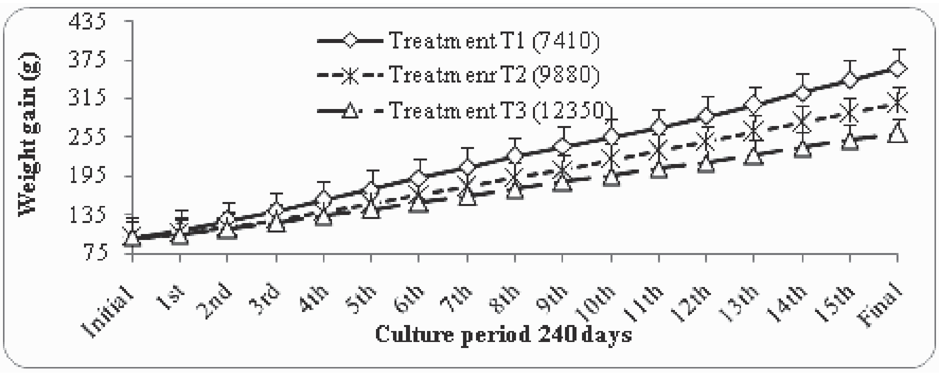

Fig. 7: Fortnightly mean weight (g) gain of Cuchia, *Monopterous cuchia* under three treatments during 240 days study

Fig. 8: Produced cuchia fish ready for marketing

30.64%, respectively. Feeds were supplied to the fish at the rate of (2-5)% of their total biomass in the evening commencing from the first day of stocking. Daily ration was adjusted by estimating the standing crop once in each fortnight by random sampling of the stock. In order to meet the increasing dietary demand, cuchia was fed with live fry of carp at 4% body weight with an interval of 15 days for 240 days, dry fish (1%), earthworm (0.2%), and tadpole and apple snail (0.8%) in every alternative day. Ration was adjusted by estimating the standing crop fortnightly.

Physico-chemical parameters of experimental area has been maintained fortnightly between 9.00 and 10.00 h. Water temperature was recorded using a Celsius thermometer and transparency was measured by using a Secchi disc of 20 cm diameter. Dissolved oxygen and pH were measured directly using a digital electronic oxygen meter (YSI Model 58) and an electronic pH meter (Jenway Model 3020). Total hardness and alkalinity was determined by titrimetric method (Clesceri *et al*.,1989). *M. cuchia* was fortnightly sampled by using trap and plastic pipe. Length (cm) and weight (g) of cuchia was measured (measuring scale and a portable sensitive balance Model HL 400 EX) separately to assess the growth condition of cuchia (Fig. 5).

At list twenty fish of *M. cuchia* was sampled fortnightly by using trap and plastic pipe. Growth in terms of length and weight, Average daily gain (ADG), Specific Growth Rate (SGR) and Food conversion rate (FCR) was estimated. SGR and FCR were calculated according to Brown (1957); Castell and Tiews (1980) and Gangadhara *et al*., 1997, respectively. After seven weeks, the fingerlings were harvested by repeated netting, followed by drying the ponds. The fingerlings were counted and weighed. Survival (%) and production (number/ha) of fingerlings were then calculated and compared among the treatments.

Sampling and data collection

The growth rate was estimated by using the formula given by Gangadhara *et al.*,1997 as below-

$$\text{Growth } (\%) = \frac{W_2 - W_1}{W_1} \times 100$$

Where, W_2 = Final weight in g

W_1 = Initial weight in g

$$\text{Average daily gain (ADG)} = \frac{\text{Average final weight (g)} - \text{average initial weight (g)}}{\text{Rearing period (days)}}$$

$$\text{Survival rate (SR \%)} = \frac{\text{No. of fish harvested}}{\text{Initial number of fishes stocked}} \times 100$$

$$\text{Specific growth rate (SGR \%)} = \frac{\text{Ln}W_2 - \text{Ln}W_1}{T_2 - T_1} \times 100 \text{ (Brown 1957)}$$

Where,

W_2 = the weight of fish at time T_2

W-$_1$ = the weight of fish at time T_1

T_2 - T_1 = culture period (days)

$$\text{The food conversion ratio (FCR)} = \frac{\text{Total supplementary feed given}}{\text{Total body weight gain (kg)}}$$

Analysis of experimental data

The data were analyzed through one way analysis of variance (ANOVA) using MSTAT followed by Duncan's New Multiple Range test to find out whether any significant difference existed among treatment means (Duncan, 1955; Zar, 1984). Standard deviation in each parameter and treatment was calculated and expressed as mean ±S.D. The level for significance was set at 0.05%. A simple cost-benefit analysis was done to estimate the net benefits from different treatments.

