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Study of the production performance by releasing carp fingerlings at selected floodplain of Kotalipara Upazilla, Gopalganj, Bangladesh

Md. A. Halim[1, 2*]

[1] International Institute of Aquaculture and Aquatic Sciences, Universiti Putra Malaysia (UPM), Port Dickson 71050, Malaysia

[2] Assistant Director, Bangabandhu Academy for Poverty Alleviation and Rural Development (BAPARD), Kotalipara, Gopalgonj-8110, Bangladesh

[*]Corresponding Author: (rabihalim@gmail.com ; robi21114@gmail.com

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ABSTRACT

This study was undertaken to conduct a study of the production performance by releasing carp fingerlings at selected floodplains of Kotalipara Upazilla, Gopalganj, Bangladesh for 210 days. Greater weight increase was statistically varied (P<0.05), daily rise in weight, survival rate, SGR, FCR and condition factor were highest at T_1 than T_2 and T_3. The weight gain (g) of fishes were found T_1 (Rohu: 1250.10±30.10, Catla: 1210.10±30.23, Mrigal: 1201.70±31.75, Silver carp: 1270.12±16.35, Sarputi: 506.15±17.75and Bata: 570.45±16.90) statistically (P<0.05) greater than T_2 and T_3. The FCR of species were found T_1 (2.50) drastically (P<0.05) best than T_2 (2.90) and T_3 (3.20). Specifically, the SGR (% day-1) and condition factor (K) of species were found to be similar in all the treatments. The production (kg/dec.) of species were found in T_1 (Rohu: 37.50±5.01, Catla: 7.26±5.03, Mrigal: 6.01±6.35, Silver carp: 6.35±3.27, Sarputi: 2.53±3.55and Bata: 3.42±2.82) statistically (P<0.05) superior to T_2 and T_3. The total production (kg/dec.) species were found T_1 (63.06±15.60) drastically (P<0.05) more than T_2 (47.76±23.04) and T_3 (49.31±42.36). The total expenditure (Tk/Dec) species were found T_3 (6,683.76±5.95) statistically (P<0.05) greater than T_1 (6,379.25±8.12) and T_2 (5,955.12±9.07). The BCR species were found in T_1 (1.26) drastically (P<0.05) more than in T_2 (1.21) and T_3 (1.12).

INTRODUCTION

Africa, Asia, and South America's subtropical and tropical regions are present in the majority of the world's seasonal floodplains **(Welcomme, 1979)**. The Himalayas dominate the topography of southern Asia **(Craig *et al.*, 2004)**. The Brahmaputra, Ganges, Indus, Mekong, and Yangtze are just a few of the enormous rivers that originate from the snowfields and glaciers of the Alps **(Craig *et al.*, 2004)**. For more than 4500 years, great civilizations have been supported by the silt-rich valleys and enormous Ganges-Brahmaputra deltas **(Beazley, 1993)**. Approximately 144,000 km^2 of Bangladesh, located in 20045'-26040' N; 88003'-90042' E, is made up of an alluvial delta created by the Ganges-Padma, Meghna, and Jamuna-Brahmaputra, river ecosystems and tributaries **(BBS, 2011)**. According to the FAO Agro-Ecological Zones (AEZ) plan the bulk of Bangladesh is made up of floodplains which make up about 80% of the country **(FAO/UNDP, 1988)**.

