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Density Based Growth Performances of Thai Climbing Perch (*Anabas testudineus*) through Semi-intensive Culture System in Bangladesh

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Abstract: Stocking variation experiments on survival, production and growth performances of Thai climbing perch (*Anabas testudineus*) was carried out in 8 earthen ponds under semi-intensive culture system to determine the effects and their relationships. 8 replicates were designed with 3 treatments after assigned with fixed stocking density for each treatment among 1200-1600 individual/decimal. During 30 days of culture period, 4 sampling were done from all replicates of the treatments for observation. The final tabulated data showed the higher production rate and better growth performances along with lower stocking density (T_1). Higher stocking density (T_3) possessed lower survival rates through all replicates than other treatments. Gross yield and specific growth were also declined with higher stocking rates of Thai climbing perch (TCP). During sampling at 21st days, the average growth of TCP fries was observed higher through all treatments.

Key words: Semi-intensive・Thai climbing perch・Stocking density・Survival・Gross yield

INTRODUCTION

Bangladesh is enriched with fisheries biodiversity [1]. It accelerated the economic growth of this country as raw; even dried [2]. Capture fisheries covered most of the revenue commercially [3]. However, farming of fishes and shrimps are earning popularity nowadays [4, 5]. Especially, Small indigenous species (SIS) production is increasing rapidly in Bangladesh [4]. In terms of nutritional value, they possess higher protein, minerals and vitamins [6, 7] i.e., Thai climbing perch (*Anabas testudineus*) than other species. Thai climbing perch (*Anabas testudineus*) is known as an important exotic species of fish in Bangladesh [8]. It was introduced in 2002 from Thailand as Thai strain [9, 10]. They considered as valuable diet towards patients [11] and possessed medicinal importance [12, 13]. There are two categories of climbing perch in Bangladesh, local and Thai variety.

Previously, SIS was cultured in the ponds as by product while various large carp species were cultured as main crop. Nowadays, production systems are continuously changing [14, 15]. Currently, fish farmers culture SIS as a main cash crop to multiply their income from the production units. SIS is available in a wide range through all over the Bangladesh. Recently, climbing perch is the most popular culture species among them and it's possessed a rapid growing phenomenon [16]. Culture technology of local strain is not developed yet. It is difficult to collect local climbing perch fry, therefore Thai variation stocked separately by farmers in their culture ponds. Farmers are giving importance to it due to the demand of customers and value in local markets with higher pond production [17]. TCP has fast growing features with high disease resistance and good survival rate under low oxygen and being alive after handling stress too [18].

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A very few studies have been done on TCP and its culture system. In Bangladesh, production of TCP was observed by Hasan, *et al.* [10] in nylon hapas. Culture of TCP was compared by Mondal *et al.* [19] through pond culture and cage culture under three TCP management systems. Through an integrated cage-cum-pond aquaculture technology in Vietnam, studied climbing perch production in cages by suspending in Nile tilapia *Oreochromis niloticus* (Linnaeus 1758) culture ponds [20]. However, study for optimization of climbing perch density in pond aquaculture is lacking [21].

Considering these issues, the present study was conducted to understand the growth performance of TCP in semi-intensive culture ponds under different stocking densities. The objective of this study was to clarify the effects of various stocking density of TCP on its growth, survival and production under well monitored replicated pond management and culture. There are many researches on growth and production of other fishes (i.e., *Catla catla*; [22], Oreochromis niloticus [23] had been done. We develop aquaculture technologies at farmer's field conditions by getting feedback on station research to focus farmer's problems in priority research programs of TCP. This study will transfer the technology by strengthening the linkage among researcher, farmers, extension workers and NGOs working on the same. Following technologies will be demonstrated for refinement and development in quality TCP (*Anabas testudineus*) fry production in farmer's ponds.

MATERIALS AND METHODS

Study Sites: Bangladesh Fisheries Research Institute (BFRI), under the component of Integrated Agricultural Productivity Project (IAPP) conducted 8 (eight) TCP adaptive trials under four Upazilas (Rangpur Sador, Mithapukur, Pirgonj and Gongachora) of Rangpur district in 2014-2015 through the supervision of Bangladesh Fisheries Research Institute (BFRI), Freshwater sub-station, Saidpur, Nilphamari. Farmers and study ponds were selected according to the project criteria. A comprehensive training program was conducted for the selected farmers before nursing period of TCP. Training program included pond preparation, fry selection, transportation, acclimatization, feeding management, nursing and culture techniques, sampling and harvesting technique etc. on the priority basis. Selected farmers were also trained about rotenone application for controlling predator fish and other prey animals, liming and fertilization for pond preparation, dikes nettings for protection of fry escaping from pond as well as avoid entrance of harmful outsiders and ensured well-formulated high protein feeds to the fry in nursing ponds.

