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Parvez Chowdhury

Bangladesh Fisheries Research
Institute, Headquarters,
Mymensingh, Bangladesh

Yahia Mahmud

Bangladesh Fisheries Research
Institute, Headquarters,
Mymensingh, Bangladesh

Durin Akhter Jahan

Bangladesh Fisheries Research
Institute, Headquarters,
Mymensingh, Bangladesh

Corresponding Author:

Parvez Chowdhury

Bangladesh Fisheries Research
Institute, Headquarters,
Mymensingh, Bangladesh

Freshwater mud eel (*Monopterus cuchia*) culture with supplementary feed at on-farm management

Parvez Chowdhury, Yahia Mahmud and Durin Akhter Jahan

Abstract

An experiment was conducted to demonstrate the culture of freshwater mud eel (*Monopterus cuchia*) with supplementary feed in five locations under on-farm management practices for a period of 5 months. Three ponds under each location (Upazilla, Sub-district unit) were selected for this experiment. Baby eel having weight of 50-70g were stocked in ponds at a stocking density of 10/m². Liming (CaO) was done in all the ponds at rate of 250kg/ha. A safety shelter for cuchia was developed by installing bamboo root, plastic and bamboo-made hollow pipe, aquatic vegetation and necessary objects in the pond. All physico-chemical parameters were found to be within the acceptable ranges for fish culture in all ponds. Supplementary feed composed of fish paste (50%), fish meal (40%), rice bran (5%) and wheat flour (5%) was applied at the rate of 2-3% of body weight. After five months of culture, cuchia gained weight of 165-176, 157-171, 163-170 and 160-174g from ponds in Mymensingh Sadar, Haluaghat, Jhinaigati and Nasirnagar upazilla, respectively. The net profit obtained culture of cuchia from Mymensingh Sadar, Haluaghat, Jhinaigati and Nasirnagar upazilla were Tk. 9,456-11,472; 8,302-11,102; 9,562-11,002 and 8,908-10,060, respectively which was encouraging. Among the Upazillas highest net benefit was observed in Mymensingh sadar and lowest net benefit was found in Haluaghat Upazilla.

Keywords: freshwater mud eel, culture, supplementary feed, water quality

1. Introduction

Fisheries sector plays important roles in national economy, nutrition, income generation, employment and foreign exchange earnings of Bangladesh. Most of the people of our country have been suffering from malnutrition due to shortage of animal protein in their daily diet. This protein problem can be minimized by increasing the fish production through modern and scientific fish culture and management practice. Modern fish culture means improvement of culture practices through adopting different measures such as proper doses of fertilizer application, regular feeding, optimum stocking density, maintenance of the various limnological factors, prevention of diseases and various control measures. Scientific cultural techniques and management practices are not properly followed in our country. At the same time, due to land requirement of increased people for housing, market extension, road, offices etc. the water resources are declining year after year. Therefore, to make protein easily available to the people, it is essential to increase the pond fish production in Bangladesh. However, government and non-government organizations have been exerting efforts and allocation of resources for production-oriented research and also initiation and encouraging the rural people to improve pond fish culture techniques and methods. Besides fish and shrimp, we have large varieties of non-conventional aquatic organisms those have immense potentialities for nutrition security and export earnings. Non-conventional aquatic organisms such as mud eel, snail, mollusk, turtle etc. of our inland water bodies could be brought under culture system. Farming of eel exists in many Asian countries including Japan, Taiwan, Thailand and Viet Nam. Snail, mollusk, eel and turtle are traditionally consumed by minority and tribal communities in the country and have large export potentialities.

