



## Evaluation Trial on Production Performance of Freshwater Mud Eel (*Monopterus albus*) in Farmer's Pond

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### Authors' contributions

This work was carried out in collaboration among all authors. Author PC designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AFMS and AB managed the analyses of the study. Author AB managed the literature searches. All authors read and approved the final manuscript.

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### ABSTRACT

The experiment was conducted to evaluate the production performance of freshwater mud eel (*Monopterus albus*) with supplementary feed for a period of 5 months in field level. Two ponds were selected for this experiment in Maulovibazar district. Baby eel having weight of 50-70 g were stocked in ponds at a stocking density of 10/m<sup>2</sup> in filter net. Liming (CaO) was done in all the ponds at rate of 250 kg/ha. A safety shelter for eel was developed by installing bamboo root, plastic and bamboo-made hollow pipe, aquatic vegetation and necessary objects in the pond. Different physico-chemical parameters were found to be within the acceptable ranges for *M. albus* 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 5 months of rearing, total production obtained were 28.3±1.09 and 31.9±2.56 kg from pond-1 and pond-2, respectively. The highest production was obtained from pond-2 and lowest production was obtained in pond-1. The net profit gained from pond-1 and pond-2 were tk 2559 and 3211 per decimal, respectively.

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## 1. INTRODUCTION

Bangladesh is situated in the tropical region of the world and the climatic condition of Bangladesh is very much suitable for fisheries. Fisheries sector plays a significant role in socio-economic development, employment generation, poverty alleviation, nutrition supply and earning of foreign exchange. Fish is considered as one of the most delicious and essential food item all over the world. It also contains protein, lipid and vitamins. Human beings need to eat 22.4 kg of fish per year. Fish contribute a large amount of animal protein to the diets of people in Bangladesh, about 62.58% of which comes from aquatic animals (DoF, 2019).

Bangladesh is blessed with vast water resources which include inland waters and marine water resources. Inland waters may be classified as inland open water and inland closed water resources. Inland waters include haors, baors, beels, rivers, canals and ponds. Bangladesh also has extensive marine water resources. Inland water resources of Bangladesh are considered to be one of the richest in the world both in area and potential for fisheries development. But at present the situation has changed due to environmental degradation, pollution, extensive fishing pressure on natural water bodies and use of banned fishing gear. For this reason to meet up the growing demand of aquaculture has the greatest potential in Bangladesh. Pond aquaculture in Bangladesh is expanding very fast. Currently aquaculture production accounts for about one third of the total fish production in Bangladesh). To increase the production of fish, species selection is very important.

Cuchia or scientifically *Monopterusuchia* is a freshwater species of eels available in Bangladesh which english name is mud eel had resulted from its innate nature of hiding itself under mud, but it is locally and popularly known as cuchia or cuche. Though its external appearance is like a snake, actually it doesn't commensurate with any feature of a snake. Body color of cuchia is greenish or a chest-nut brown, becoming lighter on abdomen with numerous black spot on body (Talwar and Jhingran, 1991). It is typically found in the shallow area of freshwater resources like Haors, Baors, any Beels, Floodplains, Canal as well as small ponds, lakes and ditches. It is a delicious

food among tribal and village people of Bangladesh. However, this species of eel is declining day by day due to sundry reasons exclusively for over-exploitation and climate change.

*M. cuchia* is nutritionally rich and medicinally valuable fish and could play an 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 [1]. Eel is beneficial for human health due to preventing heart diseases, development of human brain, reducing kidney disease and high blood pressure [2]. The tribal people belonging to the Garo, Monipuri, Hajong, Shaotal, khashia 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) [3] 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 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 [4]. Bangladesh has earned 10.5 million US dollar by exporting 70.0175 ton *M. cuchia* in 2018-19 year. Considering the above issues, the present experiment was undertaken to obtain growth and production of mud eel in farmer's ponds.

## 2. METHODOLOGY

### 2.1 Experimental Sites

This experiment was executed in two ponds of farmers at Kamolganj upazila (sub district unit) under Moulvibazar district of Bangladesh for five month rearing period from March to July 2019.