Duration of the experiment: Present experiment was conducted for a period of sixty days (including pond selection and pond preparation) for TCP nursing from April'15 to June'15 at different unions under Rangpur Sador, Mithapukur, Pirgonj and Gongachora Upazila of Rangpur district (Map-1), Bangladesh.

Ponds Selection: Selected ponds were near to road side with having no risk of floods and availability of sunlight. Those were easily recognizable for people i.e., as a demo pond and can hold adequate amount of water in summer season. High depth pond was avoided for this study to minimize management issues.

Farmer's Selection: Advanced fish farmers were selected for this experiment who have their own ponds. Selected farmers were educated (minimum class eight pass), highly enthusiastic and experienced in terms of fish culture. Women participations were also highly motivated, appreciable and sincere to nursing TCP fry in ponds.

Experimental Design: A total of 8 (eight) ponds were selected for the present experiment. The mean area and water depth of the ponds were 20.15 decimal and 5.87 feet respectively (Table 1). All the ponds were rain fed and managed by farmers under the guidance of fisheries experts. The experiment was carried out under three treatments. Treatment T_1 and T_2 have three replications but T_3 has two replications. Stocking density for TCP were T_1=1200 no./decimal, T_2=1400 no./decimal, T_3=1600 no./decimal. Average size of the socked fries was 2 cm and average initial weight was 0.2 gm.

Pond Management: ***Pre-stocking management:*** It started with pond preparation. Some selected ponds banks and bottom were not suitable for fry nursing. So, the banks and embankments were repaired by the farmers. Inside and outside aquatic vegetation of ponds were removed manually by the farmers. Rotenone was used and found very effective for controlling predators and undesirable species within the culture ponds where drying of the ponds were not possible. Predator and undesirable species are very harmful during fry nursing in pond conditions. Most of the selected ponds were assessed to apply rotenone at the rate of 30g/feet/decimal. Liming was

Table 1: Experimental design of the selected adaptive trail for Integrated Agricultural Productivity Project (IAPP) in the different Upazila under Rangpur District.

Sl No.	Location	Pond Area (Decimal)	Water Depth (Feet)	Treatment & Replication	Amount of Fry
01	Rangpur Sadar	20	5	T_1R_1	24000
02		20	5	T_1R_2	24000
03	Gongachora	18	5	T_1R_3	21600
04		18	5	T_2R_1	25200
05	Mithapukur	20	8	T_2R_2	28000
06		25	8	T_2R_3	35000
07	Pirgonj	20	6	T_3R_1	32000
08		20	5	T_3R_2	32000
Average		20.15	5.87	Total	221800

Table 2: Fertilizers name, doses and applying methods in pre-stocking.

Name of Fertilizer	Doses	Applying methods
Cow dung	3-5kg/decimal	Dilute with water then applying around of the pond by manually.
Urea	200 g/ decimal	Mixer with water then applying around of the pond by manually.
T.S. P	100 g/ decimal.	Mixer with water then applying around of the pond by manually.

Table 3: TCP feeding regime for 30 days culture

Age of fry(days)	Quantity of Feed (% of body weight)	Feed Type
1 -7	20	Pre-nursery
8-14	15	Pre-nursery
15 - 21	12	Nursery
22 – 30	10	Nursery

Table 4: Fertilizer names, doses and applying methods as periodic doses during post stocking.

Name of Fertilizer	Doses	Applying methods
Cow dung	250gm/decimal for 7 days interval, 35g/ decimal for 7 days interval &	Dilute with water then applying around
Urea	21 g/ decimal. for 7 days interval respectively	of the pond by manually.
T.S.P		

done at the rate of 1 kg/decimal for pond preparation. After 3-5 days of liming, fertilization was done. Both organic and inorganic fertilizers were applied for the natural food production (Table 2).

Stocking Management: Fry was transported with polyethylene sealed bag. No serious damaged or injuries were found. Same size of fry was stocked. Before releasing of fries, all of them were run through conditioning process with pond water to be acclimatized for obtaining higher survival rates.

