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EVALUATION OF DIFFERENT STOCKING DENSITY OF SMALL INDIGENOUS FISH PABDA WITH CARP POLYCULTURE SYSTEM

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Abstract

An experiment on the polyculture of carps with high valued small indigenous fish species (SIS) Pabda (*Ompok pabda*) was carried out for 152 days to evaluate the production performances of carp and pabda in some on-farm pond conditions in three Upazila of Jhenaidah district. Three stocking densities of Pabda were $T_1$500, $T_2$600, and T_3-700 fish per decimal where released, carp density was the same among the treatments at 246 nos/33 decimal. Fish was fed with commercial (sprectahexa, mega) pelleted feed at the same rate at the different stages of Pabda (0.66-50 gm BW @ 20%-4% twice a day respectively). The weight gain of Pabda was 40.965 ± 0.04, 35.17± 0.11 and 30.99 ± 1.17 g in T_1, T_2, and T_3 treatments, respectively. The production levels showed significant difference ($P<0.05$) among the treatments. The SGR (%) of Pabda was 2.76 ± 0.0006, 2.66 ± 0.002 and 2.58 ± 0.024 in T_1, T_2, and T_3, respectively that showed a significant difference ($P<0.05$) among the treatments. The weight gain of carp was 1177.24 ± 30.87, 1150± 0.001, 1154.85 ± 3.43 in T_1, T_2, and T_3, respectively, which was also significantly different ($P<0.05$) when ANOVA was performed. The water quality parameters like transparency and dissolved oxygen in the treatments showed significant differences ($P<0.05$) except temperature, pH, and ammonia nitrogen. The results of the present study demonstrated that the fishes showed better growth, survival, and production in the low stocking density of Pabda in T_1 treatment.

Keyword: Polyculture, Pabda (*Ompok pabda*), Carp, Stocking density, Pond

Introduction

The foundation of Bangladeshi aquaculture has been carp farming, the oldest known type of aquaculture worldwide. The rich ichthyofauna of Bangladesh has drastically degraded in recent years because to increased anthropogenic pressure on inland water supplies. The practice of commercial pabda fish farming is progressively gaining traction in the region. Along with other carp species including Rui, Catla, and Mrigal, the pabda is typically raised in ponds. Typically, the pabda is raised in ponds with other carp species including Mrigal, Rui, and Catla. The commercial pabda fish farming industry is highly lucrative and generates foreign exchange through exports to India, particularly from the districts of Jashore and Jhenaidah (Bangla Tribune, June 20, 2020). In the wild, pabda is an omnivore fish (Taleb *et al.*, 1991). According to Kohinoor *et al.* (1997), pabda farming with rajputi and small carp is profitable and appropriate for the environment in the area.

The native catfish Pabda is a member of the Siluriformes order within the family Siluridae. Due to several biological changes in inland water bodies, the number of catches of this fish has severely decreased in open waters such as rivers, beels, haors, etc. in recent years, and it is currently listed as an endangered species. Pabda has a dorso-ventrally flattened head and is elongated and laterally compressed. There are two pairs of barbells and a rounded nose. The pectoral fin has smooth spines, the caudal fin is forked with rounded lobes, and the superior mouth has a

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lower jaw. This species is found in freshwater and lotic environments. It grows to a length of 17 cm, and according to Mukhopadhyay and Ghosh *et al.* (2007), Pabda is distributed geographically over various South-east Asian nations, including Bangladesh, Pakistan, Afghanistan, and Myanmar. It is resilient to extreme weather, including low oxygen levels and large temperature swings. Due to its high market value and excellent nutritional content, this little fish is a significant component of the harvest in inland fisheries. People in Bangladesh, North East India, and East India find this species of fish to be delectable and nutrient-dense because of its rich lipoprotein content and flexible bone structure. A number of indigenous fish that are significant for commerce are seriously threatened, and some—like the gulsha (*Mystus cavasius*) and pabda—are in danger of going extinct (Akhteruzzaman *et al.*, 1991, 1993). Although its production can be boosted through cultural practices, it is difficult to obtain a significant quantity of pabda fry and fingerlings from natural sources for stocking in ponds. However, pabda fry and fingerlings produced through induce breeding are accessible. Furthermore, this species' fry and juveniles show cannibalistic tendencies (Parameswaran *et al.*, 1971), which poses a management challenge.

In Jenaidah, the district fisheries office recorded an annual carp production of 38,265.64 MT, which is significantly more than the district's Pabda production of 911 MT for the 2019–2020 fiscal year. Typically, the pabda is raised in ponds alongside other carp fish species including Mrigal, Rui, and Catla. In the area, commercial pabda farming is a very profitable enterprise (Bangla Tribune, June 20, 2020). In contrast, farmers using the Pabda and Carp polyculture method do not follow any prescribed density or feeding rate. Therefore, a good design research of pabda-carp polycutur esystem can assists to boost Pabda production in the region which is prior demand at this moment in the study area. The primary objective of the current investigation was to optimize the overall fish yield from the pabda-carp polyculture system within the region. The precise goals were to measure the growth, survival, and productivity of both carp and pabda at various stocking densities in the carp-pabda polyculture system, as well as to evaluate the various stocking densities of pabda and carp in the polyculture system.

Materials and Methods

Study area and duration

The study was carried out at Jhenaidah Sadar Upazila, Kaliganj Upazila, and Mahespur Upazila in Jhenaidah district. The research was carried out for 152 days to find out the growth, survival and production of carp and pabda at different stocking density of pabda with carp pabda polyculture system.

Experiment design

Three treatments with two replications each were used in the design of the current experiment; these treatments were called T1, T2, and T3, respectively. Per decimal (carp 246/33decimals) pond area, the fish stocking density for pabda-carp was 500+246 in T1, 600+246 in T2, and 700+246 in T3. In this case, carp was a stable fish species while pabda was changeable. Six farmer's ponds with an average depth of 4.5±1.03 feet each, measuring 33 decimal places (Sadar Upazila: 2, Kaliganj Upazila: 2, Mahespur Upazila: 2, and so on) were used for the experiment. The current study was divided into three treatments, each with two replications, and given the designations T1, T2, and T3, in that order. In T1, T2, and T3 treatments, the fish stocking density per decimal (carp 246/33decimals) pond area was 500+246; in T3, 600+246; and in T3. Here, the fish species that varied was carp, while pabda was stable. Six farmer's ponds with an area of 33 decimal feet each and an average depth of 4.5±1.03 feet were used for the experiment (Sadar Upazila: 2 ponds, Kaliganj Upazila: 2 ponds, Mahespur Upazila: 2 ponds).

Collection and release of fishes:

Carp was gathered from Kotchandpur Upazila and pakda from Jashore. Following a week of fertilization, all research ponds were supplied with Pabda (ABW: 0.66 gm) and Carp (ABW: 250 gm) (Rui: 99 nos/33 decimal, Catla: 33 nos/33 decimal, Mrigal: 66 nos/33 decimal, Silver 48 nos/33 decimals). The fish were given an hour to get used to the experimental setup before the experiment began.