The world's richest fishery is located in Bangladesh's four million hectares of inland waterways and floodplains **(Sultana & Thompson, 2008)**. Inland waters total 4.69 million acres, with floodplains making up 58% of them (FRSS 2015). Bangladesh is a nation having extensive floodplains and one of the most significant wetlands in the world **(Ahmed, 1997; Khan, 1997)**. One of Bangladesh's main common-pool resources (CPRs) is floodplain waterbodies **(Thompson *et al.*, 1998; Sultana & Thompson, 2008)**. Floodplain waterbodies cover 2.8 million ha in Bangladesh **(FRSS, 2019)**. Numerous fish, plant, bird and other wildlife species find habitat in these wetlands, which are also a major livelihood option for millions of rural residents **(MACH, 1999; DFID, 2000)**. Together, the first two make up the tributary marshland and occupy 80,500 km^2 (or 55%) of the nation **(Brammer, 1997)**. Many inhabitants (800 people per km^2) in this country depend on the floodplains for their daily survival **(Craig *et al.*, 2004)**. It benefits people's food and nutrition status on a variety of levels, from farms and households to communities and the nation as a whole **(Filipski & Belton, 2018)**. Additionally, it raises asset value by creating income from the sale of fish and creating work possibilities, both of which have a major impact on the demand for and intake of food **(Belton & Little, 2011; Kassam & Dorward, 2017)**. Bangladesh is one of the top nations in the world for aquaculture industry, with a total output of 43.84 lakh MT in 2018-19 **(FRSS, 2019)**. Inland open water (catch) and inland closed water (culture) combined account for 28.19% (12.35 lakh MT) and 56.76% (24.89 lakh MT) of the total production, respectively **(FRSS, 2019)**. A number of wild creatures, especially fish, use the floodplain as a grazing, spawning, and rearing environment **(Tsai & Ali, 1987)**. The highest possible yields are found in tropical floodplains that are heavily exploited, at 110-160 kilogram/hector/year **(Bayley, 1988)**. In Bangladesh, the floodplains directly support about 6.7 million individuals of which 2.7 million individuals who are considered to be poor or extremely poor **(Dey & Prein 2005; Dey *et al.*, 2005; World Fish Center, 2005; FRSS, 2012)**. The production in the inundation zone area is currently just 283.00 kilogram/hector, but with earnest and coordinated community efforts, this level of output might be boosted tenfold **(FRSS, 2019)**. Fish farming on seasonal floodplains can be a useful strategy for boosting rural economies and agricultural productivity in a sustainable way **(Khan *et al.*, 1999; Dey & Prein, 2005; Nagabhatla *et al.*, 2012; Haque & Dey, 2017)**. During the monsoons, the marshland of Bangladesh coalesces into a single ecologically supply chain **(Craig *et al.*, 2004)**. Particles found in water and aqueous microalgae ability to fix nitrogen sustain and improve soil fertility **(Craig *et al.*, 2004)**. Even though the income is controlled by farming, the large numbers on the country's fishery for nutrition, that provide around 80% of the recommended intake for animal products **(Rashid, 2019)**. Bangladesh has 260 native freshwater bony fish species that are classified into 55 groups and 145 species **(Rahman, 1989)**. In Bangladesh, species assemblages differ greatly due to ecological variety and geographic province **(Halls *et al.*, 1998)**. Numerous of all these animals have indeed been divided into the two distinct behavioral and morphological groupings known as white fish and blackfish **(Welcomme, 1985; Halls *et al.*, 1998)**. There are 273 types of aquatic vertebrates with 13 of them being foreign, according to a conservative assessment **(Craig *et al.*, 2004)**. Twenty to thirty different species of fish, most of which are blackfishes that inhabit wetlands and can survive in low dissolved oxygen environments **(Craig *et al.*, 2004)**. Monsoon floodplains are nutrient-rich and serve as important adolescent and larvae nurseries for a variety of fish species **(Bayley, 1988; Junk *et al.*, 1989)**. Since 1970, erected drainage doors or turbines along embankments or silt dikes have either completely stopped or controlled Bangladesh's floodplain's yearly inundation of 1-2 million ha **(Siddiqui, 1990; ESCAPE, 2000)**. This diminution of the wetland is frequently cited as among the causes of Bangladesh's declining floodplain fisheries **(Compartmentalization Pilot Project, 1994; Halls *et al.*, 1998)**. However, there were also reports of inland fish stocks being overexploited **(Tsai and Ali, 1987; Ahmed, 1992; Graaf de *et al.*, 2001)**. Additionally, the growth may significantly change throughout the year and has been linked to the duration and intensity of water **(Halls *et al.*, 1999)**.

The study's goals were to assess production by releasing carp fingerlings at selected floodplain of Kotalipara Upazilla, Gopalganj.