Post-stocking Management: Readymade pre-nursery and nursery feeds (Manufacturing company: Aftab Floating Koi Feed) were applied three times in a day for TCP fry (Table 3). Feeding times were 09:00 am, 01:00 pm and 05:00 pm. As a periodic doses, fertilization was done at culture periods. Both organic and inorganic fertilizers were applied for producing sufficient the natural foods in ponds to be fed by fries (Table 4).

Sampling and Monitoring: Successive sampling of fish fries was done by seine net, push net and cast net as needed. Captured fry was measured by the scale in centimeter for its length and a digital balance was used for weight taking. Then sampling data was recorded (Table 5). Regular monitoring and checking of the ponds were carried out. There was no evidence of infection and pouching of stocked population during study period. After 30 days of nursing of TCP, complete harvesting was performed. Mainly seine net was used to harvest the reared fingerlings. For the calculation of feeding rate, sampling was done every ten days intervals by using a push net. Small and rather inadequate sample 10-20 TCP were taken to make some rough assessment of growth trends, it is assumed that such samples might represent the actual growth situation. Weight of TCP fry in each sampling was measured by using a digital electronic balance (TANITA KD160, range: 0-2 kg). The length of the fishes was also measured by using a steeliness scale during sampling. Ponds were visited regularly and pond

Table 5: Sampling and harvesting report of three treatments

Treatment & Replication	Total No. of harvested fry	Total wt. harvested Production (kg)
T_1R_1	18720	60.65
T_1R_2	18240	90.65
T_1R_3	17280	65.49
T_2R_1	19656	54.25
T_2R_2	22400	40.32
T_2R_3	27300	82.17
T_3R_1	24320	63.71
T_3R_2	24960	74.63
Average	21609.5	66.48

conditions and TCP health condition were monitored during the culture period. The sampled fries were handled very carefully to avoid unnecessary handling stresses as the small fry obtained delicate health.

Data Analysis and Growth Parameters Estimation: During culture period, every data was tabulated carefully. To evaluate the fish growth, FCR (Food conversion Ratio) and weight (wt.), some parameters were used such as survival (%) and production of fish (kg/acre). Some necessary equations [24] were:

Weight gain = mean final wt gain – mean initial wt gain

$$\text{Percent weight gain (\%)} = \frac{\text{mean final wt. gain} - \text{mean initial wt. gain}}{\text{mean initial wt. gain}} \times 100\%$$

$$\text{Survival rate (\%)} = \frac{\text{No. of harvested individuals}}{\text{No. of stocked individuals}} \times 100\%$$

$$\text{FCR} = \frac{\text{Dry feed fed wt.}}{\text{Live wt. gain}}$$

$$\text{Gross yield at the end} = \frac{\text{Total harvested fry wt. (kg)}}{\text{Total decimal (acre)}} \times 100\%$$

RESULT

In the pond, TCP nursing is a new technology in the North-west region of Bangladesh. Most of the fish farmers does not know how to nursing of TCP in the ponds. As a different point of view, BFRI established of TCP adaptive trails at marginal fish farmer levels. BFRI also arranged short course training with the fish farmers for technical knowledge development. Integrated Agricultural Productivity Project (IAPP) of Bangladesh Fisheries Research Institute (BFRI) launched for the implementation of the project at the marginal level and carry out successful results in aquaculture.

In treatment 1, survival rate was higher (80%) in R_3 replicate but the number of total harvested fry was higher (18720 pieces TCP) in R_1. However, total harvested production was higher (90.65 kg) in R_2 with higher sampling weight during sampling periods. In treatment 2, sampling weight of R_1 was higher at 7th (0.97 g/fry) and 14th (2.47 g/fry) sampling days but R_3 was higher at 21st (3.21 g/fry) and 30th (3.01 g/fry) days. Survival rate was higher in R_2 (80%) but Total number of harvested fries were higher at R_3 (27300 pieces TCP) with total production too (82.17 kg). In treatment 3, sampling weight of R_1 was higher at 7th day (1.08 g/fry) but R_2 was picked at 21st (3.19 g/fry) and 30th days (2.99 g/fry) than R_1 with highest survival rate and production too. At 14th day, both replicates showed similar average sampling weight (2.81 g/fry).