Fish stocking:

The stocking of fish among the experiment ponds is presented in Table 1.

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Table 1. Stocking of fish in the experimental ponds of three treatments with two replications

Treatment		**Stocking densities of Pabda**					
		T_1-500		**T_2-600**		**T_3-700**	
Averag individual weight (g)	Pabda	0.66	0.66	0.66	0.66	0.66	0.66
	Carp	250.0	250.0	250.0	250.0	250.0	250.0
Stocking number (nos)	Pabda	16500		19800		23100	
	Carp	246		246		246	
Total stocking weight (kg)	Pabda	11.0		13.2		15.4	
	Carp	61.5		61.5		61.5	

Feeding

The fish was fed twice a day in the evening & late night with commercial (spectra hexa, mega) feed at various rate with the initial to final harvest which is shown in Table 2

Table 2. Feeding of experimental Pabda fish based on their average body weight

Average body weight (g) of pabda	**Feeding %**	**Feed size & type**
0.66	20	Powder
7	12	0.8 mm floating feed
20	8	0.8 mm floating feed
30	6	1.00 mm floating feed
40	5	1.00 mm floating feed
45	4	1.5 mm floating feed

For the Carp, the floating feed was also provided @ 3% BW once a day. Pond Care (Pro-biotic) was used 1g/decimal with 15 days intervals. Essential water quality parameters were recorded weekly and growth of fish was recorded after 15 days interval.

Post stocking management of fish

Fish health was monitored every three months using netting, adding fresh water to the pond to prevent oxygen deficiency, harrowing when too much gas accumulated in the bottom, and applying 1 kg/decimal lime at the start of winter to prevent epizootic ulcerative syndrome (EUS).

Water quality monitoring

To maintain a suitable atmosphere for carrying out the research work gently, all of the physico-chemical parameters of the water in the experimental ponds were checked and documented on a weekly basis. Every experimental pond's water temperature was routinely measured in Celsius using a thermometer during the study period. For the experiment, the mean value of the pond water temperature (ºC) was recorded. Using a Secchi disc with a 20 cm diameter, the water clarity of each experimental pond was routinely evaluated during the current study period. On-the-spot measurements of dissolved oxygen (DO) were made using a digital DO meter (YSI, model 58). SoT1 had a greater rate of weight growth than Treatments T2 and T3. When analyzed using ANOVA, the SPG of pabda values in T1, T2, and T3 (Table 4) indicated a significant difference at 2.76 ± 0.0006, 2.66 ± 0.002, and 2.58 ± 0.024 percent. Throughout the various treatments, the SPG pabda fluctuated. In T1, the highest value was recorded, and in T3, the lowest. Kohinoor *et al.* (2018) found that, with three treatments, the SPG of pabda is 1.38, 1.32, and 1.26% at 800, 1000, and 1200 fish/dec of pabda, respectively. Nonetheless, the current investigation discovered 2.76 ± 0.0006, 2.66 ± 0.002, and 2.58 ± 0.024% at 500, 600, and 700 fish/dec of pabda, respectively, using three treatments. These results are different, but both trials discovered the maximum SPG at the lowest stocking density that was in agreement.

Sampling of fishes

After a 15-day break, samples were taken using a seine net to monitor carp and pabda growth and modify the feeding schedule. Even though it was known that the small and insufficient sample size of 10–15 fish would not accurately reflect the true growth situation, the fish were nonetheless used to make some crude assessments of growth trends. The growth of carp and pabda in each sample was measured using a Denver-XP-3000 digital electronic balance (precision = 0.1 gram). Following a 152-day culture period, the research pond was dried out, and pabda and carp fish were gathered for the analysis.

Analysis of growth performance of the experimental fishes

The following equations were used to determine the growth parameters,

a) Weight gain (g):

Weight gain = Mean final weight − Mean initial weight

b) Percent weight gain (%):

$$\% \text{ Weight gain} = \frac{\text{Mean final weight} - \text{Mean initial weight}}{\text{Mean initial weight}} \times 100$$

c) Average daily gain (g):

$$\text{ADG (g)} = \frac{\text{Mean final weight} - \text{Mean initial prawn weight}}{T_2 - T_1}$$

d) Specific growth rate (% per day):

$$\text{SGR (\% per day)} = \frac{\log_e W_2 - \log_e W_1}{T_2 - T_1} \times 100$$

Where,

W_1 = Initial live body weight (g) at time T_1 (day)

W_2 = Final live body weight (g) at time T_2 (day)

Harvesting of fishes

On November 5, 2019, the fish were fully harvested following 152 days of raising. The main method used for the partial harvesting of fish was repeated netting using a seine net. Using a pump, the ponds were dewatered to complete the harvest. To determine the fish output and survival rate, all of the fish in each pond were gathered, weighed, and numbered throughout the harvesting process.

Statistical analysis of data

Data obtained from the present study were analyzed using the SPSS Version-20. ANOVA was performed on all the dependent variables to see whether the treatment had any significant effect or not. The level of significant was set at $P< 0.05$.

Results and discussions

Water quality parameters

The current study examined the water quality metrics in the experimental ponds to look for any noticeable changes that might have resulted from various treatments. Table 3 displays the overall mean values for each water quality measure across several treatments. Figures 1 through 5 show the monthly fluctuations in the water quality characteristics of the various treatments. The results were subjected to a one-way analysis of variance (ANOVA) to see whether or not there were any differences between the treatments. The results of which are shown in Table 3. The results of the physico-chemical water quality parameters of present study are presented in the Table 3.

Table 3. Physico-chemical water quality parameters of three treatments during the experimental period

Variables	Different stocking densities of Pabda		
	(T_1-500)	**(T_2-600)**	**(T_3-700)**
Transparency (cm)	28.43 ± 0.47^a	29.54 ± 0.66^b	28.48 ± 0.83^a
Temperature (°C)	29.22 ± 0.66^a	27.99 ± 0.57^b	28.32 ± 0.69^b
DO (mg l^{-1})	6.34 ± 0.71^a	5.62 ± 0.46^b	5.59 ± 0.45^b
pH	7.65 ± 0.43^a	7.37 ± 0.48^a	7.76 ± 0.30^a
NH_3-N (mg l^{-1})	0.13 ± 0.02^a	0.15 ± 0.03^a	0.14 ± 0.02^a

Here (T_1-500) refers to stocking density of pabda 500 nos/decimal, and Carp 246 nos/33 decimal. (T_2-600) refers to stocking density of pabda 600 nos/decimal, and Carp 246 nos/33 decimal. (T_3-700) refers to stocking density of pabda 700 nos/decimal, and Carp 246 nos/33 decimal

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Transparency (cm)

The mean ± SD values of transparency were 28.43 ± 0.47, 29.54 ± 0.66, & 28.48 ± 0.83 in T_1, T_2-600, and T_3 treatments, respectively.