Monopterus cuchia is a freshwater fish species commonly known as mud eel, swamp eel, cuche or cuchia. It is looks like snake and smooth slimy scale less skin. They do not have pectoral, pelvic and dorsal fin. The dorsal and anal fins are fused caudal or tail fins forming a single ribbon along the whole length of the fish. The gills of *M. cuchia* are reduced and the fish has a pair of air breathing organ in the form of a sac two sides of the head^[11]. Mud eel is native to sub-tropical and tropical Asia and is widely distributed in Bangladesh, Pakistan,

Myanmar, Nepal and India^[9]. It is a tasty fish and popular among ethnic people of Indian subcontinent. This fish is normally found in muddy ponds, swamps and rice fields and often spends the day hiding under crevices, water hyacinth, stones and mud^[13]. Cuchia is highly carnivorous and nocturnal as it comes out at night in search of food and may go into adjacent water bodies to feed. In nature, cuchia feed on live small fishes, preferably small fish, aquatic insects, invertebrates, worms, snail and tadpoles. Eels are considered as natural pesticides and fertilizers for crops and are necessary for ecological balance. Eel traditionally consumed by minority and tribal communities in the country and have large export potentialities.

Cuchia is nutritionally rich and medicinally valuable fish which could play a important role for welfare of the human body. It contains high protein and omega-3 fatty acids. The caloric value of eel flesh is reported to be as high as 303 kcal^[8]. Eel is beneficial for human health due to preventing heart diseases, development of human brain, reducing kidney disease and high blood pressure. The tribal people belonging to the Monipuri, Garo, Hajong, Shaotal and Rajbongshi communities believes this fish to be therapeutic one and traditionally use for treatment of various ailments, Viz. anemia, weakness, rheumatic fever and diabetes. However, presently the population of the freshwater eel is declining at an alarming rate from natural water bodies due to several reasons, especially for overfishing while increasing the population of this fish completely depends on natural reproduction and thus this fish are recorded as endangered in natural habitats. International union for conservation of nature (IUCN)^[7] has entitled *M. cuchia* in their red list of threatened fishes of Bangladesh as a vulnerable taxon. To overcome this situation, research on culture technique of cuchia in farmer's level is necessary to ensure its conservation and rehabilitation. In Bangladesh, this mud eel is now considered as an export fishery item which is playing significant role in export earnings. The mud eel has a great demand in the Asian due its medicinal value and maximum freshwater eel is being exported from Sylhet division of Bangladesh^[11]. Bangladesh has earned 10.5 million US dollar by exporting 70.0175 ton cuchia in 2018-19 year. Considering the above circumstances, the present study was undertaken to know growth and production of cuchia with supplementary feed in different locations at farmer's ponds.

2. Materials and Methods

2.1 Experimental sites

The experiment was carried out in 12 ponds from Mymensingh Sadar and Haluaghat (Mymensingh district), Jhinaigati (Sherpur district) and Nasirnagar (Brahmanbaria district) upazillas of central region of Bangladesh. The duration of the experiment was 5 months from February to June 2018.

2.2 Preparation of pond

Twelve earthen ponds of about 1-5 decimal (1 dec.= 40 m²) area each and rectangular in shape, were used for the experiment. The ponds each have an average depth of half meter. The ponds were rain fed and provision for water supply from underground using flexible plastic pipes whenever needed. The pond embankment was well protected and covered with grass. For the preparation of pond, half meter bottom soil was removed from each pond and then filter nets were placed in the bottom to prevent the escaping of mud

eel. After setting the filter net, removed soil was further placed on the filter net and compost fertilizer was used on the pond bottom (fig-1). Liming (CaO) was done in all the ponds at rate of 250kg/ha. A safety shelter for cuchia was developed by installing bamboo root, plastic and bamboo-made hollow pipe, aquatic vegetation and necessary objects in the pond. To prevent the entry of unwanted animals, net fencing was set on the dyke of each pond.



Fig 1: Pond preparation of eel culture

2.3 Supply of water

Ponds were supplied with water after 7 days of liming and fertilization from a deep tube-well water supply system.

2.4 Stocking of fish

Baby eel (50-70 g) collected from natural source were stocked in all the ponds at the stocking density of 10/m².