In average, replicates T_2R_3 with medium stocking density provided the highest harvested fries (27300 pieces) but the total production (Table 6; 90.65 kg) as well as specific production (Fig. 7; 17%) was observed higher in T_1R_2 replicate with lower density. Box-whisker plots revealed that the range of growth variations were also higher in T_1R_2 replicate (Fig. 8). Survival rates were found higher in T_1R_3 and T_2R_2 (Fig. 2). The average survival rate was very low in T_3 (Fig. 3D). Rather than T_2 and T_3, all growth parameters of TCP included in T_1 were higher (Fig. 3A, B, C, E & F) during these experiments.

Figure 4 showed that the total harvested production picked rapidly (Fig. 4a) with less stocking density (Fig. 4b) along with all T_1 replicates. During 30 days of culture periods, average growth performance (Fig. 5) and fries' weights (Fig. 6) of all treatments was observed higher during the sampling at 21st day. Average growth of all treatments was gradually gone higher from 7 to 14 days

Table 6: Comparative stocking rate of TCP in various reports

Treatments	Fry size (g)	Stocking density (ind. /dec.)	Culture period	Production (Kg/ha)	Author
T_1	0.20	1200	30	2275.6357	This Study, 2015
T_2		1400		1708.252	
T_3		1600		1926.9458	
T_1	0.25	1000	100	16381.2	Chakraborty and Haque [25]
T_2				19851.6	
T_3				22063	
T_1	4.8-5.2	350	90	7093.84	Jannat *et. al.* [21]
T_2		400		7736.04	
T_3		550		9971.39	
T_1	0.15	300	120	6669	Halim *et al.* [27]
T_2		350		6246.63	
T_3		400		6086.08	
T_1	3.11	300		6480	Kohinoor *et al.* [33]
T_2	3.08	400		6384	
T_3	3.17	500		6617	

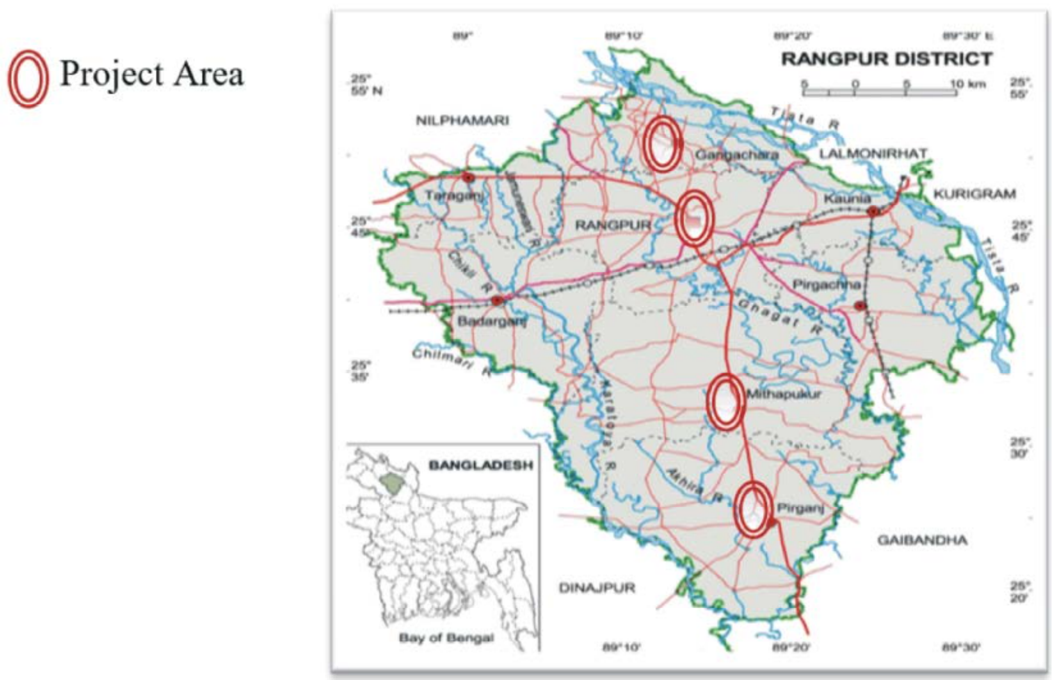

Fig. 1: Show the experimental area in the Rangpur District.