MATERIALS AND METHODS

1. Site Selection

The research was conducted for a while of 210 days from July/2020 to February/2021. It has been located at the Kotalipara Upazilla (located at 22.9833°N 89.9917°E), Gopalganj, Bangladesh. Average area was 120.40±25.70 ha **(Fig. 1)**.

2. Floodplain preparation for culture

Aquatic weeds were manually pulled out of the floodplains after they were totally drained. All floodplains were limbed 1 kilogram per decimal. After fertilizing the floodplains combining TSP and urea at rates of 100 gm/decimal and 50 gm/decimal, respectively, one week later. After being soaked in TSP overnight, urea and TSP were combined and manually applied to the floodplains' water surface on a sunny day (10.00-11.00 am).

Fig. (1). Pictrol view of study areas

3. Collection of experimental fingerlings and experiment designs

The fingerlings were collected from Sonali Fisheries Hatchery, Kotalipara, Gopalganj.

4. Fingerlings Releasing

Fig. (2). Pictrol view of fingerling releasing

5. Feeding

In the floodplains of all treatments, fertilization was applied weekly at the same rate (100g/dec urea and 50g/dec TSP). The homemade feeding was supplied to the fingerlings at a rate of 10% of their weight gain at the beginning of the experiment; afterwards, this rate was lowered to 3%. Feed was applied twice daily, half at 9.00 am and the other half at 9.00 pm (4.00 pm).

6. Sampling

In order to monitor the growth of fingerlings and alter feeding rates, ten fingerlings of each species were sampled every 30 days using a cast net **(Table, 1)**. A portable digital balance was used to weigh the fingerlings during sampling **(Fig. 3)**.

Fig. (3). Pictorial view of sampling

Table (1): Fish species and the experimental design

SL	Treatments	Replications	Species name	Stocking Density (Dec^{-1})
1.	**T_1**	**3**	Rui (*Labeo rohita*)	50
			Catla (*Catla catla*)	10
			Mrigal (*Cirrhinus cirrhosis*)	10
			Sarputi (*Puntius sarana*)	10
			Silver carp (*H. molitrix*)	10
			Bata (*Labeo bata*)	10
2.	**T_2**	**3**	Rui (*Labeo rohita*)	60
			Catla (*Catla catla*)	10
			Mrigal (*Cirrhinus cirrhosis*)	10
			Sarputi (*Puntius sarana*)	10
			Silver carp (*H. molitrix*)	10
			Bata (*Labeo bata*)	10
3.	**T_3**	**3**	Rui (*Labeo rohita*)	70
			Catla (*Catla catla*)	10
			Mrigal (*Cirrhinus cirrhosis*)	10
			Sarputi (*Puntius sarana*)	10
			Silver carp (*H. molitrix*)	10
			Bata (*Labeo bata*)	10

7. Water quality parameters

For a period of 30 days, the following water quality characteristics were measured: temperature, biochemical oxygen demand, pH, ammonium, NO_2 and NO_3. A DO meter was used to measure the floodplain temperature and dissolved oxygen content. A pH meter was used to record the water's pH. Using API test kites, ammonia, nitrite, and nitrate concentrations were determined **(Fig. 4)**.

Fig. (4). Pictorial view of water quality parameters

8. Growth performance

Each 30 days sampling was randomly collected from each floodplain to measure their body weights. At final sampling, all fingerlings were counted. Survival rate, weight gain, Daily weight gain, FCR, SGR and Condition Factor (*K*) were calculated using following equations:

$$\textbf{Survival Rate (\%)} = \frac{\text{Number of harvested fish}}{\text{Number of stocked fish}} x100$$

$$\textbf{Weight gain (\%)} = \frac{\text{Mean final weight} - \text{Mean initial weight}}{\text{Mean initial weight}} x100$$

$$\textbf{Daily weight gain (DWG) (g/day)} = \frac{Wt - W0}{t}$$

Where: $\mathbf{W_t}$ and $\mathbf{W_0}$ are the final and initial bodyweight of the fishes, respectively, and **t** is the total duration of the grow-out trial in days.

$$\textbf{Feed conversion ratio (FCR)} = \frac{\text{Total amount feed given (g)}}{\text{Weight gain (g)}}$$

$$\textbf{Specific growth rate (SGR, \% day}^{-1}\textbf{)} = \frac{lnWf - lnWi}{t} x100$$

