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Development of a compatible aquaculture technique of stinging catfish, *Heteropneustes fossilis* (Bloch) in the southern coastal region of Bangladesh

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Abstract
Aquaculture of stinging catfish is not well developed in the southern coastal region of Bangladesh because of the crevices problem and lack of suitable culture techniques. A study was conducted using bamboo splits made mats and small mesh sized net as fence to develop culture technique for a period of 167 days. Similar sized fingerlings (average weight 5.75 g) were stocked at a density of 600, 800 and 1,000 fish·40 m^{-2}. Commercial feed was applied once a day at 17.00 to 18.00 pm. The survival varied from 68.64±5.52 to 82.89±4.42%, and the significantly highest survival was found in T_{600}. The highest production was found in T_{1000} followed by T_{800} and T_{600} those were not significantly difference among the treatments. The calculation of economic efficiency showed the highest input cost in T_{1000}, but the highest economic efficiency was found in T_{600} and lowest in T_{1000}. The findings indicate that the stocking density in T_{600} was appropriate and encouraged to develop stinging catfish culture in the southern coastal wetlands to solve the crevices problem. Adopting this technology, local people may enhance their livelihood and increase the national fish production as well as the economy of the country.

Keywords: Coastal wetlands, stinging catfish, growth and production, stocking density, economic efficiency

1. Introduction
In Bangladesh, the stinging catfish, *Heteropneustes fossilis* (Bloch), is a famous and economically valuable fish species among the air-breathing fishes. It is a very healthy, appealing, and delectable fish that is widely preferred due to its fewer spines and fat, as well as its excellent digestion (Khan *et al.*, 2003) [1]. It is also recommended in the diet of ill and convalescents. *H. fossilis* is now a vulnerable fish species in Bangladesh (IUCN, 2000) [2], because the availability of wild *H. fossilis* has decreased due to the destruction of its aquatic biodiversity (Hussain and Mazid, 2001) [3]. Furthermore, the use of pesticides in paddy fields, the discharge of poisonous pollutants from manufacturing sites, the loss of ecological habitats, and dewatering during the exploitation of natural resources are all major contributors to this species status as endangered in Bangladesh (Khan *et al.*, 2003; Kohinoor *et al.*, 2012) [1, 4]. Harvesting of stinging catfish (*H. fossilis*) from ponds, ditches, and other water reservoirs is impossible without dewatering in the cultured area, which adds to the cost and destroys the ecological balance by killing small fish indiscriminately.
H. fossilis has recently been deemed a promising fish species for aquaculture due to its rapid growth, high market value, ability to survive in low oxygen environments, ability to adapt effectively to hypoxic water bodies, and ability to cultivate in high stocking densities (Haniffa and Sridhar, 2002; Hossain *et al.*, 2016) [5, 6]. It is a robust fish that can survive in slightly saline water. It can breathe by gulping in air (Munshi, 1993) [7] and can sustain for several hours beyond the water because of the presence of auxiliary respiratory organs (Kohinoor *et al.*, 2012) [4]. However, aquaculture of *H. fossilis* has not been well flourished in the southern coastal region of Bangladesh due to lack of appropriate culture techniques, though this region has a vast area of tidally flooded wetlands resource.

Recently, some entrepreneurs have practiced aquaculture of *H. fossilis* in polyculture system with tilapia and Indian major carps in different ways, but they have faced various problems especially crevice problem in the southern coastal region of Bangladesh. The crevice is common phenomena in the ponds and water reservoirs in the coastal region that created linkage within the ponds and surrounding environment because of changes the height of water level (average 0.7 m) between high tide and ebb tide (Hossain *et al.*, 2016) [6].

Tidal water floods most of the wetlands in the southern coastal region twice daily throughout the year, however during the rainy season (July to October), those wetlands contain 0.8-1.0 m deep water which can be used for aquaculture utilizing bamboo splits made mats and small mesh sized net as fence (Hossain *et al.*, 2020a) [8]. In the winter season, these coastal wetlands naturally dried up during ebb tide and continued to 5-6 hour next following high tide. This additional facility may be used for harvesting of stinging catfish accumulating in an artificial created tiny canal or ditch without dewatering cost, which can reduce the operational cost and increases the benefit of stinging catfish culture in the southern coastal region of Bangladesh. As a whole, utilization of bamboo splits made mats and small mesh sized net as fence in the tidally flooded coastal wetlands for stinging catfish culture may solve the crevices problem, because water is not hold forcibly in this system like ponds, and may be possible to conserve the natural small fish and other organisms in this region. Therefore, the study aim is to develop a compatible aquaculture technique of stinging catfish in the coastal wetlands solving crevices problem, conserving small fishes with preserving ecological balance and dewatering cost during harvesting of stinging catfish.

