



e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes



ORIGINAL RESEARCH ARTICLE



## Growth and production performance of Mud Eel, *Monopterusuchia* (Hamilton, 1822) using different types of feed in the Northern region of Bangladesh

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### ARTICLE HISTORY

Received: 09 October 2022

Revised received: 15 November 2022

Accepted: 12 December 2022

### Keywords

Bangladesh

Different feeds effect

Growth

*Monopterusuchia*

Survival rate

### ABSTRACT

The experiment was conducted to assess the growth and production performance of freshwater Mud Eel (*Monopterusuchia*) using different types of feed in nine earthen ponds in Bogura and Naogaon district of Bangladesh over a period of 180 days from 01 July, 2020 to 31 December, 2021. Three different treatments having three replicates each [T<sub>1</sub>{Live fish spawn (60%), Vermi compost (40%)}, T<sub>2</sub>{Live fish spawn (40%), Fish paste (60%)} and T<sub>3</sub>{Vermi compost (40%), fish paste (40%), Rice bran (10%) and Wheat flour (10%)}] were used where significantly higher ( $P < 0.05$ ) gross production and low FCR were recorded in T<sub>1</sub> treatment. Juvenile *cuchia* were stocked @ 400 nos/dec in each treatment having mean initial body weight of 25 g and mean initial body length of 20 cm where highest weight gain of 130.09±1.79 g was found in T<sub>1</sub> ( $p < 0.05$ ), followed by the T<sub>2</sub> (112.89±1.51 g) and T<sub>3</sub> (95.02±0.16 g). Survival rate (82.11±2.21%) and specific growth rate (1.01± 0.02 % day<sup>-1</sup>) were also found to be highest in T<sub>1</sub> compared to the T<sub>2</sub> and T<sub>3</sub>. Feed were applied twice a day up to satiation level using feeding tray to check feeding performance of fish. Water quality parameters like temperature, dissolved oxygen, pH and alkalinity were in the optimum range for fish culture. Results from the present study clearly indicate that live fish spawn and vermi compost is suitable for the grow-out culture of *M. cuchia* in earthen ponds for its better growth, survival rate and production.

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**Citation of this article:** Das, D. R., Dey, S. K., Mithun, M. H., Moniruzzaman, M., Rahman, M. K., & Mahmud, Y. (2022). Growth and production performance of Mud Eel, *Monopterusuchia* (Hamilton, 1822) using different types of feed in the Northern region of Bangladesh. *Archives of Agriculture and Environmental Science*, 7(4), 509-513, https://dx.doi.org/10.26832/24566632.2022.070404

### INTRODUCTION

*Monopterusuchia* is (commonly known as mud eel, swamp mud eel) a fresh water air breathing fish locally known as Cuchia or Kucha belonging to the family Synbranchidae of the order synbranchiformes. It is one of the most delicious fish species having nutritional and medicinal values with high market demand in the international market. Bangladesh has earned 14.26 million US dollar by exporting *M. cuchia* in 2021-22 year (EPB, 2021-22). The fresh blood of this fish has high demand and popularity among the ethnic people of Bangladesh which can cure anemia,

weakness and asthma of human being as well as piles and diabetes (Saikia and Ahmed, 2012). Four species of eel, *Monopterusuchia*, *Anguila bengalensis*, *Pisodonophis boro* and *Pisodonophis cancrivorus* are available in Bangladesh among which *M. cuchia* is widely distributed and have economic importance. The geographic distribution of this species is in Bangladesh, India, Nepal, Pakistan and Myanmar etc. (Mirza and Alam, 2002; Menon, 1999; Talwar and Jhingran, 1991). According to IUCN Red List (2015), it is enlisted as vulnerable fish species in Bangladesh (IUCN, 2015). The main causes of its vulnerability are habitat degradation, water pollution, degradation of breeding