It was discovered that the transparency of the experimental pond water varied little amongst treatments. Table 3 shows the average values of water transparency for each treatment. The average water transparency values for T1, T2-600, and T3 treatments were 28.43 ± 0.47, 29.54 ± 0.66, and 28.48 ± 0.83, respectively. Table 3. Between the treatments, there was no discernible variation in transparency (P>0.05). Figure 1 displays the monthly mean variations in pond water transparency (cm) for each treatment. In the T2 treatment, the highest transparency was observed in September, but in the T3 treatment, the lowest transparency was observed in July (Figure 1.)

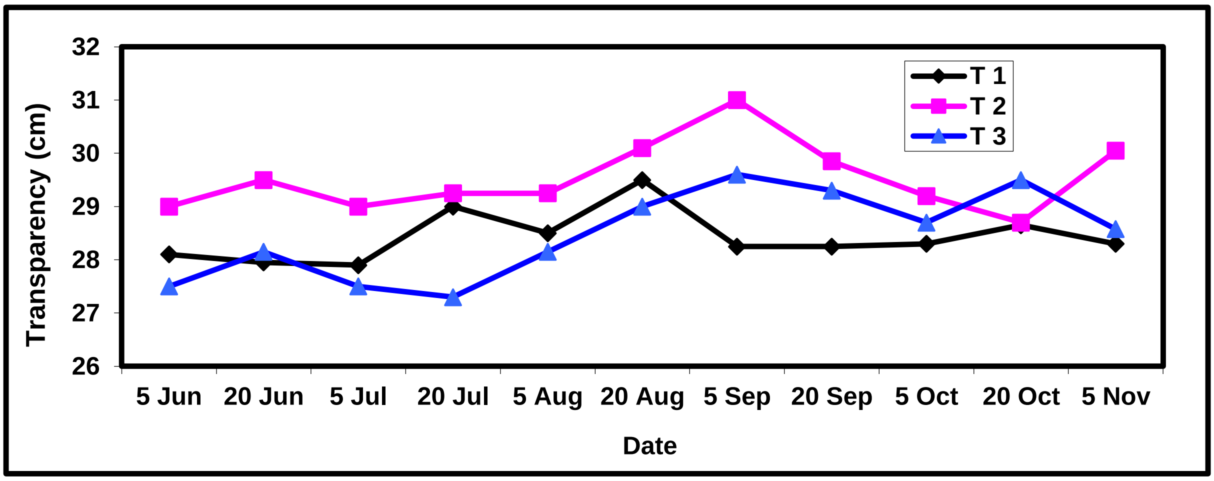


Figure 1. Transparency of the experimental ponds among three treatments

Temperature (°C)

It was discovered that the temperature of the water in the experimental pond was roughly identical across all treatments. Table 3 displays the average water temperature readings for each treatment. In T1, T2-600, and T3 treatments, the mean water temperature was 29.22 ± 0.66, 27.99 ± 0.57, and 28.32 ± 0.69, respectively (Table 3). There was no discernible difference in temperature (P>0.05) between the treatments.

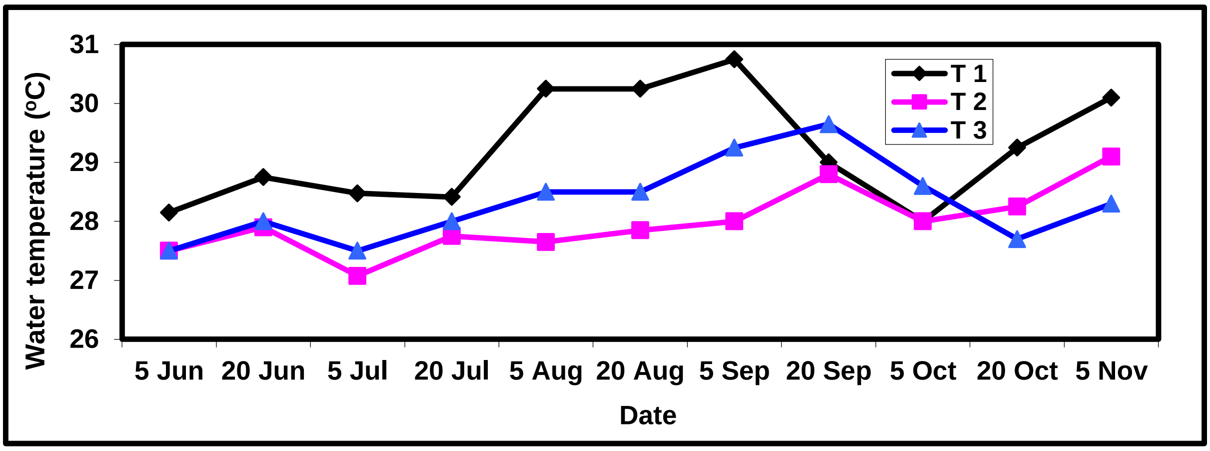


Figure 2. Temperature (°C) of the experimental ponds among three treatments

Monthly mean variations of pond water temperature (^{0}C) of different treatments are shown in Figure: 2. The maximum temperature was found during September in T_1 treatment while the mminimum temperature was found during July in T_2-600 treatment (Figure 2.)

Dissolved oxygen (mg l^{-1})

The mean values of DO were 6.34 ± 0.71 mg/l, 5.62 ± 0.46 mg/l, & 5.59 ± 0.45 in T_1, T_2-600, and T_3 treatments, respectively.

It was discovered that the dissolved oxygen (DO) in the experimental pond water varied little across treatments. Table 3 displays the average DO values of the experimental pond water under various treatments. In T1, T2-600, and T3 therapies, the mean DO concentrations were 6.34 ± 0.71 mg/l, 5.62 ± 0.46 mg/l, and 5.59 ± 0.45 mg/l, respectively (Table 3). There were no appreciable differences in dissolved oxygen (P>0.05) between the treatments. Figure 3 displays the monthly mean variations of DO (mg l-1) in pond water for various treatments. The T1 treatment's maximum DO was discovered in November, while the T2-600 treatment's minimum was discovered in July (Figure 3.)

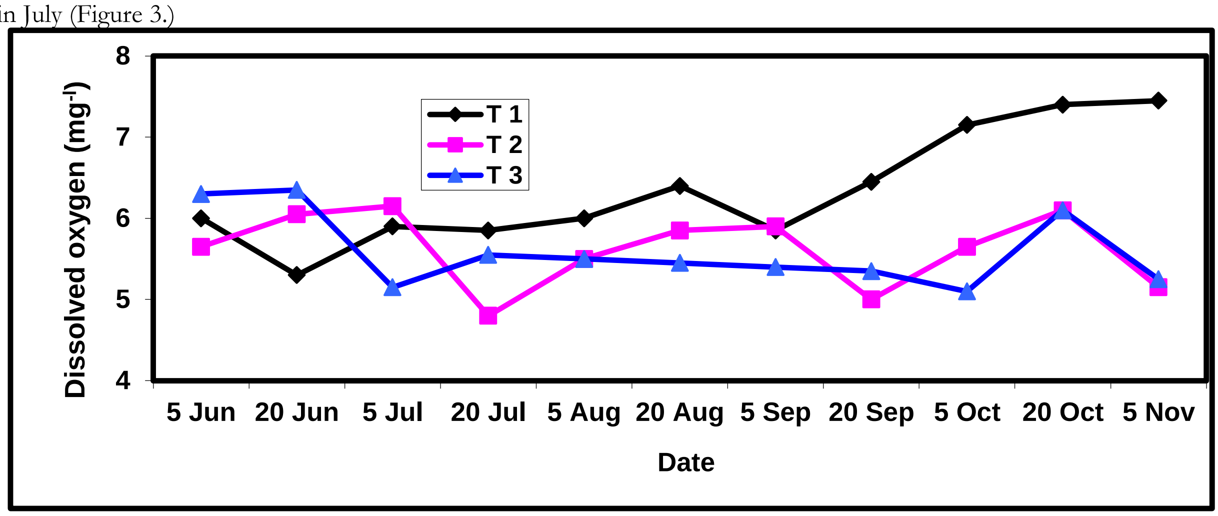


Figure 3. Dissolved oxygen (mg l^{-1}) of the experimental ponds among three treatments