2. Materials and Methods

2.1 Study area

The study was conducted in the Banaripara upazila (sub district) under Barisal district for a period of 167 days between 28 May and 11 November 2019. The experiment was carried out in three treatments each with three replications under natural condition in the coastal wetlands located between latitude 22°45´ to 22°55´ N and longitude 90°00´ to 90°15´ E (Figure 1). The experimental site is naturally flooded twice daily by tidal action and average 0.7 m water level changed (up-down) daily which is the natural phenomenon of the coastal region of Bangladesh.

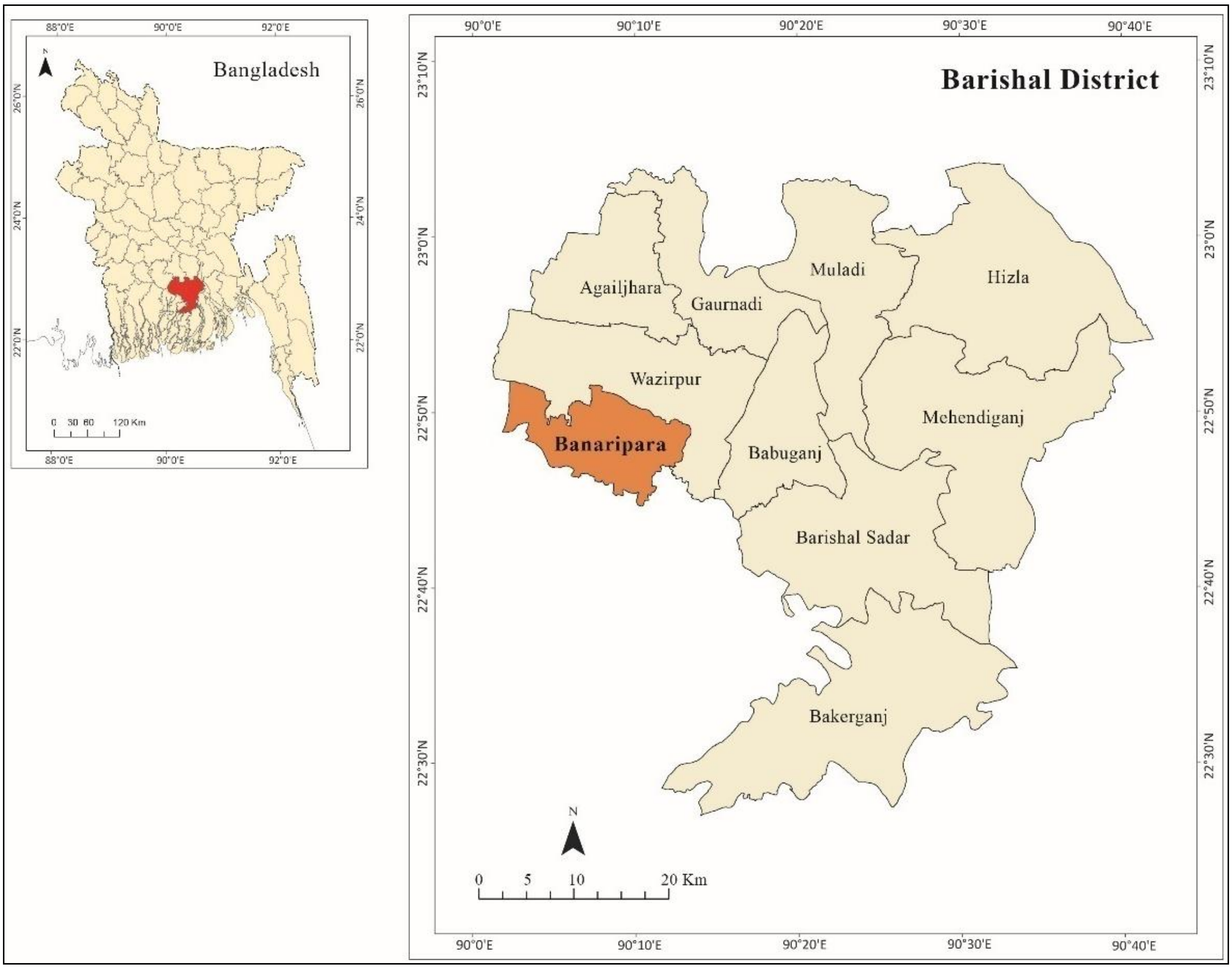


Fig 1: Map of Bangladesh and Barishal district showing the study area and experimental site.

2.2 Experimental site and design

Three treatments with three replications each were used in the study. In the selected study area, the two lateral sides were previously closed by 1.3 m height dykes (locally called Kandi) by land owner for producing more vegetables crop in the dykes. The remaining two sides were closed with bamboo split made mats and a fine mesh sized net (0.5cm), allowing tidal water to flow through but not the stocked fish. The height of the dykes was increased by excavating the bottom soil of the sites. Thereafter, the whole chosen area was split into nine experimental plots following CRD design for three treatments and each plot area was 60 m^2 (Figure 2).

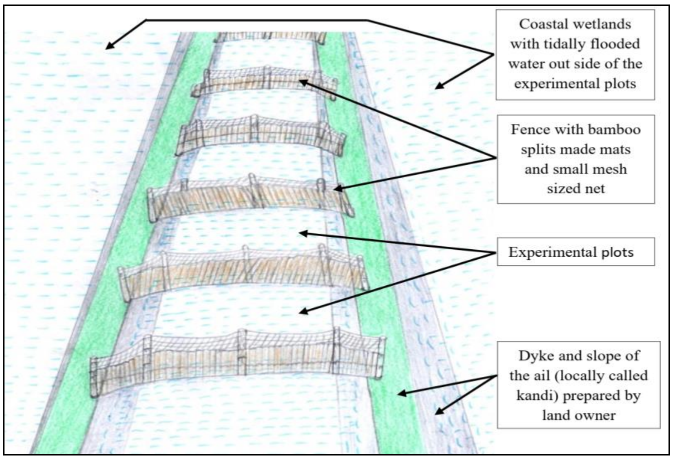


Fig 2: Sketch of the experimental plots showing different parts of the system. A total of 540 m^2 experimental area was divided into 9 experimental plots.

Here, water is not hold forcibly in this system, because water is naturally entranced and goes out through the bamboo splits made and net throughout the study period. On the other hand, before stocking of fish, 18 pieces (6×3) of plastic pipes (10 cm diameter and 1.5 m length) (Figure 3) were attached parallel in the bottom soil in each treatment as shelter for stocked fish, because *H. fossilis* prefer dark place and show their minimum physical activities in day time.