Where: $\mathbf{W_f}$= final weight, $\mathbf{W_i}$= initial weight and **t**= time in days

Fulton's condition factor (K): Fulton's condition factor (*K*) was calculated according to Htun-Han (1978) equation as per formula given below:

$$K=\frac{W}{L3}X100$$

Where: **k** = condition factor, **W** = average body weight (g), **L** = average body length (cm).

$$\textbf{Benefit-cost ratio (BCR)} = \frac{Total\ net\ return}{Total\ input\ cost}$$

9. Harvesting of fish

Following 210 days of growth, all of the floodplains' fish were totally collected by seine net. To evaluate the survival rate and production, every fish was counted and weighed separately throughout the harvest **(Fig. 5)**.

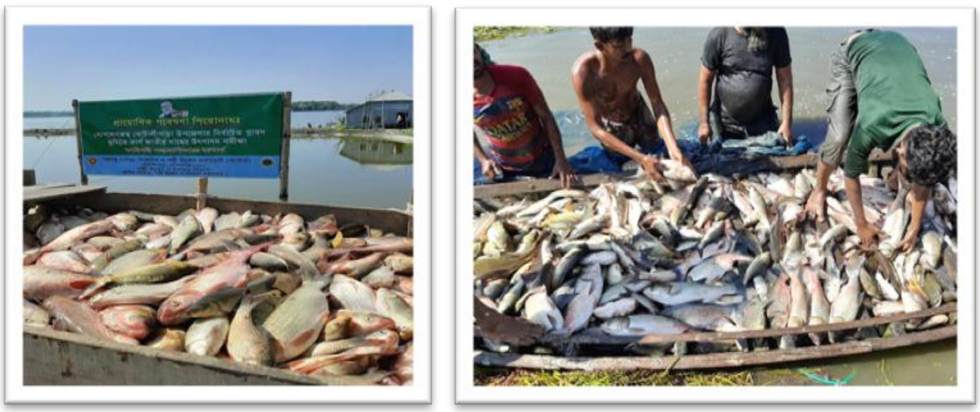

Fig. (5). Pictorial view of fish harvest

10. Statistical analysis

The SPSS version 25 was used for the statistical analysis. Normality and similarity of the modifications were performed via Shapiro-Wilks and Levene's test. A one-way analysis of variance (ANOVA) was employed to examine treatment differences. When significant differences were identified α threshold of 5% (P < 0.05); multiple range tests by Duncan have been used for post hoc comparison of mean between different groups. In the tables, all information was presented as mean and standard deviation, and significant difference at α = 5%.

RESULTS

1. Water Quality Parameters

Results in **Table (2)** showed the variations in the average values of various water quality metrics under various treatments over the entire month. The pH was same (not significantly, P>0.05) T_1 (7.8±0.50), T_2 (7.7±0.56) and T_3 (7.5±0.60). The ammonia (mg/L) was statistically (P<0.05) greater in T_3 (0.50±0.015) than T_1 (0.25±0.01) and T_2

(0.25±0.02). The dissolved oxygen (mg/L) was statistically (P<0.05) superior in T_1 (5.5±0.60) than T_2 (5.10±0.75) and T_3 (4.90±1.50). The temperature (°C) was same (not statistically, P>0.05) T_1 (28.50±0.0), T_2 (28.52±0.012) and T_3 (28.60±0.15). The nitrite (mg/L) was statistically, (P<0.05) greater in T_3 (0.50) than T_2 (0.25) and T_1 (0.00). The nitrate (mg/L) was statistically, (P<0.05) greater in T_3 (0.50) than T_2 (0.25) and T_1 (0.00).