RESULTS AND DISCUSSION

Mean levels of physico-chemical parameters over the 240 days culture of cuchia fish is presented in Table 2. The mean water temperatures in treatment T_1, T_2 and T_3 were not statistically significant. Mean secchi disk transparency differed significantly, increasing from T_1 to T_3. pH decreased from T_1 to T_3 but did not differ significantly. The mean dissolved oxygen (DO) obtained in the morning hours was significantly different, decreasing from T_1 to T_3. Total alkalinity was decreased from T_1 to T_3 but differ significantly. Despite these variations, water quality parameters in all the experimental ponds were within the normal range for fish culture (Table 2).

Fortnightly growth (length and weight) of *M. cuchia* were shown in fig. 7 and 8. The increase in length and weight was the highest in T_1 followed by T_2 and T_3.

Table 1: A chart of feeds item

Type of feed	Rate	Application method
Carp or Tilapia fry	4.0%	At 10 days interval
Dry fish (Fish meal)	0.7%	Alternative day
Earthworm	0.2%	Alternative day
Tadpole and apple snail	1.1%	Alternative day

Table 2: Physico-chemical characters of water in the earthen nursery ponds during the experimental period

Parameter	**Treatments**		
	T_1	**T_2**	**T_3**
Temperature (0^C)	29.48±2.77 (26.18-31.15)	29.55±2.616 (26.44-31.25)	29.35±2.44 (26.20-31.12)
Transparency (cm)	27.62±4.16^a (24.05-31.60)	34.20±5.04^b (31.34-39.22)	40.66±5.88^c (38.54-45.48)
pH	7.77±0.15 (7.42-8.12)	7.71±0.19 (7.62-8.05)	7.75±0.16 (7.47-8.00)
Dissolved oxygen (mg l^{-1})	5.02±0.85 (4.10-5.52)	4.90±0.56 (4.54-5.20)	3.98±0.88 (3.16-4.18)
Total alkalinity (mg l^{-1})	133.16±8.05^a (118.35-141.55)	127.45±7.04^b (122.04-131.68)	120.35±8.14^c (110.11-126.48)

Note: Figure in the same row having the same superscript are not significantly different (P>0.05); Figure in the parenthesis indicates the range

Table 3: Survival, feed conversion ratio, growth performance and production of mud eel, *Monopterus cuchia* after 240 days of rearing; mean ± SD with ranges in parentheses

Parameters	**Treatments**		
	T_1	**T_2**	**T_3**
No. of fish stocked ha^{-1}	7410	9880	12350
Initial length (cm)	29.20±8.98 (22.20-32.30)	29.20±8.98 (22.20-32.30)	29.20±8.98 (22.20-32.30)
Final length (cm)	49.48±12.14 (45.52-52.66)	47.80±14.19b (42.56-55.30)	45.40±16.06c (41.28-56.80)
Initial body weight (g)	99.90±1.80 (94.40-104.60)	99.90±1.80 (94.40-104.60)	99.90±1.80 (94.40-104.60)
Final body weight (g)	362.10±5.74^a (351.17-373.03)	308.22±5.81^a (296.44-322.84)	261.40±6.12^a (255.34-266.68)
Net weight gain (g)	262.20±15.46^a (251.07-273.33)	178.32±3.28^b (167.40-186.54)	134.62±3.94^b (127.30-140.88)
Average daily gain(g)	1.09±0.12^a (1.00-1.18)	0.81±0.03^b (0.69-0.78)	0.67±0.04^c (0.62-0.72)
Specific growth rate	3.97±0.04^a (3.88-3.01)	3.81 ±0.05^b (3.77-3.81)	3.65±0.06^c (3.60-3.69)
Survival rate (%)	93.40±1.27^a (90.8-95.20)	80.02±0.71^b (78.80-81.20)	74.10±0.71^c (56.80-59.80)
FCR	1.95±0.04^a (1.91-1.98)	2.06± 0.06^b (2.01-2.11)	2.16±0.07^c (2.16-2.24)
Production (kg ha^{-1})	2505.73±8.38^a (2499.8-2511.66)	2434.20±9.31^b (2421.50-2440.55)	2392.07±9.46^c (2380.41-2401.44)
Native and carp live species (kg ha^{-1})	1231.08±10.08 (1201.20-1240.40)	1181.68±11.32 (1176.08-1190.40)	1098.44±12.22 (1085.11-1101.50)

Note: Average daily gain (g) = (mean final weight-mean initial weight) / time interval (days).
Specific growth rate (SGR)=Ln mean final weight-Ln mean initial weight)/time interval (days)× 100.
FCR (Food conversion ratio) = Total diet fed (kg)/ total wet weight gain (kg).