Fig 3: Plastic pipes (10 cm diameter and 1.5m length) provided as shelter for *Heteropneustes fossilis* in each treatment.

Additionally, a tiny ditch was created in the middle of each plot for each treatment so that it contains a few of water and accumulated stocked fish during ebb tide in the season. Finally, similar sized fingerlings of stinging catfish (average weight 5.75 g) were stocked at a density of 600, 800 and 1,000 fish·40 m^{-2} (per decimal) and designated as T_{600}, T_{800} and T_{1000}, respectively. During the stocking of fish, the initial weights of suitable number of the fish in each treatment were measured using a portable weighing balance and kept recorded independently.

2.3 Monitoring of water quality parameters

Crucial water quality parameters such as temperature (°C), dissolved oxygen (mg·L^{-1}), pH, salinity (‰), total alkalinity (mg·L^{-1}), nitrate-nitrogen (mg·L^{-1}), and phosphate-phosphorus (mg·L^{-1}) were measured at a monthly interval. The temperature of water, dissolved oxygen, pH, and salinity were monitored in the experimental site at 9.00 to 10.00 am using a Celsius thermometer, a transportable dissolved oxygen meters (DO-5509, AF.11581, Taiwan), a portable pH meter (pHep, HANNA Instruments, Romania), and a hand held refractometer (Brix HI 96801). Additionally, water samples were taken from each place in 250 mL plastic bottles to assess the total alkalinity, nitrate-nitrogen, and phosphate-phosphorus concentrations in the laboratory. Titration with 0.02 N H_2SO_4 titrant and methyl orange tracer was used to evaluate total alkalinity. However, during the research period, nitrate-nitrogen and phosphate-phosphorus concentrations were assessed using a spectrophotometer (DR 1900, HACH, USA). The nitrate nitrogen was determined using the NitraVer@5 nitrate reagent while the phosphate phosphorus was determined using the PhosVer@3 phosphate reagent.