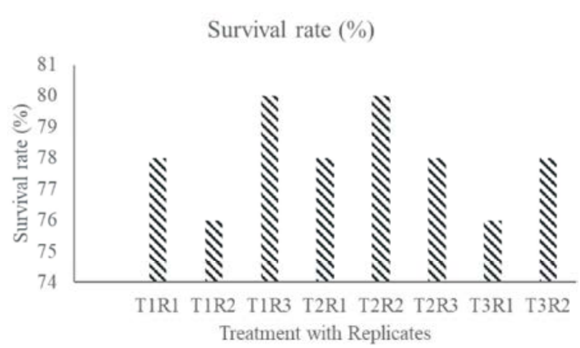

Fig. 2: Specific Survival of TCP under nursery management in different stocking densities.

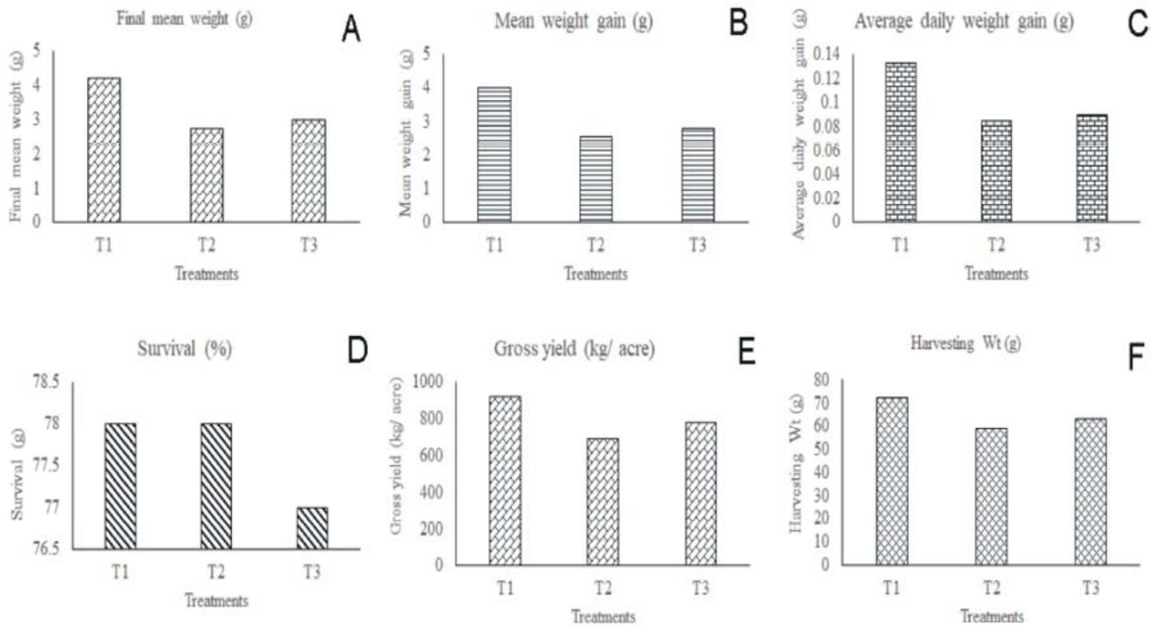

Fig. 3: Growth parameters of TCP in different treatments during 30 days of culture period.

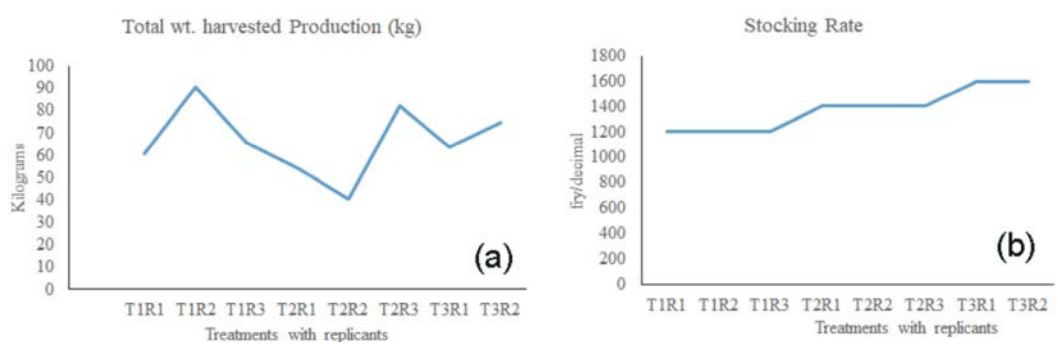

Fig. 4: Comparative view of stocking rate and fry production during study period.