Table 4: Cost and benefits from the culture of *M. cuchia* in 1 ha earthen ponds for a period of 240 days

Item	Amount TK•ha^{-1}•month^{-2}			Remarks
	Treatment T_1 (Tk)[a]	Treatment T_2 (Tk)	Treatment T_3 (Tk)	
Return from Cuchia	776550	705860	645840	Price is related with size and weight
Return from native fish and carp	186660	177150	164700	
Total return (TR)[b]	963210	883010	810540	
a. Variable cost:1. Price of juvenile	116150	148200	205250	
2. Feed (Tk. 60.00/kg)	171480	192800	188480	
3. Fertilizer, lime	9130	9500	9765	
4. Human labour cost (Tk.200/day)	48000	48000	48000	01 labour day^{-1}
5. Chemicals	4808	5260	6350	
6. Miscellaneous	20000	20000	20000	With harvesting.
Total Variable cost (TVC)	360438	414260	448080	
b. Fixed cost :1.Pond rental value	49400	49400	49400	Tk. 200 dec.$^{-1}$ according to local rate.
2.Interest of operating capital	36043	41426	44808	10% interest according to BKB, Bangladesh
Total fixed cost (TFC)	85443	90826	94208	
Total cost(TC= TVC+TFC)	445881	505086	542288	
Gross margin(GM= TR-TVC)	602772	468750	362460	
Net return (TR-TC)	517329	377924	268252	

Note: [a]1 US$ =Tk. 82.00; BKB= Bangladesh Krishi Bank; Figures with different superscripts in the same row varied significantly (P<0.05). Figures in the parenthesis indicate range. [b]Sale price of M. cuchia Tk.310.00 kg^{-1}; (T_1), Tk.290.00 kg^{-1}; (T_2) and Tk.270.00 kg^{-1} (T_3). Sale price of carp and native fish Tk.15 0.00 /kg; (T_1, T_2 and T_3).

Growth and production parameters are shown in the table- 3 and 4. The initial length and weight of fingerlings, stocked in all the treatments were same. The fish in T_1 treatment showed the highest gain in both length and weight over T_2 and T_3 treatment, where stocking density of fingerlings was 7410 ha^{-1}. However, the mean final length and weight of fishes in different treatments were significantly different. The highest weight gain was in T_1 and lowest in T_3. SGR in T_1 was significantly higher than T_2 and T_3, and was significantly different. FCR was significantly lower in T_1 than T_2 and T_3. Therefore, SGR and FCR were best for fish in T_1 where lowest number of stocking individual was reared. The highest survival rate was also observed in T_1, and the lowest in T_3. There was a significant variation in the survival rate in *M. cuchia* among different treatments.

The initial length and weight of fingerlings stocked in all the ponds was the same, 29.20±1.80 cm and 99.90 g. It is evident from the data that the fish attained an average size of 49.48±12.14 cm in length and 362.10±5.74 g in weight in treatment T_1 with lowest stocking density of 7410 fingerlings ha^{-1}, while the fish attained an average size of, 47.80±14.19cm in length and 308.22±5.11 -g in weight with 9880 fingerlings ha^{-1} density in treatment T_2 and 45.40±16.0 cm in length, 261.40±5.32g in weight in T_3 with 12350 fingerlings ha^{-1} density.

This is clearly indicated that maximum growth in length and weight was attained at the lower stocking density of 7410 fingerlings ha^{-1} with the growth gradually decreasing with increase in density, showing a negative correlation between density and growth.

The mean productions (kg ha^{-1}) of cuchia and native carp were 2505.73 and 1231.08 kg in treatment T_1, 2434.20 and 1181.68 kg in treatment T_2; and 2392.07 and 1098.44 kg in treatment T_3, respectively (Fig. 8 and Table 2). Production was higher in treatment T_1, and lowest in treatment T_3. However, total production of different treatment was differed significantly. On the other hand, cost of production in treatment T_1 was consistently lower than those treatments T_2 and T_3 (Table 4). Highest net benefit (Tk. ha^{-1}) was obtained in treatment T_1 (517329) followed by (377924) and T_2 (268252) in that order.