2.4 Feeding

Commercial pellet feed (Paragon Fish Feed Ltd., Bangladesh) was applied at first fifteen days 'pre-starter' feed (sized: 0.5 mm); next two months 'starter' feed (sized: 1.0 mm); and rest of the culture period 'grower' feed (sized: 1.5 mm) was applied once a day between 17:00 to 18:00 pm in all treatments. For the first two months, feed was supplied at a rate of 8% of the fish's body weight. Then it was adjusted to 6% of body weight for the next two months, and subsequently to 5% of body weight for the remaining of the culture period.

2.5 Fish sampling and growth monitoring

Fish were sampled approximately 10% of the stocked fish once a month to assess the growth, health status, and feeding rations adjustments. Fish were sampled using a bamboo made chai (local fishing trap) with feed as bait (Figure 4). A total of 18 chai was used (2 chai in each plot) during sampling of stoked fish.

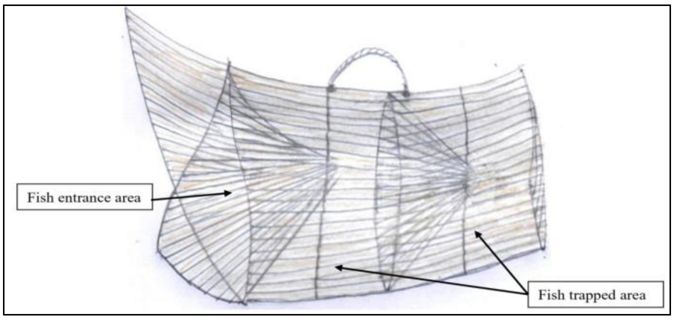


Fig 4: Sketch of the fishing trap showing different parts used for sampling of stocked fish during the study period.

2.6 Harvesting of fish and data collection

At the end of the research period in November, all of the stocked fish were harvested. Firstly, about 5% stocked fish was harvested by repeated seine netting. Subsequently, the rest of the fish were accumulated in artificially created tiny ditches within a few of water. The surrounding area naturally dried up due to ebb tide and got 3-4 h each day to harvest the fish. The water in the ditches was manually removed and accumulated fish were easily harvested from the ditches without dewatering cost. Harvesting was completed within 3 days from all treatments. At the end of fishes harvesting, the experimental sites were flooded again by tidal water regularly. All the harvested fishes were counted and weighed separately according to the treatments. Following that, we calculated the growth parameters (final weight, weight gain, and specific growth rate), survival, and total production using the following equations.

a. Weight gain = Final weight (g)-Initial weight (g);

b. $\text{Specific Growth Rate (\% body weight day}^{-1}) = \frac{\ln(\text{final weight}) - \ln(\text{initial weight})}{\text{Culture period (days)}} \times 100$ (Brown, 1957);

c. $\text{Survival} = \frac{\text{No. of harvested fishes}}{\text{Initial no. of stocked fish}} \times 100;$

d. $\text{Food conversion ratio (FCR)} = \frac{\text{Weight of supplied feed}}{\text{Weight gain of harvested fish}}$; and

e. $\text{Production (kg} \cdot \text{ha}^{-1}) = \frac{\text{No. of total harvested fishes} \times \text{Average individual weight of fish (g)}}{\text{Cultured area (m}^2) \times 1000} \times 10000$

2.7 Data analysis

All measured variables have their values presented as means±SD. Prior to conducting statistical analysis, all groups of data were checked for normality and homogeneity of variance. The data for water quality and growth parameters were evaluated using one-way analysis of variance (ANOVA), followed by Duncan's Multiple Range Test to determine pair-wise differences. The 5% level of significance ($p<0.05$) was used to determine significance. A tabular quantitative analysis was conducted to determine the economic effectiveness of this culture technique according to Shang, 1990. The IBM SPSS Statistics program, version 20.0, was used for all statistical analysis.