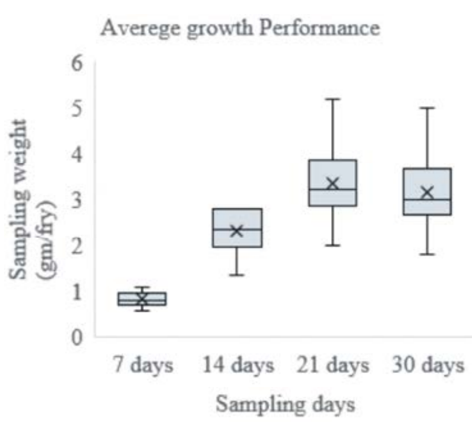

Fig. 5: Average Growth performance of TCP in grams per fries during sampling days

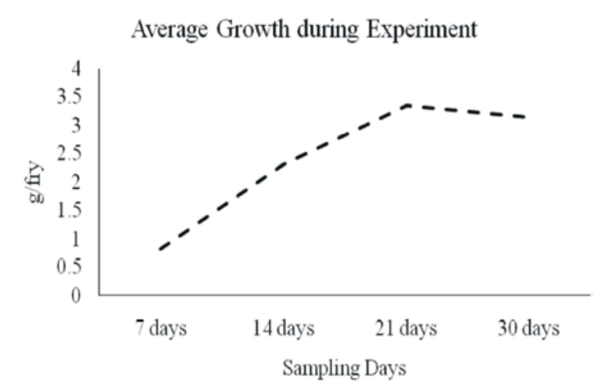

Fig. 6: Cumulative average growth in grams per fries of whole experiment

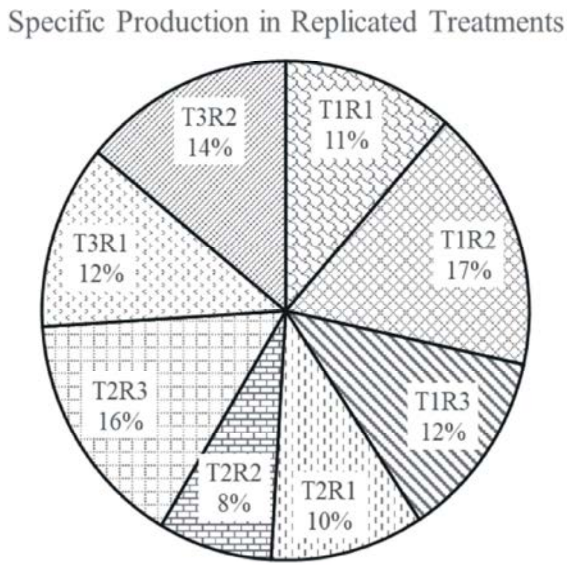

Fig. 7: Comparative production rates of all treatment in percentages with their replicants.

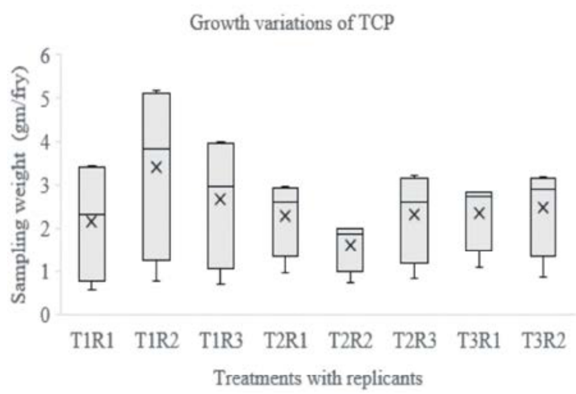

Fig. 8: Growth variations of TCP in gram per fries in different treatments.

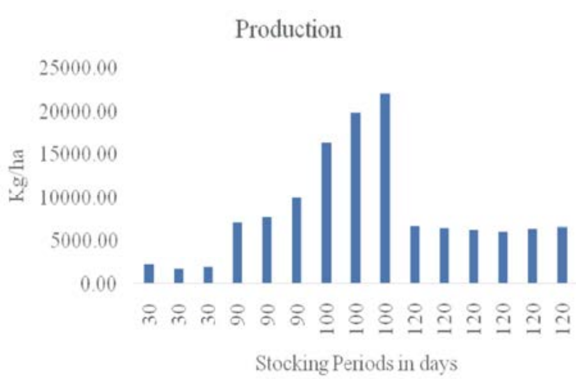

Fig. 9: Production rate of TCP in kilograms per hector with related stocking periods during tests in various reports from Table 6.