pH (Hydrogen ion concentration)

The mean ± SD values of pH were 7.65 ± 0.43, 7.37 ± 0.48, 7.76 ± 0.30 in T_1, T_2-600, and T_3 treatments, respectively. Monthly mean variations of pond water pH of different treatments are shown in Figure 4.

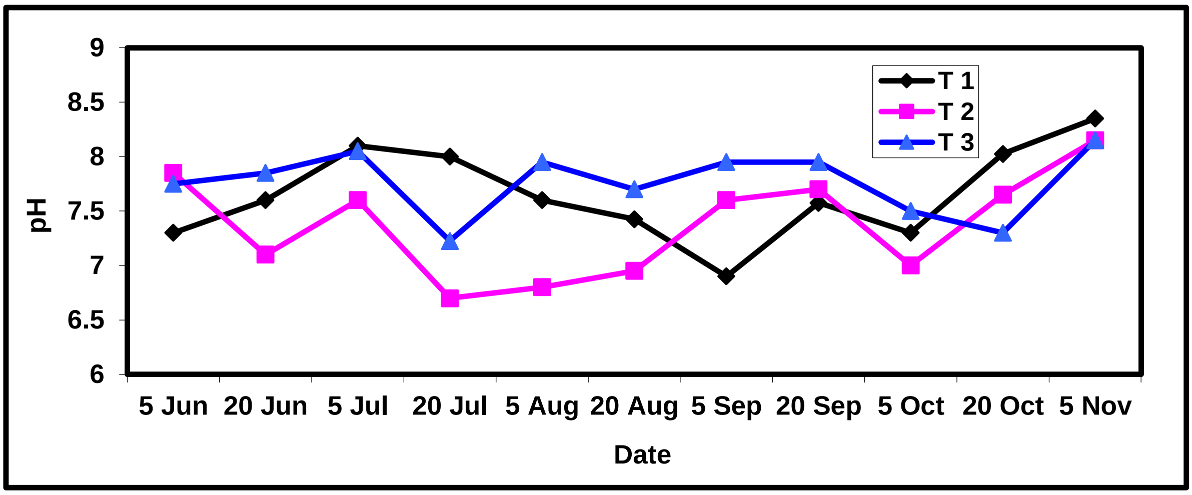


Figure 4. pH of the experimental ponds among three treatments

Ammonia-nitrogen (mg l^{-1})

The mean ± SD values of Ammonia were 0.13 ± 0.02, 0.15 ± 0.03, 0.14 ± 0.02 mg/l in T_1, T_2-600, and T_3 treatments, respectively. Monthly mean variations of pond water Ammonia-nitrogen (mg l^{-1}) of different treatments are shown in Figure 5.

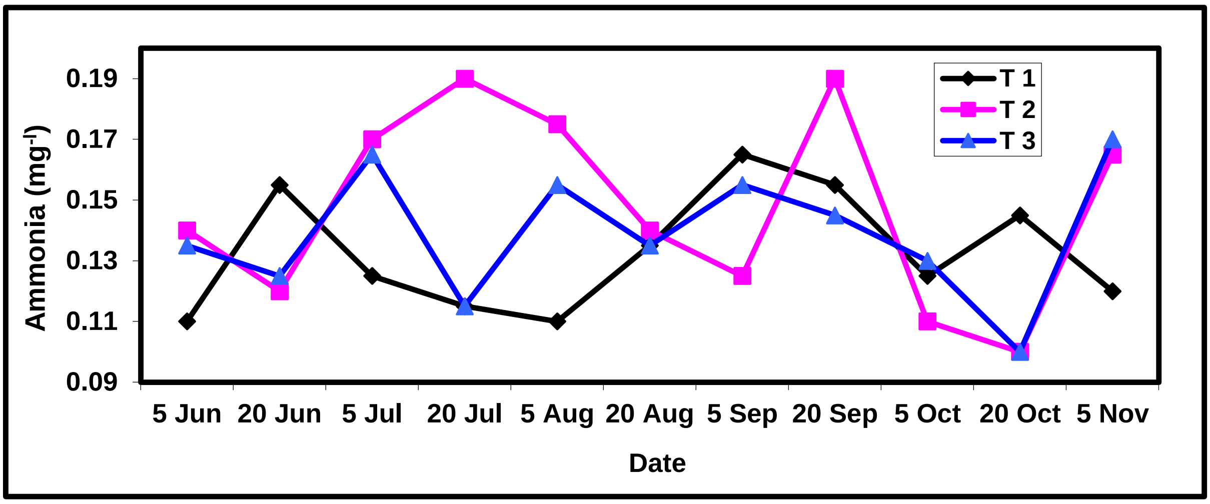


Figure 5. Ammonia-nitrogen (mg l^{-1}) of the water of experimental ponds among three treatments

Growth performance and survival of the experimental fishes

Growth performance and survival of the experimental fishes after 152 days rearing in the ponds are presented in Table 4 and Figures 6-8.

Table 4. Fish Production production and survival% of different stocking densities in three treatments.

Treatment	Different stocking densities of Pabda					
	(T_1-500)		(T_2-600)		(T_3-700)	
	Pabda	Carp	Pabda	Carp	Pabda	Carp
No of fishes harvested	13500	219	14999	223	16385	226
Total weight (g)	561937.5	312565.6	537414.2	311500.0	518585.3	317495.0
Weight gain (g)	40.965 ± 0.04^a	1177.24 ± 30.87^d	35.17 ± 0.11^b	1150 ± 0.001^e	30.99 ± 1.17^c	1154.85 ± 3.43^e
Weight gain (%)	6206.82 ± 5.36^a	470.90 ± 12.35^d	5328.79 ± 16.07^b	460.00 ± 0.01^e	4695.46 ± 177.85^c	461.94 ± 1.37^e
Daily weight gain (g/day)	0.27 ± 0.002^a	7.85 ± 0.21^d	0.23 ± 0.0007^b	7.67 ± 0.001^e	0.21 ± 0.008^c	7.70 ± 0.02^e
Specific Growth Rate (%d^{-1})	2.76 ± 0.0006^a	1.16 ± 0.01^d	$2.66 \pm .002^b$	1.15 ± 0.001^e	2.58 ± 0.024^c	1.15 ± 0.001^e
Survival (%)	81.82 ± 1.71^a	89.02 ± 1.72^d	75.75 ± 0.35^b	90.45 ± 1.43^e	70.93 ± 1.32^c	91.87 ± 0.57^f
Fish production (kg/dec/year)	40.86	22.73	39.08	22.65	37.72	23.09

Here (T_1-500) refers to stocking density of pabda 500 nos/decimal, and Carp 246 nos/33 decimal. (T_2-600) refers to stocking density of pabda 600 nos/decimal, and Carp 246 nos/33 decimal. (T_3-700) refers to stocking density of pabda 700 nos/decimal, and Carp 246 nos/33 decimal.