and feeding grounds, construction of dams in the floodplain areas, and use of insecticides and pesticides in the agriculture field (Rahman, 2005; Begum et al., 2017). The population of species is declining at an alarming rate due to several reasons, especially for indiscriminate harvesting from the natural water bodies while increasing the stock of this fish is completely depends on natural propagation (Rahman et al., 2018). Every year naturally collected mud eel is being exported to South East Asia and different countries of the world from Bangladesh which creates a huge pressure on natural stock of this species. The cost of freshwater eel culture is low compared to other fish culture because it does not require large water bodies and expensive formulated feed (Narejo et al., 2015). It is very hardy and pollution resistant fish which can be profitably raised with aquatic crops like swamp cabbage (Miah et al., 2015) As very few technologies for commercial culture and production of this fish is developed in Bangladesh while supply demand is increasing day by day, therefore, it is necessary to develop a scientific eel culture system. It is time to think about expanding freshwater eel fisheries and develop new technologies to increase its production for capture the world market. Therefore, considering the high export and nutritional value of *M. cuchia*, this research have been carried out to observed the growth and production of this species using different types of feed in the northern region of Bangladesh which may create a new dimension for the people involved in fisheries sector.

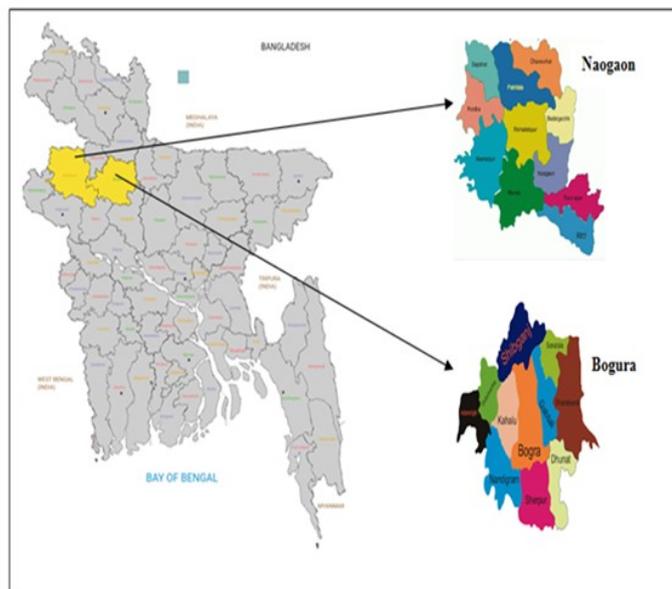


Figure 1. Experimental site.

Table 1. Experimental design.

Treatment	Feed used	Location	Replication	Stocking density nos/dec
T <sub>1</sub>	Live fish spawn (60%), Vermi compost (40%)	Kahalu, (Bogura)	3	400
T <sub>2</sub>	Live fish spawn (40%), Fish paste (60%)	Raninagor, (Naogaon)		
T <sub>3</sub>	Vermi compost (40%), fish paste (40%), Rice bran (10%) and Wheat flour (10%)	Atrai, (Naogaon)		

Table 2. Feeding chart given in grow out ponds of *M. cuchia* in different treatments.

T <sub>1</sub> (Kahalu)	T <sub>2</sub> (Raninagor)	T <sub>3</sub> (Atrai)
Live fish spawn (60%), Vermi compost (40%)	Live fish spawn (40%), Fish paste (60%)	Vermi compost (40%), fish paste (40%), Rice bran (10%) and Wheat flour (10%)

## MATERIALS AND METHODS

### Experimental sites

The experiment was carried out by Flood plain sub-station, Santahar, Bogura of Bangladesh Fisheries Research Institute in three different upazilla of Kahalu, Raninagar and Atrai in Bogura and Naogaon districts (Figure 1) during the period from 01 July 2020 to 31 December 2021.

### Experimental design

The experiment was designed for three different feeds as treatment and was assigned into a Completely Randomized Design having three replicates each (Table 1). The fish species was a high valued threatened species *M. cuchia*, which is locally known as "cuchia". Each pond of three treatments was stocked with juvenile cuchia at the same rate of 400 nos/dec.