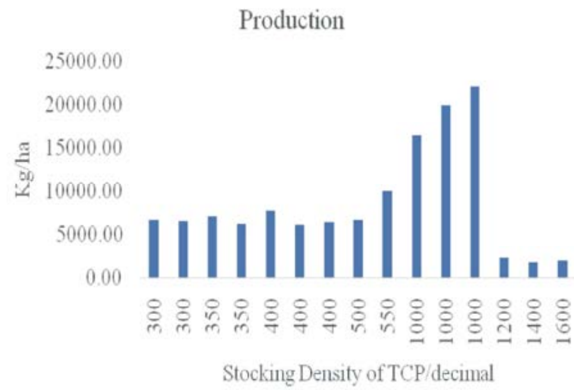

Fig. 10: Production rate in kilograms per hector of TCP with related stocking density per decimal in various reports from Table 6.

and it was picked at 21day. After that, it decreased slightly (Fig. 6). Similar distribution of average growth performances was also observed through all treatments (Fig. 5).

DISCUSSION

The present study maintained an approximate average stocking density from 1200-1600 TCP fries per decimal. Chakraborty and Haque [25] arranged 1000 TCP/decimal and obtained 22063 kg. ha^{-1}. days^{-100}. Increasing stocking density, present study observed 780-921 kg. acre^{-1} days^{-30} which is lower production than Chakraborty and Haque [25]. Jannat *et. al*. [21] managed higher production (2872-4,037 kg. acre^{-1} days^{-90}) with 350-550 TCP fries per decimal which is higher than [26]. It may state that, rather than moderate stocking rate, higher stocking density may causal to lower production of TCP.

Vietnamese climbing perch also showed higher production (6669 kg/ha) in lower stocking density (300-400) after 120 days [27]. In cage culture, Mondal *et al*. [19] showed the higher production of TCP with moderate stocking rate which is also supported by Habib *et al.* [28]. However, they used bigger size of fries in cage culture for higher production and moderate survival rate.

Fry sizes are also a factor for higher growth. Other fish (i.e. Labeo bata**)** maintained lower production rate in higher stocking density with small fries [29] and higher yield with higher stocking density (i.e. Labeo rohita) with big size fries [30]. In cage system, TCP showed 205 kg. ha^{-1}. days^{-120} gross yield with 2000

TCP/decimal [19]. Stocking period may also have some impact on production which is not reported by any researcher yet.

Present study used 1kg lime which is twice than report of Jannat *et al*. [21] and Chakraborty and Haque [25].Chakraborty and Haque[25] used cow dung more (10 kg/decimal) than twice of present study. They also used higher rate of food supply than this experiment (Table 3). Initial lengths were higher but initial weights were lower (Table 5) of TCP fries in this experiment than Chakraborty and Haque [25]. Jannat *et al*. [21] used older fries which obtained higher initial weights. All these parameters combined effects the higher production of TCP in their reports than present study.

During these experimental periods, FCR was near 1 which was higher in the treatments of Chakraborty and Haque [25] with lower average survival rate than present study. Highest survival rates were found in one replication of each T_1& T_2 treatments but the average higher survival rate was obtained by T_2. Pratyush *et al*. [31] reported higher growth in body weight of TCP by using higher protein feed. So, rather density, feed protein has an influence on growth. That's why all experiments were treated by same TCP feed from single company.

Compering with various studies, it revealed that average production rate was decreased by increasing culture period of TCP over 3 months (Fig. 9). It reduced rapidly by increasing stocking rate over 1000 TCP/decimal (Fig. 10). Though there were a lot of different amounts of parameters (Table 6) used in all reports, a cumulative work should be done to understand the best stocking density of TCP among 300-1600 individual/decimal. After fixing all parameters in all treatments and considering all situations, a higher production scenario was revealed with 1000 individual/decimal of TCP in 100 days culture period. Environmental conditions and feeding rates with fertilizing amounts have also some influences on this system. Thus, the socio-economic status of fishermen can increase by this culture system besides capturing fisheries [32].

CONCLUSION

Effect of stocking density on TCP stated that moderate density of TCP per decimal may provided higher production rate after managing all external parameters. However, further research should be done with fixed protein-based feed and all parameters along with economic stocking density to determine the profitable stocking value of TCP for marginalized fish farmers.

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