## 2.2 Preparation of Pond

Rectangular shape two earthen ponds were used for this evaluation trial. The ponds each have an average depth of half meter. 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 (22 m<sup>2</sup>) and compost fertilizer was used on the pond bottom (Fig. 1). Liming (CaO) was done in all the ponds at rate of 250 kg/ha. A safety shelter for cuchia was developed by setting 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 (Parvez et al 2019).

## 2.3 Supply of Water

Ponds were supplied with water after 7 days of liming from a deep tube-well water supply system; rainfall was also a source of water supply to the ponds.

## 2.4 Stocking of Fish

Baby cuchia having weight of 50-70 g were stocked in ponds at a stocking density of 10/m<sup>2</sup> in filter net which was set in pond.

## 2.5 Feeding of Mud Eel

After stocking, supplementary 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%). Feed were supplied in ponds at the time of sunset.

## 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).



Fig. 1. Net preparation of eel culture in pond

## 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.

### 3.2 Survival Rate, Growth and Production of Fish

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

#### 3.2.1 Survival rate

The survival rate of *cuchia* species in two 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 in *cuchia* in pond-1 and pond-2 were 84 and 88%, respectively (Table 2).

#### 3.2.2 Growth and production of fishes

The productions of fish were different in different location. After five month culture, the harvesting weight of *cuchia* in pond-1 and pond-2 were  $242 \pm 2.77$  and  $258 \pm 1.73$  g, respectively (Fig. 2). The total production (kg) of *cuchia* in ponds from pond-1 and pond-2 were  $28.3 \pm 1.09$  and  $31.9 \pm 2.56$ , respectively (Table 2).

## 4. DISCUSSION

The present experiment was conducted to examine the production performance of mud eel (*M. cuchia*) with supplementary feed in different location of Bangladesh.

**Table 1. Water quality parameters (Mean $\pm$ SD) in demonstration ponds**

Parameter	Pond-1	Pond-2
Temperature ( $^{\circ}$ C)	29.15 $\pm$ 2.59	29.40 $\pm$ 1.44
Dissolved oxygen (mg/L)	5.44 $\pm$ 2.37	4.17 $\pm$ 1.23
pH	7.13 $\pm$ 0.81	7.39 $\pm$ 4.13
Ammonia-nitrogen (mg/L)	0.01 $\pm$ 3.06	0.01 $\pm$ 1.78
Total Alkalinity (mg/L)	133.27 $\pm$ 21.13	150.31 $\pm$ 13.67

**Table 2. Pond area, growth, production, survival and net benefit of *cuchia* during March to July 2019**

Pond no.	Stocking density /m <sup>2</sup>	Pond area (Dec)	Net size (m <sup>2</sup> )	Harvesting weight (g)	Total production (kg)	Survival rate (%)	Net benefit / Dec(BDT*)
Pond-1	10	2.5	22	242 $\pm$ 2.77	28.3 $\pm$ 1.09	84	2959
Pond-2	10	3.5	22	258 $\pm$ 1.73	31.9 $\pm$ 2.56	88	3211

\*(1 US\$ = BDT. 85)



**Fig. 2. Production of cuchia fish in farmer's pond**

#### **4.1 Water Temperature (°C)**

The mean values of temperature recorded in the pond 1 and pond 2 of present experiment were  $29.15 \pm 2.59$  and  $29.40 \pm 1.44$  °C, respectively. Ali [5] stated that water temperature of ponds remain  $20.20$  to  $36.50$  °C which was favorable to fish culture. Chowdhury et al, 2019 found the level of temperature vary from  $22.2$  to  $27.2$  °C in twelve experimental cuchia culture ponds in Bangladesh. Begum et al. [6], Majumder [7] found more or less similar results. In the present experiment the mean dissolved oxygen values were within suitable range.