Table (2): During survey period, various treatments were used to change water quality metrics

Water Quality Parameters	Treatments		
	T_1	T_2	T_3
pH	7.8±0.50[a]	7.7±0.56[a]	7.5±0.60[a]
Ammonia (mg/L)	0.25±0.01[a]	0.25±0.02[a]	0.50±0.015[b]
Dissolved oxygen (mg/L)	5.5±0.60[a]	5.10±0.75[b]	4.90±1.50[c]
Temperature (^{0}C)	28.50±0.01[a]	28.52±0.012[a]	28.60±0.15[a]
Nitrite (mg/L)	0.00[a]	0.25[b]	0.50[c]
Nitrate (mg/L)	0.00[a]	0.25[b]	0.50[c]

Mean ±SE within the same line with the same superscript do not differ statistically (P > 0.05), but distinct letters do differ considerably (p <0.05).

2. Growth and production

All growth parameters in terms of Survival rate, final weight, Daily weight gain, FCR, SGR and Condition Factor (K) were notably different across the treatments. Statistically significant (P<0.05) increases were recorded in weight gain, daily weight gain, survival rate, SGR, FCR and condition factor were the highest at T_1 than T_2 and T_3. The weight gain (g) of fishes were found T_1 (Rohu: 1250.10±30.10, Catla: 1210.10±30.23, Mrigal: 1201.70±31.75, Silver carp: 1270.12±16.35, Sarputi: 506.15±17.75 and Bata: 570.45±16.90) statistically significant (P<0.05) higher than T_2 and T_3 **(Tale 3)**.

The FCR species were found T_1 (2.50) statistically significant (P<0.05) superior than T_2 (2.90) and T_3 (3.20). The SGR (% day^{-1}) and Condition factor (K) species were found same all the treatments (Not significantly (P>0.05). The production (kg/dec.) of species were found T_1 (Rohu: 37.50±5.01, Catla: 7.26±5.03, Mrigal: 6.01±6.35, Silver carp: 6.35±3.27, Sarputi: 2.53±3.55 and Bata: 3.42±2.82) statistically significant (P<0.05) more than T_2 and T_3 **(Tale 3)**.

The total production (kg/dec.) species were found T_1 (63.06±15.60) significantly (*P*<0.05) higher than T_2 (47.76±23.04) and T_3 (49.31±42.36). The total expenditure (Tk/Dec) species were found T_3 (6,683.76±5.95) statistically significant (*P*<0.05) greater than T_1 (6,379.25±8.12) and T_2 (5,955.12±9.07). The BCR species were found T_1 (1.26) statistically significant (*P*<0.05) superior than T_2 (1.21) and T_3 (1.12) **(Tale 3)**.

Table (3): Details of stocking, survival rate, daily weight gain, FCR, SGR, and condition factor of species in the three therapies over the research periods (cultural period= 120 days)

Parameters	Species	Treatments		
		T_1	T_2	T_3
Initial length (cm)	Rohu	16.06±3.56	16.06±3.56	16.06±3.56
	Catla	16.41±4.60	16.41±4.60	16.41±4.60
	Mrigal	16.20±3.90	16.20±3.90	16.20±3.90
	Silver carp	15.40±6.50	15.40±6.50	15.40±6.50
	Sarputi	8.40±2.90	8.40±2.90	8.40±2.90
	Bata	8.61±0.00	8.61±0.00	8.61±0.00
Initial Weight (g)	Rohu	125.50±0.12	125.50±0.12	125.50±0.12
	Catla	120.40±0.15	120.40±0.15	120.40±0.15
	Mrigal	121.30±0.17	121.30±0.17	121.30±0.17
	Silver carp	123.25±0.11	123.25±0.11	123.25±0.11
	Sarputi	70.15±0.10	70.15±0.10	70.15±0.10
	Bata	72.12±0.15	72.12±0.15	72.12±0.15
Final Length (cm)	Rohu	$61.23±8.21^a$	$57.65±9.54^b$	$57.09±13.23^c$
	Catla	$60.25±6.50^a$	$57.45±8.35^b$	$52.94±10.24^c$
	Mrigal	$60.04±8.70^a$	$57.72±9.85^b$	$57.39±8.25^b$
	Silver carp	$61.73±10.60^a$	$57.97±13.90^b$	$54.40±15.80^c$
	Sarputi	$38.96±6.50^a$	$38.59±8.70^a$	$35.55±12.70^b$