3. Results

3.1 Monitoring of water quality parameters

The average values of monthly measurements of water quality parameters such as water temperature (ºC), dissolved oxygen ($mg \cdot L^{-1}$), pH, salinity (‰), total alkalinity ($mg \cdot L^{-1}$), phosphate-phosphorus ($mg \cdot L^{-1}$) and nitrate-nitrogen ($mg \cdot L^{-1}$) in Table 1. Among the parameters of water quality, no marked variation was observed during the study period (data not shown). The parameters averaged across the study period were not significantly different among the treatments. All of the measured water quality factors were found within a range that was adequate for fish culture.

Table 1: Water quality parameters (mean± SD, n = 21) under three distinct treatments (no statistical difference [$p>0.05$] was observed).

Parameter	Treatment		
	T_{600}	T_{800}	T_{1000}
Temperature (ºC)	29.38±2.18 (24.70-32.70)	29.29±2.18 (24.80-32.80)	29.39±2.18 (24.40-32.50)
DO ($mg \cdot L^{-1}$)	5.53±0.25 (5.10-5.90)	5.38±0.23 (5.00-5.90)	5.41±0.21 (5.10-5.80)
pH	7.10±0.12 (6.80-7.30)	7.09±0.13 (6.80-7.30)	7.05±0.10 (6.80-7.30)
Salinity (‰)	1.0±0.0	1.00±0.0	1.00±0.0
Total alkalinity ($mg \cdot L^{-1}$)	127.67±19.17 (108-178)	126.48±21.27 (106.0-188.0)	124.76±17.33 (106.0-178.0)
Nitrate-nitrogen($mg \cdot L^{-1}$)	0.06±0.02 (0.04-0.12)	0.06±0.02 (0.03-0.09)	0.06±0.02 (0.04-0.12)
Phosphate-phosphorus ($mg \cdot L^{-1}$)	0.52±0.14 (0.33-0.79)	0.49±0.11 (0.29-0.74)	0.54±0.15 (0.34-0.94)

Note: DO = Dissolved oxygen; the values enclosed in parenthesis denote the ranges.

3.2 Growth and production performances

At harvest the average body weight of the experimental fish was between 40.97±7.89 and 51.43±7.07 g with moderate to high survival rate (68.64±5.52 - 82.89±4.42). The results showed apparent effects of stocking rate on growth of stinging catfish whereby final weight, weight gain, specific growth rate (SGR) and, survival rate was highest ($p<0.05$) in T_{600} followed by T_{800} and T_{1000} (Table 2). Notably, survival rate of T_{800} and T_{1000} were not significantly ($p>0.05$) different. In addition, feed conversion ratio was lowest in T_{600} followed by T_{800} and T_{1000}.

Table 2: Growth and production efficiency of cultured stinging catfish *Heteropneustes fossilis* (Mean±SD, n=75) in three distinct treatments.

Treatments	Weight (g)			SGR (% per day)	FCR	Survival rate (%)	Production ($kg \cdot ha^{-1}$)
	Initial weight (g)	Final weight (g)	Weight gain (g)				
T_{600}	5.75±1.05	51.43±7.07^a	45.67±7.02^a	0.57±0.06^a	2.28±0.24^c	82.89±4.42^a	6,466.67±258.59
T_{800}	5.79±1.19	46.78±7.15^b	41.00±7.30^b	0.55±0.07^b	2.80±0.31^b	73.50±4.72^b	6,850.00±601.84
T_{1000}	5.75±1.21	40.97±7.89^c	35.22±7.92^c	0.51±0.07^c	3.03±0.21^a	68.64±5.52^b	7,076.67±342.42

Note: SGR=Specific growth rate; FCR = Food conversion ratio. Mean ± SD in the same column superscripted with different letters are significantly different ($p<0.05$).

During the study period, the growth increment of *H. fossilis* in three different treatments is shown in Figure 5.