### Pond preparation

For pond preparation, at least two feet bottom soil were removed from all ponds and then filter net was placed in the bottom due to avoid the burrowing habit of Cuchia. Considering the burrowing habit of Cuchia, a layer of clay soil of about 50 cm deep was provided at the bottom of each pond. Ground water was supplied to the pond up to 25 cm depth. After dewatering, each of the pond were treated with lime (CaO) at the rate of 1 kg/dec. After then, ponds were filled with underground water up to 70 cm depth. Cuchia ponds were fertilized with Urea and TSP at the rate of 150 g/dec and 120 g/dec to enhance the production of natural food. Water hyacinth was provided to the ponds for suitable and safe shelter of Cuchia.

### Collection and stocking of fish

The average length of 20 cm and weight of stocked cuchia was 25 g which was collected from the fishermen of Bogura and Naogaon districts in Bangladesh. Juveniles of Cuchia were stocked at a stocking density of 400 Juveniles/dec in all treatment of T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> respectively for culturing of 180 days.

### Feeding of cuchia

After stocking, Cuchia were fed supplementary feed as well as live feed twice a day at the rate of 3-2% body weight. As they are nocturnal feeder, feed were given before sunrise and after sunset daily at the same place of the ponds in feeding tray. Feeding was done up to their satiation level. The formulations of supplementary feed are given in Table 2.

### Monitoring of water quality parameters and fish growth

Physico-chemical parameters of pond water were monitored fortnightly basis between 9.00 and 10.0 am. Water temperature was recorded using a portable Celsius thermometer. Dissolved oxygen, pH, and ammonia were measured directly using a Hanna multi-parameter (YSI, Model 58, USA), Total alkalinity was determined by titrimetric method. Growth parameters of *M. cuchia* were recorded at monthly basis by using measuring scale and portable digital electronic balance (Model FX-300).

### Harvesting of cuchia

After 180 days of culture periods the ponds were dewatered and fish were harvested by hands. To determine the survival rate and production, the harvested fishes were weighted and counted.

### Harvesting and estimation of yield parameters

After 180 days of culture period harvested fish were recorded for estimating different yield parameters as follows:

Survival rate (%) = Number of fish stocked ÷ Number of fish harvested × 100

Specific growth rate (SGR, %day<sup>-1</sup>) = [ln (final weight) – ln (initial weight) × 100]/ No. of days of the experiment

Final weight gain (g) = Final individual weight – Initial individual weight

Average daily gain (ADG, g/day) = (Mean final weight – Mean initial weight) ÷ Culture days

Feed conversion ratio (FCR) = Feed applied (dry weight)/ Live weight gain

Net production (kg/decimal) = Total biomass at harvest – total biomass at stocking

### Statistical analysis

The data were analyzed through one way analysis of variance (Statistix-10) using Tukey HSD All-Pairwise Comparisons Test to find out whether any significant difference existed among treatment means. In all statistical analysis, the difference was considered to be significant when  $P < 0.05$ .

## RESULTS AND DISCUSSION

The physico-chemical parameters such as pH, dissolved oxygen, total ammonia and temperature for different treatment were maintained and recorded fortnightly during the experimental period.

Although the physico-chemical parameters of water showed variations among the treatments during the culture period, but were similar ( $p > 0.05$ ) and noted within the recommended range for the growth performance of cultured fish. The mean temperature, dissolved oxygen, pH, alkalinity, and ammonia among the treatments are presented in (Table 3). The initial weight, final weight, weight gain, average daily weight gain (ADWG), specific growth rate (SGR), survival and gross yield of *Cuchia* are presented in (Table 4). The survival rate of *Cuchia* in the present experiment was found to be 82.11±2.21%, 79.23±1.45%, and 81.30±2.52% in T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub> respectively, with no significant differences among the treatments ( $p > 0.05$ ). The survival rate of *Cuchia* in the present experiment was more or less similar that has been reported by Khan et al. (2021) for the same species reared using different types of feeds with 400 fry/ decimal stocking densities in earthen pond. On the other hand, Miah et al. (2015) reported the survival rate of this species was 92.5% reared in earthen ditches with live fish, which is higher compared to the result of the present findings.