	Bata	41.37±10.25a	38.66±12.80b	36.89±11.80c
Final Weight (g)	**Rohu**	1250.10±30.10[a]	1109.13±20.50[b]	1085.13±60.35[c]
	Catla	1210.10±30.23[a]	1100.17±21.90[b]	934.23±27.84[c]
	Mrigal	1201.70±31.75[a]	1110.62±12.56[b]	1098±34.25[c]
	Silver carp	1270.12±16.35[a]	1120.18±19.34[b]	986.50±23.50[c]
	Sarputi	506.15±17.75[a]	496.32±14.45[b]	421.80±18.70[c]
	Bata	570.45±16.90[a]	498.25±18.63[c]	453.75±22.78[b]
Survival Rate (%)	**Rohu**	60[a]	50[b]	40[c]
	Catla	60[a]	50[b]	50[c]
	Mrigal	50[a]	50[b]	40[c]
	Silver carp	50[a]	40[b]	60[c]
	Sarputi	50[a]	50[b]	40[c]
	Bata	60[a]	40[b]	50[c]
Average survival rate (%)		55[a]	46.67[b]	46.67[b]
FCR		2.50[a]	2.90[b]	3.20[c]
Daily weight gain (g/day)	**Rohu**	5.36±0.14[a]	4.67±0.10[b]	4.57±0.27[b]
	Catla	5.19±0.15[a]	4.66±0.10[b]	3.86±0.13[c]
	Mrigal	5.14±0.15[a]	4.71±0.05[b]	4.65±0.16[b]
	Silver carp	5.46±0.07[a]	4.75±0.09[b]	4.11±0.08[c]
	Sarputi	2.07±0.08[a]	2.02±0.06[b]	1.67±0.08[b]
	Bata	2.37±0.08[a]	2.03±0.09[a]	1.82±0.11[b]
Specific growth rate (SGR, % day^{-1})	**Rohu**	1.09±0.15[a]	1.04±0.25[a]	1.03±0.65[a]
	Catla	1.10±0.42[a]	1.05±0.75[a]	0.96±0.63[a]
	Mrigal	1.09±0.45[a]	1.05±0.35[a]	1.04±0.30[a]

	Silver carp	1.11±0.12[a]	1.05±0.45[a]	0.99±0.24[a]
	Sarputi	0.94±0.45[a]	0.93±0.25[a]	0.85±0.20[a]
	Bata	0.98±0.75[a]	0.92±0.42[a]	0.86±0.32[a]
Condition factor (*K*)	**Rohu**	0.54±0.05[a]	0.57±0.03[a]	0.58±0.06[a]
	Catla	0.55±0.04[a]	0.58±0.09[a]	0.66±0.03[a]
	Mrigal	0.55±0.08[a]	0.59±0.04[a]	0.58±0.06[a]
	Silver carp	0.54±0.03[a]	0.56±0.07[a]	0.61±0.05[a]
	Sarputi	0.86±0.12[a]	0.86±0.05[a]	0.94±0.09[a]
	Bata	0.81±0.08[a]	0.86±0.06[a]	0.88±0.05[a]
Production (Kg/Dec.)	**Rohu**	37.50±5.01[a]	27.73±4.10[c]	30.38±15.06[b]
	Catla	7.26±5.03[a]	5.50±4.38[b]	4.67±5.57[c]
	Mrigal	6.01±6.35[a]	5.55±2.51[b]	4.39±8.56[c]
	Silver carp	6.35±3.27[a]	4.48±4.83[c]	5.92±3.92[b]
	Sarputi	2.53±3.55[a]	2.48±2.89[a]	1.68±4.68[b]
	Bata	3.42±2.82[a]	1.99±4.65[c]	2.27±4.56[b]
Total production (Kg/Dec.)		63.06±15.60[a]	47.76±23.04[c]	49.31±42.36[b]

Mean ±SE within the same line with the same superscript do not differ statistically (P > 0.05), but distinct letters do differ considerably (p <0.05).