Physico-chemical parameters are very important factors in case of feed consumption and growth of fish. The temperature of the experimental ponds was within the suitable range for culture ponds that agrees well with the findings of Clesceri *et al.* (1989) and Chakraborty and Mirza (2007). Transparency was consistently higher in T_3, possibly due to the reduction of the plankton population by higher density of fish (Haque *et al.*, 1994). The dissolve Oxygen in the morning was low in ponds stocked with a high density of fish compared to ponds stocked with a low density. Fluctuation of dissolve oxygen concentration might be attributed to photosynthetic activity and variation in the rate of oxygen consumption by fish and other aquatic organisms (Boyd, 1982). However the level of dissolve oxygen (DO) is within the acceptable range in all the ponds. pH values agree well with the findings of Chakraborty *et al*. (2003). Alkalinity levels indicate productivity of the ponds was medium to high (Bhuiyan, 1970). Higher total alkalinity values might be due to higher amount of lime doses during pond preparation and frequent liming during the experimental period (Boyd, 1982; Clesceri *et al*.1989; Jhingran, 1991).

In this experiment, crude protein levels (32.88% dry weight) in supplementary feeds are very near the dietary protein of 31% for the optimal growth of *Labeo rohita* (De silva and Davy, 1991). Growth in terms of length, weight, weight gain and SGR of *M. cuchia* was significantly higher in T_1 where the stocking density was low compared to those of T_2 and T_3 although same food was supplied in all the all treatments at an equal ratio. The causes might include competition for food and habitat due to higher density of fish (Islam *et al*., 1999, Islam 2002; Chakraborty *et al*., 2006; Chakraborty *et al*. 2010; Faruque, *et al*., 2015; Chakraborty *et al*. 2017). High density of fingerlings in combination with high concentration of food in the rearing system might produce a stressful situation, if not from the build-up of metabolites then from competitive interaction (Haque *et al*., 1994). The FCR values of T_{-1} are significantly lower than those T_2 and T_3, respectively. The FCR values reported are lower than the values reported by Das and Ray (1989), Islam (2002), De Silva and Davy (1992) stated that digestibility plays an important role in lowering the FCR value by efficient utilization of food. Digestibility, in turn, depends on daily feeding rate, frequency of feeding, and type of food used (Chiu *et al*., 1987; Narejo *et al*. 2002). However the lower FCR value in the present study indicates better food utilization efficiency, despite the values increased with increasing stocking densities. Fishes of *M. cuchia* had significantly higher survival in T_1, where, the stocking density was lower than T_2 and T_3. The reason for reduced survival rate in these treatments was due to higher stocking density as well as competition for food and space in the experimental ponds. Similar results were obtained by Brett, (1979), Threpathi *et al*. (1979), Haque *et al*. (1994), Chakraborty (2016) and Chakraborty *et al*. (2010, 2017) for various carp, barb and mud eel species.

In the present study, a significant higher production was recorded in pond stocked with 7410 fingerlings ha^{-1} than those of from the ponds stocked with 9880 and 12350 fingerlings ha^{-1}, respectively. Despite this, consistently higher net benefits were obtained from ponds stocked with 7410 fingerlings ha^{-1} than those from 9880 and 12350 fingerlings ha^{-1}. The higher market price of the larger size produced in ponds with 7410 fingerlings ha^{-1}, substantially increased the net benefit compared to smaller size that produced in other ponds with higher stocking densities. Overall, highest growth, survival and benefits of *M. cuchia* were obtained at a density of 7410 fingerlings ha^{-1}. Growth of fish to a greater extent depended on the quality and quantity of food available. In the present study, the amount of supplementary feeds given in different treatments was based on the number of individual stocked and amount of feed provided per fish was kept at the same level. Hence, the observed low growth at higher stocking densities could be due to less availability of natural food and some variations in environmental parameters (Chakraborty, 2017; Chakraborty *et al*., 2010). The results in the present experiment are very similar to those of Hossain (2001), Chakraborty 2016 and Chakraborty *et al*. (2003, 2006, 2010, 2017).

Finally, it can be concluded that the survival, growth, production of *M. cuchia* fish were inversely related to the stocking densities of fingerlings. Stocking density of 7410 fingerlings/ha may be advisable for rearing of *M. cuchia* fish for 240 days in semi intensive culture system. This technology is helpful to prevent the fish from being extinct and this value added fish will be available and an opportunity to export the fish to earn foreign currency. Therefore, present study has been undertaken to develop a sustainable culture method of cuchia technology through habitat restoration in all over of Bangladesh.

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