3.3 Cost-benefit analysis

The structural cost, operational cost and return from the aquaculture of stinging catfish were considered during the calculation of economic analysis of the system. The total structural costs were similar in all treatments, but the total operational costs were different, because to disparity in the number of stinging catfish fingerlings and the expense of fish feed. T_{1000} had the highest total input cost of USD 23,872.17 ha^{-1}, while T_{600} had the lowest total input cost of USD 15,919.41 ha^{-1} (Figure 6). The net benefit was found the highest in T_{600} followed by T_{800} and T_{1000}. T_{600} had the highest benefit and benefit-cost ratio of USD 24,497.28 ha^{-1} and 1.54, while T_{1000} had the lowest benefit and benefit-cost ratio of USD 20,357.02 ha^{-1} and 0.85 (Figure 6).

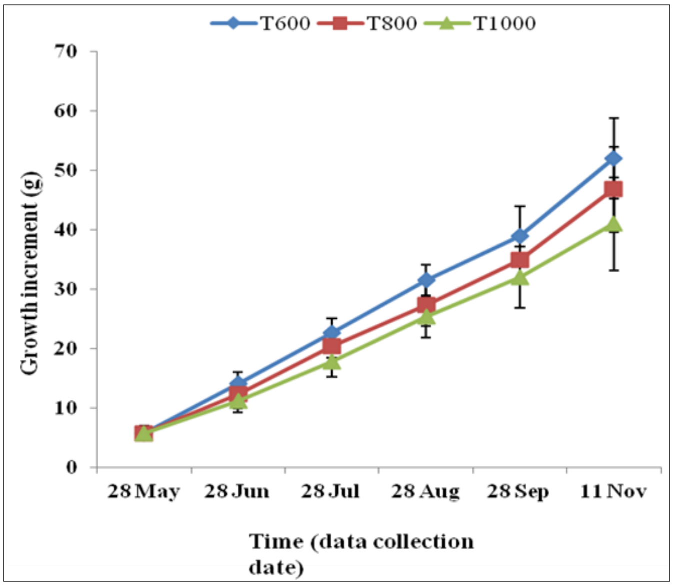
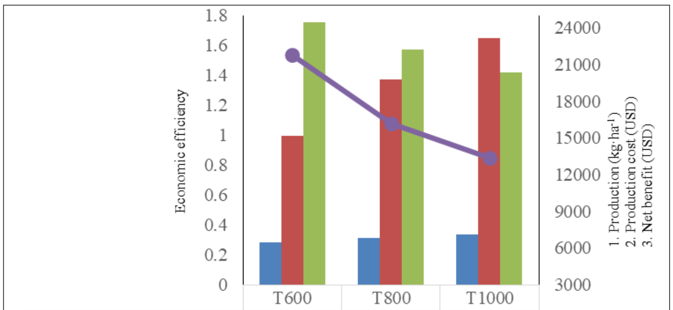


Fig 5: The growth increment (g) of *Heteropneustes fossilis* in three different treatments during the study period.



	T600	T800	T1000
Production (kg·ha-1)	6466.67	6850	7076.67
Prodcution cost (USD)	15200.66	19800.5	23153.42
Net benefit (USD)	24497.28	22242.78	20357.02
BCR	1.54	1.08	0.85

Fig 6: Production performance (kg·ha^{-1}), production cost (USD) and net benefit (USD) of *Heteropneustes fossilis* in relation to the economic efficiency in three different treatments.

4. Discussion

4.1 Water quality parameters

All of the observed water quality factors in this study were appropriate and within the allowed range for stinging catfish culture (Kohinoor *et al.* 1994; 1998; 2007; Rahman *et al.* 2014; Nabi *et al.* 2020) [9-13]. However, there were monthly fluctuations were found in water temperature due to the seasonal variations. Nevertheless, greater water temperatures were found throughout the study period, which may be conducive to increase the growth of cultured fish. Sun and Chen (2014) [14] reported that fish growth, food consumption and energy utilization increased with increasing water temperature at 27-33 °C. 1‰ salinity was found in all treatments over the entire study period. 1-2‰ salinity is ideal for increased the growth of carp fish in polyculture in tidally flooded coastal wetlands of Bangladesh (Hossain *et al.*, 2020b) [15] and stinging catfish can tolerate slightly brackish water. Comparatively low levels of nitrate-nitrogen and more or less similar ranges of total alkalinity and phosphate phosphorus were found in all treatments those could be related to the regular tidal exchange of water into the experimental site (Hossain *et al.*, 2020a; 2020b) [8, 15].