3. Economic Analysis

The fingerling cost was (Av.15 Tk/pic) during the experimental time. The feed requirement (Kg/Dec) was T_2 (138.50±0.30) statistically significant (P<0.05) lower than T_1 (157.64±0.27) and T_3 (157.79±0.20). The feed cost (Homemade, 30Tk/Kg) was T_3 (4733.76±5.95) statistically significant (P<0.05) higher than T_1 (4,729.25±8.12) and T_2 (4,155.12±9.07). The total expenditure (Tk/Dec) species were found T_3 (6,683.76±5.95) significantly (P<0.05) higher than T_1 (6,379.25±8.12) and T_2 (5,955.12±9.07). The net return (Tk./dec.) species were found T_1 (1,687.95) statistically significant (P<0.05) than T_2 (1,276.08) and T_3 (833.44). In 1999 and 2000, respectively. The BCR species were found T_1 (1.26) statistically significant (P<0.05) higher than T_2 (1.21) and T_3 (1.12).

Table (4): Economic analysis of species in the three treatments during the study periods

Components	Treatments		
	T_1	T_2	T_3
Expenditure (Tk/Dec)			
Fingerling Cost (Av.15 Tk/pic)	1,500.00	1,650.00	1800.00
Feed requirement (Kg/Dec.)	157.64±0.27[a]	138.50±0.30[b]	157.79±0.20[a]
Feed Cost (Homemade) [30Tk/Kg]	4,729.25±8.12[b]	4,155.12±9.07[c]	4733.76±5.95[a]
Lime Cost	50.00	50.00	50.00
Operational cost	100.00	100.00	100.00
Total expenditure (Tk/Dec)	6,379.25±8.12b	5,955.12±9.07c	6,683.76±5.95a
Income			
From Target Return (120Tk./Kg)	7,567.20±12.90[a]	5,731.20±15.45[c]	5,917.20±16.90[b]
Weed Fish Return	500.00	1,500.00	1,600.00
Gross Return	8,067.20±12.90[a]	7,231.20±15.45[c]	7,517.20±16.90[b]
Net Return (Tk./Dec)	1,687.95[a]	1,276.08[b]	833.44[c]
BCR	1.26[a]	1.21[b]	1.12[c]

Mean ±SE within the same line with the same superscript do not differ statistically (P > 0.05), but distinct letters do differ considerably (p <0.05).

DISCUSSION

The measures of water quality that were measured over the entire experiment fell within the acceptable range for fish culture **(Jhingran, 1991)**. The pH was same (not significantly, P>0.05) T_1 (7.8±0.50), T_2 (7.7±0.56) and T_3 (7.5±0.60). The average pH level suggested ideal conditions for aquatic species' best growth and health **(Hora & Pillay, 1962)**. Many authors have noted that pH can differ wildly from 7.18 to 9.24 **(Kohinoor *et al.*, 1998)**, 7.03 to 9.03 **(Roy *et al.*, 2002)**, 6.8 to 8.20 **(Begum *et al.*, 2003)** and 7.50 to 8.20 **(Chakraborty *et al.*, 2005; Rahman *et al.*, 2005)** in fertilized fish pond. The ammonia (mg/L) was statistically significant (P<0.05) in T_3 (0.50±0.015) than T_1

(0.25±0.01) than T_2 (0.25±0.02). The average ammonia level was 0.25±0.05 and 0.25±0.10 in T_1 and T_2 **(Singh *et al.*, 2017; Nabi *et al.*, 2020)**. The DO (mg/L) was statistically significant ($P<0.05$) in T_1 (5.5±0.60) than T_2 (5.10±0.75) than T_3 (4.90±1.50). The optimal level of DO is 5-15 mg/l **(Biswas *et al.*, 2009)**. Both direct and indirect information, such as stratification, microbial activity, respiration, and the supply of nutrients are provided by its proximity to a water body **(Premlata, 2009)**. The temperature (°C) was same (not significantly, $P>0.05$) T_1 (28.50±0.0), T_2 (28.52±0.012) and T_3 (28.60±0.15). The temperature changes among some of the methods of treatment were discovered to be comparable and within the range necessary for intensive aquaculture in tropical wetlands **(Roy *et al.*, 2002; Begum *et al.*, 2003; Kohinoor *et al.*, 2004)**. The nitrite (mg/L) was statistically significant ($P<0.05$) in T_3 (0.50) than T_2 (0.25) and T_1 (0.00). NO_2 is hazardous (harmful or death) to several fishes at 2 ppm (mg/L) and above; the acceptable threshold of nitrite for aquaculture farms was 0.3 mg/L (**Boyd, 1990)**. The nitrate (mg/L) was statistically significant ($P<0.05$) in T_3 (0.50) than T_2 (0.25) and T_1 (0.00) similar to **(Biswas *et al.*, 2009)**.