Survival rate (%):

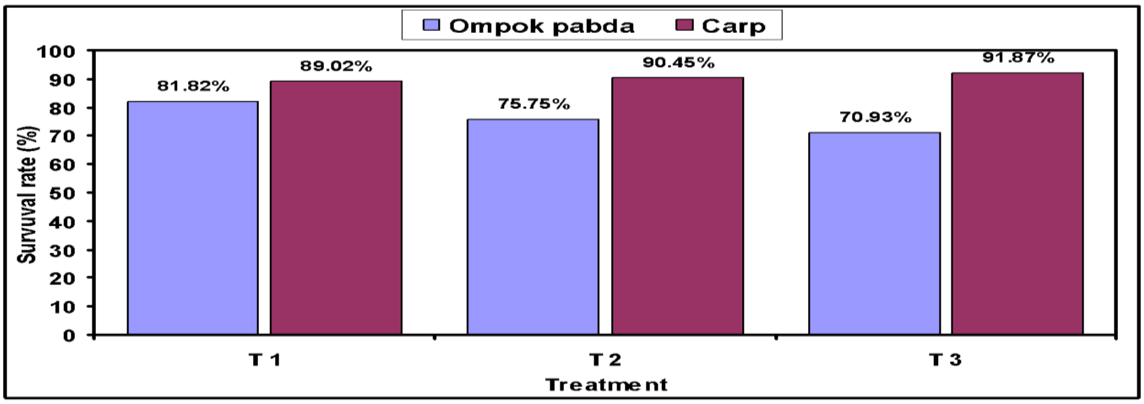


Figure 6. Survival rate (%) of the experimental fish (*Ompok Pabda* and Carp) fishes among three treatments.

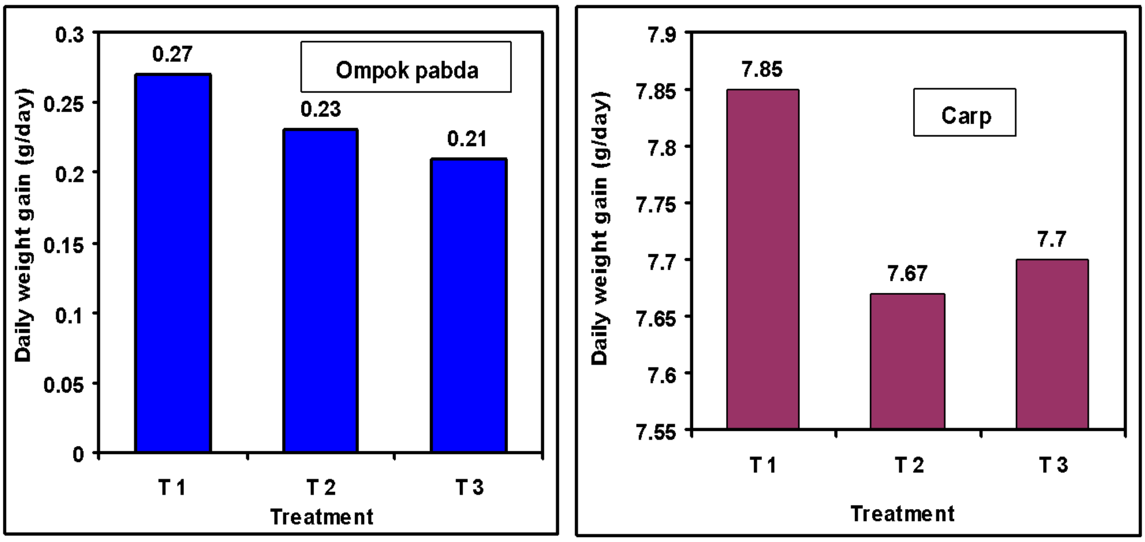
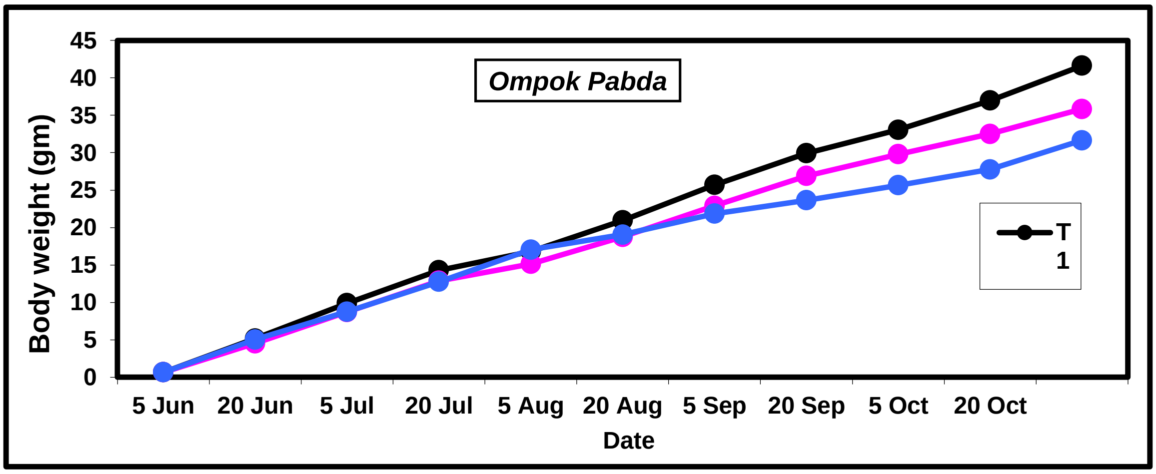


Figure 7. Daily weight gain of the experimental fish (g/day) among three treatments a). *Ompok Pabda* b). Carp