2.5 Feeding of mud eel

After stocking, supplementary feed as well as live feed was applied to the stocked eel at the rate of 2-3% of estimated body weight. Supplementary feed was prepared by fish paste (50%), fish meal (40%), rice bran (5%) and flour (5%). Cuchia is nocturnal fish that why feed were supplied in ponds at the time of sunset. We supplied feed in the pond regularly at the same time and at the place of ponds.

2.6 Study of water quality parameters

Physico-chemical parameters of pond water were monitored weekly between 09.00 and 10.00 h. The procedures and methods followed to study water quality parameters have been given below.

2.6.1 Temperature (°C)

Temperature of water was measured by a portable digital water analyzer (HQ 40d) and data was recorded carefully.

2.6.2 Dissolved oxygen (mg/L)

Dissolved oxygen of water was measured by a portable digital dissolved oxygen (DO) meter (model: DO5509, Lutron, made in Taiwan).

2.6.3 pH (Hydrogen-ion concentration)

pH was determined by a portable digital pH meter (Hanna Instruments, Italy, model-H 196107).

2.6.4 Total alkalinity (mg/L)

To determine total alkalinity, samples were collected in 250 ml black plastic bottles and total alkalinity of water samples was determined by titrimetric method using methyl orange indicator.

2.6.5 Ammonia-nitrogen (mg/L)

Ammonia-nitrogen was determined by a digital Nitrate Meter (model HI 93728, Hanna Instruments).

2.7 Sampling of fish

M. cuchia was sampled fortnightly by using plastic and bamboo made pipe in the ponds. Weight (g) of *cuchia* was measured separately to assess the growth condition. Weight was measured by a portable sensitive balance Model KD-160.

2.8 Harvesting of eel

At the end of the experiment the ponds were drained out and all the fish were harvested by hand picking. The harvested fishes were counted and weight to determine the survival rate and production, respectively.

2.9 Statistical analysis

T-test of net fish production of the ponds under three treatments was done by a computer using SPSS package programme.

3. Results

During the experiment, results of the regarding the growth performance, survival rate, fish biomass, water quality parameter and all other aspects as recorded are presented below.

3.1 Water quality parameters

The results of the different physico-chemical parameters of the experimental ponds have been presented in the Table 1. All physico-chemical parameters were found to be within the acceptable ranges for fish culture in all treatments.

Table 1: Water quality parameters (Mean±SD) in demonstration ponds.

Upazillas	Pond no.	Parameters				
		Dissolved oxygen (mg/l)	pH	Temperature (°C)	Ammonia-nitrogen (mg/l)	Total alkalinity (mg/l)
Mymensingh Sadar	Pond-1	5.27±2.77	6.70±1.87	22.2±2.77	0.11±1.57	120±0.65
	Pond-2	6.26±1.07	7.02±2.21	23.7±4.97	0.01±3.09	131±5.77
	Pond-3	5.99±2.77	5.78±2.07	23.3±0.57	0.03±2.79	118±2.85
Haluaghat	Pond-1	5.67±7.34	5.51±2.77	25.3±2.77	0.05±0.47	121±2.17
	Pond-2	5.90±1.77	5.93±0.61	25.3±2.77	0.01±2.77	112±0.77
	Pond-3	5.83±2.07	6.50±2.57	24.9±1.98	0.01±3.96	138±2.67
Nasirnagar	Pond-1	6.35±3.54	7.45±5.37	26.2±1.77	0.07±0.77	126±2.07
	Pond-2	5.95±0.97	6.95±4.07	26.0±2.77	0.01±2.55	146±6.37
	Pond-3	5.87±3.76	7.05±2.77	25.2±3.94	0.02±2.77	138±2.09
Jhinaigati	Pond-1	5.65±0.57	6.57±2.37	25.5±2.77	0.03±3.65	108±2.11
	Pond-2	4.45±2.47	6.35±2.77	27.2±5.32	0.01±2.66	129±6.22
	Pond-3	4.29±1.27	6.06±0.07	26.5±0.87	0.04±2.57	128±4.87

3.2 Survival rate, growth and production of fish

Details of growth, production, survival and net benefit performances in twelve ponds are presented in Table 2.