4.2 Growth and production performance

The final weight, weight gain, SGR and the survival of the harvested stinging catfish were found significantly higher (p<0.05) in T_{600} followed by T_{800} and T_{1000} which might be due to the variation and effect of higher stocking densities in T_{1000} and T_{800} in comparison with T_{600}. Since the environmental condition were similar in all treatments, but stocking densities were 1.67 and 1.33 times higher in T_{1000} and T_{800}, respectively in comparison with T_{600} and as a result, the stocked fish in T_{1000} and T_{800} might not have found similar space, shelter and food preference as the fish in T_{600}. This result is supported by Kohinoor *et al.* (2012) [4] and Ali *et al.* (2018) [16] who observed lower growth performances of *H. fossilis* with higher stocking densities and mentioned higher food and habitat competition among the fish in higher stocking densities in ponds. In stinging catfish farming, Narejo *et al.* (2005) [17] found that lower stocking numbers resulted in the best growth. Similar result was found by many other authors and reported the higher growth performance with lower stocking densities of stinging catfish in fish polyculture system (Rahman *et al.*, 2014; Saokat *et al.*, 2017; Hossain *et al.*, 2018; Mahmud *et al.*, 2021) [12, 18, 19, 20]. Survival of stocked fish is related to the stocking densities and food preference. In the present study, the survival was found significantly higher in T_{600} (82.89±4.42%) followed by T_{800} (73.50±4.72%) and T_{1000} (68.64±5.52%), and the results of survivals were related to the stocking densities of the cultured stinging catfish that are strongly supported by many authors (Rahman *et al.*, 2014; Ali *et al.*, 2018; Saokat *et al.*, 2017; Nabi *et al.*, 2020) [12, 13, 16, 18]. The food conversion ratio (FCR) is an important growth parameter in aquaculture; particularly it determines the farmers benefit from the system. The lower FCR indicates the best utilization of supplied feed by the stocked fish with better growth performance and higher benefit from the aquaculture system, whereas the higher FCR specify the loss of supplied feed and lower benefit of farmers. In the present study, the FCR was found significantly lower in T_{600} (2.28±0.24) that indicated the higher benefit in T_{600} in comparison with T_{800} (2.80±0.31) and T_{1000} (3.03±0.21). Ali *et al.* (2018) [16] reported the lowest FCR (2.84±0.07) in the lowest rearing fish treatment in comparison with higher rearing fish treatment during the growth of stinging catfish in ponds with GIFT and Thai Sharpunti at various stocking densities. Saokat *et al.* (2017) [18] found FCR 2.65 to 3.08 in the adaptability of polyculture of stinging catfish and Rahman *et al.* (2014) [12] found FCR 2.51 to 3.93 in stinging catfish culture potentials under various stocking densities those were higher than T_{600}. The production of stinging catfish was found highest in T_{1000} (7,076.67±342.42 kg·ha^{-1}) followed by T_{800} (6,850.00±601.84 kg·ha^{-1}) and T_{600} (6,466.67±258.59 kg·ha^{-1}) those were not significantly difference among the treatments. Although, the stocking densities were 1.67 and 1.33 times higher in T_{1000} and in T_{800}, respectively in comparison with T_{600}, but the production performance of T_{800} and T_{1000} were more or less similar with T_{600}. On the other hand, FCR was significantly higher in T_{1000} (3.03±0.21) in comparison with other two treatments (2.28±0.24 in T_{600} and 2.80±0.31 in T_{800}) that indicated the lower growth performance and lower benefit in T_{1000} in comparison with T_{800} and T_{600}. Similar growth and production performance of stinging catfish was found in polyculture with GIFT and Thai sharpunti in ponds (Ali *et al.*, 2018) [16]. According to Chakraborty and Mirza (2008) [21], the output of *H. fossilis* in monoculture systems nourished on commercial feeds in earthen ponds ranged from 4,512 to 7,276 kg· ha^{-1}. 8months^{-1}. In polyculture of stinging catfish alongside Indian major carps in ponds, total production ranged from 6,366.42 to 6,610.27 kg·ha^{-1}·5months^{-1} (Hossain *et al.*, 2018) [19]. Rahman *et al.* (2017) [23] found that stinging catfish produced between 5,760.79±450.76 and 9,708.16±421.40 kg·ha^{-1}·7months^{-1} in cultural potentials at various stocking densities in Bangladesh's northern area. The findings of the growth and production performance of stinging catfish of the present study clearly indicate that the density effects the growth performance and it also supported by many other authors (Rahman *et al.*, 2014; Saokat *et al.*, 2017; Samad and Imteazzaman, 2019; Nabi *et al.*, 2020) [12, 13, 18, 23]. According to the current data, T_{600} had the highest growth performance and output, and farmers in the coastal region might enhance this culture technique for higher economic gain. The most important and technical theme of this study is the harvesting of stinging catfish (*H. fossilis*) that is very difficult from the ponds, ditches and other water reservoirs without dewatering from the cultured area, and require additional cost and destroy the ecological balance and indiscriminate killing of small fishes. In the present study, stinging catfish was cultured in the tidally inundated coastal wetlands for reducing dewatering cost, and to preserve the ecological balance and many other small fishes and finally to develop a culture technique of stinging catfish in the southern Bangladesh. Here most important affair, these tidally flooded coastal wetlands presently remain unused during the time of study period that has an opportunity to use and adopt a new technology to get maximum economic benefit from these unused wetlands. According to our findings and prior publications, stinging catfish may be a viable cultural species in the southern coastal region of Bangladesh. This technology provides an innovative aquaculture system of stinging catfish with conserving natural resources, because water is naturally entranced and goes out through the bamboo splits made mats and net, and water is not forcibly hold in this system. Finally, utilization of bamboo splits made mats and small mesh sized net as fence in the open side (s) of tidally flooded coastal wetlands may solve the crevices problem for stinging catfish culture, because water is not forcibly hold and hence there is not create any crevice in the aquaculture site, and in this way the natural small fish and other organisms is possible to conserve in this region. Presently, plastic net (mesh sized 2 mm or as required) is available in the market, which will be more durable and economically viable. Although, we searched it in the market during study period, but it was not available then in the market. Moreover, providing floating feed may be reduced FCR and increase the benefit of the farmers. Otherwise, commercial pellet feed should be provided to any compatible feeding tray so that fish can consume all-supplied feed proficiently that can reduce feed loss and increase the farmers benefit in this technology. Now, encouragement is required the coastal people to adopt this technology for stinging catfish culture sustainable who have available tidally flooded coastal wetlands. If required, government or non-government organizations can give financial and logistical support to encourage stinging catfish culture. It has the potential to improve their socioeconomic condition and raise the overall national fish production of the country.