**Table 3.** Mean and range values of water quality parameters during the experimental period of 180 days.

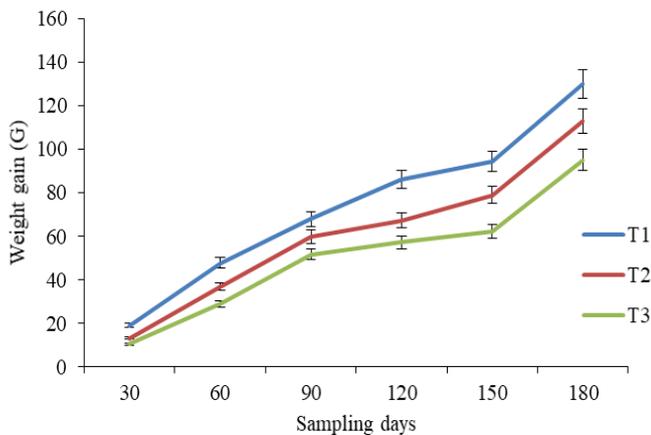
Parameters	Treatment 1	Treatment 2	Treatment 3
	Mean ± SD	Mean ± SD	Mean ± SD
Temperature (°C)	27.12±3.52 a	28.66±4.22 a	27.55±2.63 a
DO (mg/L)	5.31±1.65 a	4.61±1.01 a	6.55±3.33 a
pH	7.6±2.55 a	7.7±2.15 a	7.5±2.15 a
Alkalinity (mg/L)	58.5±2.13 a	62.5±2.75 a	57.6±2.25 a
Ammonia (mg/L)	0.05±0.01 a	0.09±0.02 a	1.01±0.15 a

**Table 4.** Growth and production performance of *M. cuchia* using three different types of feeds during the 180 days of culture period.

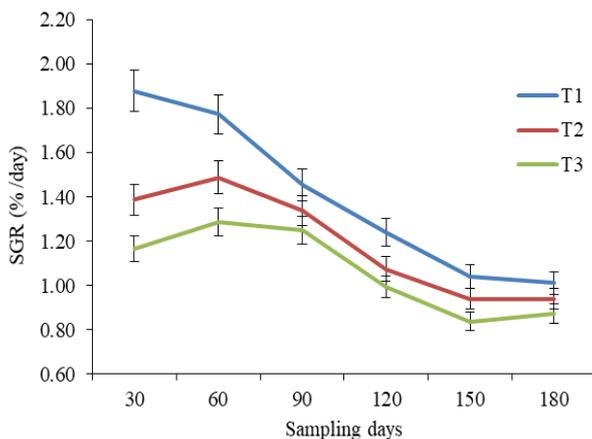
Parameters	Treatment 1	Treatment 2	Treatment 3
	Mean ± SD	Mean ± SD	Mean ± SD
Initial Length (cm)	19.15±0.99 a	19.40±0.61 a	20.18±0.89 a
Initial Weight (g)	25.16±0.98 a	25.55±0.51 a	24.91±1.60 a
Final Length (cm)	44.62±1.01 a	41.34±0.75 a	38.37±0.95 a
Final Weight (g)	155.25±1.05 a	138.45±1.02 b	119.94±1.54 c
Weight gain (g)	130.09±1.79 a	112.89±1.51 b	95.02±0.16 c
SGR (% day <sup>-1</sup> )	1.01±0.02 a	0.98±0.01 b	0.87±0.03 c
ADWG	0.72±0.01 a	0.63±0.01 b	0.53±0.00 c
Survival (%)	82.11±2.21 a	79.23±1.45 a	81.30±2.52 a
Net Production (Kg/Dec.)	42.73±1.69 a	35.78±1.00 b	30.90±0.95 c
Gross Production (Kg/Dec.)	50.99±1.71 a	43.87±1.04 b	39.01±1.69 c
FCR	2.11±0.08 c	2.95±0.11 b	3.35±0.12 a