3.2.1 Survival rate

The survival rate of *cuchia* species in twelve ponds was fairly high. The main factor that may have attributed to the high survival was proper stocking of healthy seed stocked, favorable ecological conditions and proper feeding etc. The survival rates (%) of fish were different in different locations. The survival rates in *cuchia* in Mymensingh Sadar, Haluaghat, Jhinaigati and Nasirnagar upazillas were 89-94, 88-92, 89-93

and 88-94%, respectively (Table 2).

3.2.2 Growth and production of fishes

The productions of fish were different in different location. After five months culture, the harvesting weight of *cuchia* in Mymensingh Sadar, Haluaghat, Jhinaigati and Nasirnagar upazillas were 165-176, 157-171, 160-174 and 163-170g, respectively (fig-2). The total production (kg/dec) of *cuchia* in ponds from Mymensingh Sadar, Haluaghat, Jhinaigati and Nasirnagar upazillas were 62.67±4.61; 59.50±2.11; 60.37±0.61 and 61.77±4.41, respectively (Table 2).

Table 2: Pond area, growth, production, survival and net benefit of *cuchia* during February to June 2018

Upazillas	Pond no.	Pond area (dec)	Harvesting weight (g)	Total production (kg/dec)	Survival rate (%)	Net profit (Tk*/dec)
Mymensingh Sadar	Pond-1	4.5	168±2.77	61.6±9.09	89	9,543
	Pond-2	4.5	176±0.65	66.0±3.47	94	11,472
	Pond-3	2.5	165±1.08	60.4±4.23	91	9,456
Haluaghat	Pond-1	2.0	163±0.71	57.0±6.07	88	8,482
	Pond-2	2.5	171±1.73	65.0±4.56	92	11,102
	Pond-3	4.5	157±2.67	56.5±7.45	90	8,302
Nasirnagar	Pond-1	5.0	163±1.56	58.6±0.77	90	8,908
	Pond-2	5.0	166±2.09	61.8±8.06	93	10,060
	Pond-3	1.5	170±1.12	60.7±3.29	89	9,418
Jhinaigati	Pond-1	2.0	174±0.50	64.0±1.66	92	11,002
	Pond-2	2.0	160±2.42	60.0±2.43	94	9,562
	Pond-3	1.5	170±1.02	61.3±6.57	88	10,547

*(1 US\$ = Tk. 85)

The net profit gained from experimental trials of *cuchia* in ponds of Mymensingh Sadar, Haluaghat, Jhinaigati and Nasirnagar upazillas were TK 9,456-11,472; 8,302-11,102;

9,562-11,002 and 8,908-10,060, respectively. Among the upazillas highest net benefit was observed in mymensingh sadar and lowest net benefit was found in haluaghat upazilla.



Fig 2: Production of cuchia fish in farmer's pond

4. Discussion

The present experiment was conducted to demonstrate the culture of mud eel (*M. cuchia*) with supplementary feed in on-farm condition in different location of Bangladesh.

4.1.1 Water temperature (°C)

The mean values of temperature recorded in the ponds of present experiment were 23.06 ± 3.44 , 25.16 ± 2.09 , 25.80 ± 2.85 and 26.41 ± 5.43 °C, respectively from Mymensingh Sadar, Haluaghat, Nasirnagar and Jhinaigati upazillas. Ali (1998) [1] stated that water temperature of ponds remain 20.20 to 36.50°C which was favorable to fish culture. Begum *et al.* (2018) [3], Majumder (2017) [10] found more or less similar results. In the present experiment the mean dissolved oxygen values were within suitable range.