#### **4.2 Dissolved Oxygen (mg/L)**

The mean values of dissolved oxygen recorded in the pond 1 and pond 2 of present experiment were  $5.44 \pm 2.37$  and  $4.17 \pm 1.23$  mg/l, respectively. Chowdhury et al. [8] found the average dissolved oxygen of *M. cuchia* culture ponds were  $5.84 \pm 1.12$ ,  $5.80 \pm 0.98$ ,  $6.05 \pm 2.02$  and  $4.79 \pm 0.22$  mg/l, respectively in ponds of Mymensingh Sadar, Haluaghat, Nasirnagar and Jhinaigati Upazillas. Ellis et al. [9] 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.

#### **4.3 pH (Hydrogen Ion Concentration)**

The mean values of pH recorded in the pond 1 and pond 2 of present experiment were  $7.13 \pm 0.81$  and  $7.39 \pm 4.13$ , respectively. Chowdhury et al. 2019 found the mean values of pH in the *M. cuchia* culture ponds of were  $6.29 \pm 0.15$ ,  $5.98 \pm 3.09$ ,  $7.15 \pm 0.29$  and  $6.33 \pm 1.18$ , respectively from Mymensingh Sadar, Haluaghat,

Nasirnagar and Jhinaigati Upazillas. Chakraborty et al. [10] 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 [11] stated that pH 6.5 to 9.0 is suitable for pond fish culture.

#### **4.4 Ammonia-nitrogen (mg/L)**

Ammonia-nitrogen is toxic to fish and above a certain level it can cause fish mortality. The mean values of nitrate-nitrogen (mg/L) recorded in the pond 1 and pond 2 of present experiment was  $0.01 \pm 3.06$  and  $0.01 \pm 1.78$  mg/L, respectively. Chowdhury et. al 2019 found the mean values of ammonia-nitrogen were  $0.05 \pm 3.44$ ,  $0.02 \pm 2.09$ ,  $0.03 \pm 2.85$  and  $0.02 \pm 0.43$  °C in *M. cuchia* culture the ponds, respectively from Mymensingh Sadar, Haluaghat, Nasirnagar and Jhinaigati upazillas.

#### **4.5 Total Alkalinity (mg/L)**

The mean values of total alkalinity in the pond 1 and pond 2 of present experiment were  $133.27 \pm 21.13$  and  $150.31 \pm 13.67$  mg/L, respectively. Chowdhury et al. [8] found the mean values of total alkalinity in the cuchia culture ponds from Mymensingh Sadar, Haluaghat, Nasirnagar and Jhinaigati upazillas were  $123 \pm 2.61$ ,  $120 \pm 5.34$ ,  $136 \pm 1.54$  and  $121 \pm 4.57$  mg/L, respectively. Boyd [12] stated that total alkalinity of productive ponds should be 20 ppm or more and fish production increases with the increase of total alkalinity.

#### **4.6 Survival Rate (%)**

The survival rates in cuchia in pond-1 and pond-2 were 84 and 88%, respectively. Chakraborty et al. [10] found the level of survival rate vary from 86 to 91% in three experimental cuchia culture ponds in Jhinaigati Upazila under Sherpur

district. Chowdhury et al. 2019 found the level of survival rate vary from 88-94% in twelve experimental *M. cuchia* culture ponds.

#### 4.7 Production of Fish

The total production of *M. cuchia* in pond 1 and pond 2 were 28.3±1.09 and 31.9±2.56 kg, respectively. Chowdhury et al. 2019 found the total production (kg/dec) of *M. 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. [6] observed More or less similar results in different experiment revealed similar findings. The net profit gained from the demonstrations of *M. cuchia* farming in kamolganj upazillas was more or less similar with on-station results of Bangladesh Fisheries Research Institute observation.

#### 5. CONCLUSIONS

The freshwater mud eel is very much important species in terms of our national economy and food value in the different part of the world and due to reducing this fish from natural waterbody by various reasons, so now time comes to develop culture system of *M. cuchia* at farmer's level. Hence, successful culture technique of *M. cuchia* is vital issue for increasing *M. cuchia* production in farmer's level which is observed in this trial. Mass seed production and conservation through proper culture management are recommended saving this endangered species from being extinction.

#### ETHICAL APPROVAL

As per international standard or university standard ethical approval has been collected and preserved by the author(s).

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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