Cuchia grew steadily in T<sub>1</sub> treatment at about 0.72 g day<sup>-1</sup> during the entire culture period and reached to an average weight gain of 130.09 g with significant difference ( $P < 0.05$ ) among the treatments where the average weight gain was found to be 112.89 g and 95.02 g in T<sub>2</sub> and T<sub>3</sub> treatments, respectively (Table 4; Figure 2). There were also significant differences in incremental as well as in final weight gain in cuchia between T<sub>2</sub> and T<sub>3</sub> treatments ( $P < 0.05$ ). The average daily weight gain of cuchia was within the range of 1.14 to 1.29 for the same species reared using different types of feeds in earthen pond (Khan et al., 2021). The specific growth rate (SGR) of Cuchia ranged from 0.87 to 1.01% day<sup>-1</sup> with progressively a declining rate (Table 4; Figure 3). The SGR of Cuchia in T<sub>1</sub> treatment was significantly higher ( $P < 0.05$ ) compared to T<sub>2</sub> and T<sub>3</sub> treatments, respectively. The SGR of cuchia in the present experimental condition was higher that has been reported (0.64 to 0.79 % day<sup>-1</sup>) for 180 days of culture period for the same species reared in different ditches conditions and using different types of feeds in earthen pond (Khan et al., 2021; Hosen et al., 2019). The mean values of FCR were significantly different ( $P < 0.05$ ) among the treatments (Table 4). The lowest average FCR value of 2.11 was observed in T<sub>1</sub> treatment and the highest FCR value of 3.35 in T<sub>3</sub> treatment. In this study, the value of FCR was more

or less similar (2.27 to 2.61) that has been reported by Jahan et al. (2020) in case of domestication of the same species in earthen pond. Corresponding to higher growth and survival, T<sub>1</sub> treatment resulted in the significantly higher ( $P < 0.05$ ) gross mean production of 50.99 kg/decimal and net production of 42.73 kg/decimal for 180 days of culture period (Table 4). The mean gross production rate of cuchia in T<sub>2</sub> and T<sub>3</sub> treatments were 43.87 kg/decimal and 39.01 kg/decimal, respectively and the net production were 35.78 kg/decimal and 30.90 kg/decimal with significant difference ( $P < 0.05$ ). The water quality parameters in the present experiments showed variations during the culture period, but were similar ( $P > 0.05$ ) and noted within the recommended range for the growth performance of Cuchia (Chowdhury et al., 2020). In the T<sub>1</sub> treatment where we applied live fish spawn and Vermi compost as feed showed best results in terms of weight gain, SGR, survival rate and gross production of *M. Cuchia* which was similar to the result of Miah et al., (2015) where he observed that, earthen ditches fed with the earthworms and small live fish (tilapia) were the best among all other environment for better growth performance of freshwater mud eel. Chakraborty et al. (2013) reported that the lowest FCR of *M. cuchia* was found in rice field than in ponds which is supported with these experiments which clearly denotes those rearing environments is the key factor for domestication and culture of mud eel.



**Figure 2.** Growth of Cuchia in three different feed treatments during the experimental period of 180 days.



**Figure 3.** Specific growth rate of Cuchia in three different feed treatments during the experimental period of 180 days.

## Conclusion

The life history of this species is mysterious, so induced breeding of mud eel has long been regarded as an extremely difficult task. On the other hand, proper feeding is a challenge for the culture and optimum growth of *M. cuchia*. So, findings of this experiment revealed that mixed feed (live fish spawn and Vermi compost) showed the better survival rate and growth performance of cuchia in farmer's pond which will be helpful for the sustainable culture of Mud eel. Besides, further study is needed to observe their feeding performance and growth using other feed which will be economically viable.

## ACKNOWLEDGEMENT

The authors sincerely thank Bangladesh Fisheries Research Institute for the financial support to the research. The authors are also thankful to the farmers for their support in field during the implementation of the study.

## Conflicts of interest

The authors declare that there is no conflict of interest.

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