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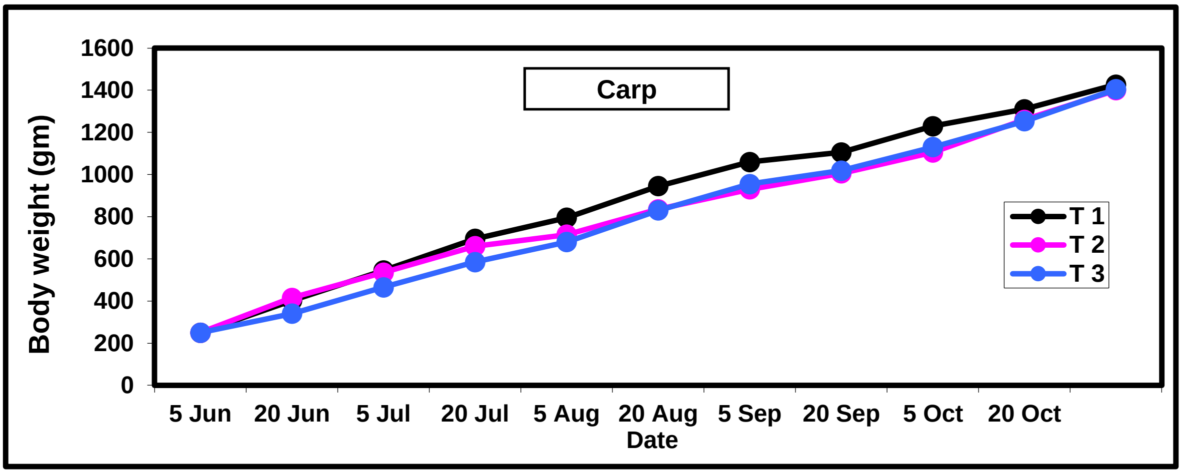

Figure 8. Daily weight of the experimental fish (gm) among three treatments a). Pabda b). Carp

Discussion

The water quality parameters in the current investigation were determined to be within the allowable range for fish culture for the entire experimental period. According to Table 3, the water transparency values for T1, T2, and T3 were 28.43 ± 0.47, 29.54 ± 0.66, and 28.48 ± 0.83, in that order. When an ANOVA was run, significant differences between the treatments were found ($p<0.05$). Boyd (1982) advised a transparency of between 15 and 40 cm for fish culture requirements. According to Rahman (1992), productive water bodies should have a transparency of 40 cm or less. Because there was less plankton available, transparency values increased as pabda stocking density increased. This suggests that pabda grazed more on plankton, which is not consistent with the findings of Parvez Chowdhury *et al.* (2019). In another study by Nahar *et al.* (2019) recorded transparency values ranging from 24 to 26 cm in pabda culture at cemented tank which is lower than the present study.

Table 3 displays the water temperature values in T1, T2, and T3 for the current investigation, which were 29.22 ± 0.66, 27.99 ± 0.57, and 28.32 ± 0.69°C, respectively. When an ANOVA was conducted, significant changes in water temperature across the treatments were found ($p<0.05$), and the results fell within the acceptable range for fish growth in tropical ponds (Jahan et al. 2013, Kohinoor et al. 2016). According to Boyd (1982), the water temperature range of 26.06 to 31.97 °C is ideal for fish culture. According to Table 3, the average dissolved oxygen concentrations in T1, T2, and T3 were 6.34 ± 0.71, 5.62 ± 0.46, and 5.59 ± 0.45 mg/l, in that order. While T2 did not change substantially from T3 treatment, T1's value was significantly ($p<0.05$) greater than T2's and T3's. The dissolved oxygen concentrations of the studied ponds showed variations among the treatments which might be due to variation in rate of dissolved oxygen consumption by fish and other animals through respiration. In T2 and T3, where fish stocking density was higher than in T1, a noticeably reduced concentration of dissolved oxygen was noted. Nonetheless, throughout the trial period, the variation in the dissolved oxygen contents in all of the treatment ponds' water was contained within the productive range (Boyd 1982). Similar findings were obtained by Majumder (2017), Mazid (2009), Sarker (2007), and Nahar (2019). The mean values of dissolved oxygen in the current experiment fell within an appropriate range for the culture of fish. The pH levels of the pond water under various treatments were found to be alkaline during the course of the investigation. Table 3 displays the average pH values for T1, T2, and T3 as 7.65 ± 0.43, 7.37 ± 0.48, and 7.76 ± 0.30, respectively. After performing an ANOVA, there was no significant difference in the pH of the water ($p<0.05$).Many writers have documented significant pH ranges in fertilized fish ponds, ranging from 7.18 to 7.24, 7.03 to 9.03, 6.8 to 8.20, and 7.50 to 8.20, and all of these ranges were productive (Kohinoor et al., 2009, 2012, 2016, 2018, Singh et al., 2017). The pH values obtained from the current experiment fall well within the specified range, demonstrating the pond's productive character.

Fish are poisonous to ammonia-nitrogen, and at high concentrations, this can result in fish death. Unionized ammonia-nitrogen mean values were 0.13 ± 0.02, 0.15 ± 0.03, and 0.14 ± 0.02 mg/l in T1, T2, and T3, respectively (Table 3). When comparing the treatments using an ANOVA, the differences were not statistically significant ($p<0.05$). Because there were a lot of fish in every treatment, unionized ammonia-nitrogen was detected in every treatment. According to New (1987), overuse of fertilizer and feed led to sedimentation on pond bottoms, which can release gasses like ammonia. In this experiment it might have happened. Due to the use of probiotics in the current experiment and low stocking density, Kohinoor et al. (2018) reported that the levels of unionized ammonia-nitrogen ranged from 0.28 to 0.145 mg/l at 800-1200 fish/dec stocking density in pond. These results are not comparable to those of the present investigation. Similar to the current investigation, Singh et al. (2017) revealed that ammonia-nitrogen concentrations in a pabda rearing pond ranged from 0.01-0.13 mg/l. Due to a distinct culture environment, Nahar (2019) reported mean ammonia-nitrogen values of pabda culture at cemented tank ranging from 0.25 to 0.70 mg/l, which differs from the current study. Less than 0.1 mg/l of ammonia nitrogen is the appropriate level for fish production ponds (Boyd 1982).

In T1, T2, and T3, the production of pabda was 561, 973.5, 537, 414.2, and 518, 585.3g, respectively (Table 4). The T1 produced the most fish, while the T3 produced the least. Fish output varied significantly ($p<0.05$), with T1 producing the most, followed by T2 and T3, in that order. It suggested that lower stocking densities were associated with the highest yield. Fish production of 2100-3600 at 500, 700, and 1000 pabda stocking densities per decimal water area were reported by Parvez et al. (2010) using three treatments. Even though the three treatments in the current study's value range of 1500–1700 g at 500, 600, and 700 stocking densities of pabda per decimal are different from the total output, both studies showed that the maximum overall production was at the lowest stocking density. Ompok pabda's weight gain in T1, T2, and T3 was 40.965 ± 0.04, 35.17 ± 0.11, and 30.99 ± 1.17 gin, respectively (Table 4). ANOVA comparisons revealed a significant difference ($p<0.05$) in the case of weight growth. Similar to the current investigation, Kohinoor et al. (2009) found that the greatest weight growth was achieved at lower stocking densities. Additionally, Kohinoor et al. (1991) showed that pabda in polyculture with rajputi and minor carp gained 28–33 g in weight over a six-month period. In contrast to the current study, the current experiment revealed weight gain of pabda30–41 gis. Compared to Treatments T2 and T3, SoT1 showed greater weight increase. ANOVA revealed a significant difference in the SPG of pabda values, which were 2.76 ± 0.0006, 2.66 ± 0.002, and 2.58 ± 0.024 percent in T1, T2, and T3, respectively (Table 4). The SPG pabda in each treatment changed from one treatment to another. T1 yielded the greatest value, while T3 produced the lowest. According to Kohinoor et al. (2018), the SPG of pabda with three treatments is 1.38, 1.32, and 1.26% at 800, 1000, and 1200 fish/dec of pabda, respectively. While the results of the three treatments at 500, 600, and 700 fish/dec of pabda were found to be 2.76 ± 0.0006, 2.66 ± 0.002, and 2.58 ± 0.024% in the current investigation, the results of the other two trials showed that the maximum SPG was found at the lowest stocking density, which concurred.