4.1.2 Dissolved oxygen (mg/L)

The average dissolved oxygen of ponds was 5.84 ± 1.12 , 5.80 ± 0.98 , 6.05 ± 2.02 and 4.79 ± 0.22 mg/l, respectively in ponds of Mymensingh Sadar, Haluaghat, Nasirnagar and Jhinaigati Upazillas. Ellis *et al.* (1946) [6] reported that the dissolved oxygen content at levels of 3 ppm or less should be regarded as hazardous to lethal and that of 5 ppm or more is suitable for fish production. In the present experiment the mean dissolved oxygen values were within suitable range.

4.1.3 pH (hydrogen ion concentration)

The mean values of pH recorded in the ponds of present experiment were 6.29 ± 0.15 , 5.98 ± 3.09 , 7.15 ± 0.29 and 6.33 ± 1.18 , respectively from Mymensingh Sadar, Haluaghat, Nasirnagar and Jhinaigati Upazillas. Chakraborty *et al.* (2010) [5] found the level of pH vary from 5.50 to 7.20 mg/L in three experimental cuchia culture ponds in Jhinaigati Upazila under Sherpur district. Swingle (1967) [13] stated that pH 6.5 to 9.0 is suitable for pond fish culture.

4.1.4 Nitrate-nitrogen (NO₃-N) (mg/L)

Ammonia-nitrogen is toxic to fish and above a certain level it can cause fish mortality. The mean values of ammonia-nitrogen were 0.05 ± 3.44 , 0.02 ± 2.09 , 0.03 ± 2.85 and 0.02 ± 0.43 mg/L in the ponds under study, respectively from Mymensingh Sadar, Haluaghat, Nasirnagar and Jhinaigati upazillas. Kohinoor *et al.* (2016) [9] recorded ammonia-nitrogen values ranged from 0.05-0.85 mg/l in a study of climbing perch in farmer's pond.

4.1.5 Total alkalinity (mg/L)

The mean values of total alkalinity in the present experimental ponds from Mymensingh Sadar, Haluaghat, Nasirnagar and Jhinaigati upazillas were 123 ± 12.61 , 120 ± 5.34 , 136 ± 1.54 and 121 ± 4.57 mg/l respectively. Boyd (1990) [2] stated that total alkalinity of productive ponds should be 20 ppm or more and fish production increases with

the increase of total alkalinity.

4.1.6 Survival rate (%)

The survival rates in cuchia in Mymensingh Sadar, Haluaghat, Jhinaigati and Nasirnagar upazillas were 89-94, 88-92, 89-93 and 88-94%, respectively. Chakraborty *et al.* (2010) [5] found the level of survival rate vary from 86 to 91% in three experimental cuchia culture ponds in Jhinaigati Upazila under Sherpur district.

4.1.7 Production of fish

In the present experiment, the harvesting weight of cuchia in ponds of Mymensingh Sadar, Haluaghat, Jhinaigati and Nasirnagar upazillas were 165-176, 157-171, 163-170 and 160-174 g, respectively. The total production (kg/dec) of cuchia in ponds from Mymensingh Sadar, Haluaghat, Jhinaigati and Nasirnagar upazillas were 62.67 ± 4.61 ; 59.50 ± 2.11 ; 60.37 ± 0.61 and 61.77 ± 4.41 , respectively. Begum *et al.* (2018) [3] observed More or less similar results in different experiment revealed similar findings.

The net profit gained from the demonstrations of cuchia farming in different upazillas was more or less similar with on-station results of Bangladesh Fisheries Research Institute observation. Among the Upazillas highest net benefit was observed in Mymensingh sadar and lowest net benefit was found in Haluaghat Upazilla.

5. Conclusions

The freshwater mud eel have great economic and food value in the different part of the world and due to reducing this fish from nature by various reasons, so now time comes to develop culture practice of cuchia at farmer's level. Hence, successful culture of cuchia is important for cuchia production which is already observed in this experiment. Mass seed production and conservation through proper culture management are recommended to save this endangered species from being extinction.

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