4.3 Cost-benefit analysis

To offset and/or minimize the expense of retrieving stinging catfish in aquaculture, we devised a system for aquaculture in naturally flooded coastal wetlands. Based on the findings of this investigation, appropriate stocking density is the most important issues to get more growth, production and benefit from the aquaculture system. The current investigation discovered the greatest net benefit in T_{600} (USD24,497.28) followed by T_{800} (USD22,242.78) and T_{1000} (USD20,357.02) those were supported by many authors (Rahman *et al.*,2014; Saokat *et al.* 2017; Ali *et al.*, 2018; Hossain *et al.*, 2018; Samad and Imteazzaman, 2019) [12, 16, 18, 19, 23]. Although, the total production was found highest in T_{1000}, but the economic benefit was found the highest in T_{600} (BCR: 1.54) in comparison with other two treatments (BCR: 1.08 in T_{800} and 0.85 in T_{1000}) which indicated that the stocking density in T_{600} was appropriate. The local farmers are encouraged to apply this technique in the tidally flooded coastal wetlands for compatible stinging catfish culture to get more benefit that enhance their livelihood and increase the national fish production of the country.

5. Conclusion

In essence, the purpose of this investigation was to bring out an easier technique to harvest the stinging catfish and to preserve the ecological balance with conserving other small fish during harvesting. The findings indicated that the food conversion ratio (FCR), survival and other growth parameters as well as total productions of stinging catfish relay on the appropriate stocking density. The present innovative aquaculture technique of stinging catfish can be compatible in the southern coastal wetlands that enhance livelihood of the coastal people and increase the annual fish production of Bangladesh. However, further study is necessary to decrease the food conversion ratio and improve survival, growth, and overall output performance, as well as net benefit. Dissemination of this innovative aquaculture technique in other water reservoirs such as seasonal open water bodies, boars, and highway borrow pits and seasonal beels may enrich the aquaculture industry.

6. Acknowledgement

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