It was shown that the different stocking densities had an impact on the survival rate of pabda. The current study's reported survival rates were 81.82 ± 1.71, 75.75 ± 0.35, and 70.93 ± 1.32 in T1, T2, and T3, respectively (Table 4), demonstrating a statistically significant difference as determined by ANOVA. It was discovered that the stocking density affected the pabda survival rate. The results revealed that higher survival rate was found at lower stocking density which is similar to the other findings (Nahar *et al.,* 2019, Kohinoor *et al.*, 2007, Rahman *et al.*, 2018, Chowdhury *et al.*, 2019). The overall results of the present study demonstrated that among all the treatments, Treatment T_1 is suitable for Carp-pabda polyculture in Jheniadah District.

Conclusion

Due to the greater overall weight gain at the conclusion of the trial, Treatment T1 (500 nos. Ompok Pabda per decimal) is deemed appropriate for Ompok Pabda carp polyculture. But compared to other T1 and T2, carp output is higher in the case of T3. There were few variations in carp productivity. Following 152 days of raising, Ompok pabda's weight gain (gm) in T1, T2, and T3 was 40.965 ± 0.04, 35.17 ± 0.11, and 30.99 ± 1.17, respectively. There were significant differences ($P<0.05$) in the output levels between the treatments. Through ANOVA, the SGR (%) of Ompok pabda in T1, T2, and T3 were 2.76 ± 0.0006, 2.66 ± 0.002, and 2.58 ± 0.024, respectively, indicating a significant difference ($P<0.05$) among the treatments. The current study's recorded survival percentages were 81.82 ± 1.71, 75.75 ± 0.35, and 70.93 ± 1.32 for T1, T2, and T3, respectively. ANOVA revealed a significant difference in these survival rates. Carp weight gain was 1177.24 ± 30.87, 1150± 0.001, and 1154.85 ± 3.43 in T1, T2, and T3, respectively, and ANOVA revealed a significant difference ($P<0.05$). With the exception of pH and ammonia nitrogen, all treatments revealed significant differences ($P<0.05$) in transparency, temperature, and dissolved oxygen. The current study's findings showed that fish in the Jhenaidah district exhibited superior growth, productivity, and survival rates when the Pabda stocking density was low (500 fish per decimal place). Future studies employing an aerator in the pond and high stocking densities of Ompok Pabda carp in a polyculture system are required.

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Conflict of Interest

The authors declare no conflict of interest.

References

Akhteruzzaman.M, A.H.M. Kohinoor, M.S. Shah, & M.G. Hussain. 1919. Observation on the induced breeding of silurid catfish, *Mystus cavasius* (Ham.) in Bangladesh. Bangladesh Journal of Life Science, 14(1-2):101-105.

Akter R., 2011. Comparative study of nutritive value of three commercial fish feed and their effect on the growth and survival of tilapia (gift strain, *Oreochromis niloticus*) fry. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. P.53

Alam M.A., Rahman L., Khan M.M.R., & S.M.Z, Rahman. 2007. Allozyme marker for the analysis of genetic variation of cross koi, *Anabas testudineus* with their parents. Bangladesh Journal of Fisheries Research, 11: 163-171.

Ariyaratne, M. H. S. & S. S. De Silva, 2021. Performance of case-reared fingerlings of commonly cultured fish species in response of different feeds. In: Reservoir and culture-based fisheries: biology and management. Proceeding of international workshop held in Bangkok, Thailand from 15-28 February, 2000. pp. 359-366.

Austreng, E. & T. Storebakken, 1985. Practical formulation of salmonid diets with emphasis on fat and protein. Acts du Group de Travail Franco Norvegien sur 1 Aquaculture Proceedings of the Norwegian French Workshop on Aquaculture. IFREMER, Brest France 342 pp.

Bangla Tribune (Online newspaper), 20 June, 2020.

Begum, M., H. K. Pal., M. A. Islam & M. J. Alam. 2008. Formulation of quality fish feeds from indigenous raw materials and their effects on growth maturity of *Mystus gulio*. Journal of Bangladesh Agricultural University, 6(2):355-360.

Bhuiyan M.I.A., 2002. Effects of different supplementary feeding methods on growth of fish in carp polyculture. MS Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. 94 pp.

Boyd, C.E 1982. Water quality management for pond fish culture. Elsevier Science Publication Company. Amsterdam-Oxford- New York. 318.

Dewan, S., M.A. Wahab, M. C. M. Beveridge, M. H. Rahman & B. K. Sarker. 1991. Food selection, selectivity and dietary overlap among planktivorous Chinese and Indian major carp fry and fingerlings grown in extensively manage, rain fed ponds in Bangladesh. Aquaculture and Fisheries Management, 22: 277-294.

DoF, 2009. Fisheries Yearbook of Bangladesh. Department of Fisheries (DoF), Ramna, Dhaka.

DoF, 1996. Matsha Pakkah Shankalan. Directorate of Fisheries, Government of People's Republic of Bangladesh, Dhaka, Bangladesh. 81 pp.

FAO 2019. Fisheries Department, Fishery Information, Data and Statistics Unit, Fish stat Plus: Ver,2. FAO, Rome, Italy. Available at http://www.fao.org/fi/statist/FISOFT/FISHPLS

Hasan, M.R., 2001. Nutrition and feeding for sustainable aquaculture development in the third millennium. In: Aquaculture in the third millennium. technical proceedings of the conference on aquaculture in the third millennium (ed. R.P. Subasinghe, P. Bueno, M.J. Phillips, C. Hough, S.E. McGladdery and J.R. Arthur), Bangkok, Thailand, 20-25 February 2000, pp. 193-219. NACA, Bangkok and FAO, Rome.

Jahan. S, K., J. Chandra & D.R. Das. 2013. Growth performance of climbing perch Koi (*Anabas testudineus*) in monoculture and polyculture system. IRJALS. 2(3): 1-10.

Kohinoor A.H.M. 2018. Production potentials of pabda (*Ompok pabda*, Hamilton) in semi intensive management under different stocking densities. Bangladesh Journal of Fisheries, 30(1): 37-45.

Kohinoor. A.H, M. Akhteruzzaman, M. Hussain, M.G. & M.S. Shah. 1991. Observations on the Induced Breeding of Koi Fish, *Anabas testudineus* (Bloch) in Bangladesh. Bangladesh Journal of Fisheries, 14(1-2):73-77.

Kohinoor. A.H.M, Hossain M.A. & M.G. Hussain. 1997. Semi-intensive Culture and Production Cost of Pabda (*Ompok pabda*) with Rajpunti (*Puntius gonionotus*) and Mirror Carp (*Cyprrinus carpio* var. specularis) in Mini Ponds. Bangladesh Journal of Zoology, 25(2):129- 133.

Kohinoor. A.H.M, Islam. M.L, M.A Wahab. & S.H. Thilsted, 1998. Effect of Mola (*Amblypharyngodon mola* Ham.) on the Growth and Production of Carps in Polyculture. Bangladesh Journal of Fisheries, 2(2):119-126.

Kohinoor. A.H.M, Begum, M. & Hussain. M.G. 2004. Culture Potentials of Gulsha, Mystus cavasius in Monoculture Management under Different Stocking Densities. Bangladesh Journal of Fisheries Research, 8(2):95-100.

Kohinoor, A.H.M, M. Begum & M.G. Hussain. 2009. Evaluation of different stocking densities of two small indigenous fish Pabda (*Ompok pabda*) and Gulsha (*Mystus cavasius*) with Indian major carps in polyculture system. Iranian Journal of Fisheries Science, 8(1): 57-64.

Kohinoor A.H.M, Rahman M.M, Moniruzzaman. H.M & Chakraborty. S.C, 2011. Production Performance of Pabda (*Ompok pabda*) and Gulsha (*Mystus cavasius*) with GIFT Strain (*Oreochromis niloticus*) in On-Farm Management System. Bangladesh Journal of Fisheries Research, 15(16):27-36.

Kohinoor, A.H.M. 2016. Moshiur Rahman, M. Shahidul Islam & Yahia Mahmud, Growth and production performance of climbing perch, Thai koi and Vietnamese koi strain (*Anabas testudineus*) in Bangladesh. International Journal of Fisheries and Aquaculture Studies, 4(1):354-357.

Kohinoor, A.H.M, M. Moshiur Rahman & M. Shahidul Islam. 2017. Evaluation of production performances of koi (*A. testudineus*) with Shing (*H. fossilis*) and GIFT Tilapia (*O. niloticus*) in semi-intensive culture management. Journal of Entomological and Zoological Studies, 5(1): 446- 451.

Kamarudin, M. S., R. A. Rahman, Z. A. Azim, S. S. Siraj, & R. I. Hutagalung, 1987. Effect of four different diets on weight gain, specific growth rate, feed conversion ration and protein efficiency of P. Sutchi (flower) fingerlings. In: Advances in animal feeds and feeding in the tropics, Proceedings of the tenth annual conference of the Malaysian society of animal production, Genting Highlands, Pahang, Malaysia, April 2-4, 1987, pp. 192-196.

Majumder, T.H., P. Chowdhury, M. Shahjahan & M.S. Rahamn. 2017. Effects of population density on growth and production of tilapia in monoculture. MS Thesis, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, Bangladesh. Pp 79

Mazid, M.A, 2009. Impacts of fish population density in the growth and production of carps in polyculture system. MS Thesis, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh, Bangladesh. Pp 89

Mohammad Rafiqur Rahman, 2018. Effects of stocking density on the growth, survival and production of endangered bata, (Labeo bata) (Hamilton, 1822) in primary nursing. International Journal of Aquaculture and Biology, 6(3): 147-156.

Mollah MFA & MA Hossain, 1990. Effects of artificial diets containing different protein levels on growth and feed efficiency of catfish (*Clarias batrachus*). Indian Journal of Fisheries, 37: 251-259.

MoFL. 2004. Fish Feed Reference standards for Bangladesh. Ministry of Fisheries and Livestock, government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

Mukhopadhyay, T. & S. Ghosh, Lipid profile and fatty acids composion of two silurid fish eggs. Journal of Oleo Science, 56 (8): 390-403.

New, M.B. 1987. Food and feeding of fish and shrimp. Ext. Man. Aqua. Dev. Coor. Prog. ADCP/REP/87/26. FAO and UNEP. 275.

Nirod, D. B. 1997. Effects of stocking density on the growth and production of mola (*Amblypharyngodon mola*). M.S. dissertation. Department of Fisheries Management, BAU, Mymensingh, 75 pp.

Okoye, F. C. & I. G. Mbagwa. 1985. Duckweed (Lemna paucicostata Heglen externa Engle) in the diet of tilapia. In: Proc. 5th Annual conf. fish. soc. (ed by E.O.Ita, T. O.Ajayia, B. Ezenwa, A.A.Olaniawo, R.E.K.Udolisa, P.A.Taggert) Nigeria Fision. Port. Harcourt 26th -29th Nobember. pp. 136-140.

Omar, E. A., 1996. Optimum dietary protein level and stocking density for catfish (*Clarias lazera*) fingerlings in concrete ponds. Journal of Animal, Physiological and Animal Nutrition, 76: 122-131.

Parameswaran. S, C. & S. Selvaraj. 1971. Radhakrishnan, Notes on the life history and biology of the catfish *Ompok pabda* (Hamilton). Journal of Zoological Society, 23(2): 137-150.

Parvez Chowdhury. 2019. Production performance of Pabda (*Ompok pabda*) and Gulsha (*Mystus cavasius*) with Rohu (*Labeo rohita*) in polyculture management. Bangladesh Journal of Fisheries, 31(2): 205-210.

DOI: https://doi.org/10.53808/KUS.SI.2023.ISFMRT.1101-ls

Paramveer Singh. 2017. A study on growth performance and survivability of Ompok pabda (Hamilton 1822) fingerlings in earthen pond fed with different feed ingredients. International Journal of Fisheries and Aquatic Studies, 5(4): 289-294.

Rahman.M. S, 1992. Water quality management in aquaculture, BRAC Prokashana, Dhaka, Bangladesh. 24-25.

Rahman, M. M. 2000. Effect of addition of calbaush (*Labeo calbasu*) in the periphyton based Aquaculture system of rohu and catla. M. S. dissertation, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. 82 pp.

Seikai, T., T. Takeuchi & G. Park, 1997. Comparison of growth, feed efficiency, and chemical composition juvenile flounder fed live mysids and formula feed under laboratory conditions. Fisheries Science, 63(4):520-526.

Singh, P., S.K. Nayak & D. Reang. 2017. A study on growth performance and survivability of *Ompok pabda* fingerling in earthen pond fed with different feed ingredients. International Journal of Fisheries and Aquatic Studies, 5(4): 289-294.

Tacon A.G.J., & S.S. De Silva, 1983. Mineral composition of some commercial fish feeds available in Europe. Aquaculture, 38: 11-20.

Wahab, M.A., Z. F. Ahmed, A. Islam & S. M. Rahmatullah, 1995. Effect of introduction of common carp Cyprinus carpio (L) on the pond ecology and growth of fish in polyculture. Aquaculture Research, 26: 619-628.