The weight gain (gm) of species were found T_1 (Rohu: 1250.10±30.10, Catla: 1210.10±30.23, Mrigal: 1201.70±31.75, Silver carp: 1270.12±16.35, Sarputi: 506.15±17.75 and Bata: 570.45±16.90) significantly ($P<0.05$) higher than T_2 and T_3. The contribution of tilapia, an invasive species, was highest in the Khirai floodplain (36.40%), *Hypophthalmichthys molitrix* comes next (16.89%) **(Akter *et al.*, 2013)**. While catla (3.07%), bata (0.63%), and kalibaus (0.18%) donated relatively slight to the overall fish production, the carp species rohu and mrigal made only small contributions (6.13% and 8.03%, respectively) **(Akter *et al.*, 2013)**. The average survival rate (%) species were found T_1 (55) significantly ($P<0.05$) higher than T_2 (46.67) and T_3 (46.67). The general life expectancy was 53.50% and was roughly the same in each of the two farmed wetlands **(Akter *et al.*, 2013)**. It was discovered that the seasonal floodplains' stocked fish had an average survival rate of 46.22±2.12% **(Ahmed, 1999)**. The FCR species were found T_1 (2.50) statistically significant ($P<0.05$) than T_2 (2.90) and T_3 (3.20) similar to **(Nabi *et al.*, 2020)**. The SGR (% day^{-1}) and Condition factor (*K)* species were found same all the treatments (Not significantly ($P>0.05$) similar to **(Roy *et al.*, 2002)**. The feed requirement (kg/dec.) species were found T_1 (157.64±0.27) and T_3 (157.79±0.20) statistically significant ($P<0.05$) than T_2 (138.50±0.30). In Khirai wetland, the typical total amount of feed consumed per hectare was 14931 kg and in Angrail floodplain, it was 4295 kg/ha **(Akter *et al.*, 2013)**. In Khirai floodplain, fertilizers (urea, TSP, and cow dung) were utilised at a rate of 9188 kg per hectare, while in Angrail floodplain, that rate was 2649 kg per hectare **(Akter *et al.*, 2013)**. The net return (Tk./dec) species were found T_1 (1,687.95) significantly ($P<0.05$) higher than T_2 (1,276.08) and T_3 (833.44). In Khirai floodplain with an ordinary net revenue of Tk. 71656 per ha, fishing industry generated a total average revenue of Tk. 281306 per ha, while in two seasonal culture-based floodplains, it was Tk. 111930/ha with a net income of Tk. 49580/ha **(Akter *et al.*, 2013)**.

The production (kg/dec.) of species were found T_1 (Rohu: 37.50±5.01, Catla: 7.26±5.03, Mrigal: 6.01±6.35, Silver carp: 6.35±3.27, Sarputi: 2.53±3.55 and Bata: 3.42±2.82) statistically significant (P<0.05) than T_2 and T_3. The total production (kg/dec.) species were found T_1 (63.06±15.60) statistically significant (P<0.05) than T_2 (47.76±23.04) and T_3 (49.31±42.36). The number of fish produced in the floodplain might range from 50 to 400 kg ha^{-1} annually, and most of the fish are consumed fresh **(Craig *et al.*, 2004)**. Floodplains make up 63% of the total inland production in the open water fisheries **(Craig *et al.*, 2004)**. The total expenditure (Tk/Dec) species were found T_3 (6,683.76±5.95) significantly (P<0.05) higher than T_1 (6,379.25±8.12) and T_2 (5,955.12±9.07). Average fish marketing costs were determined to be Tk. 15195.20/ha in the Khirai floodplain and Tk. 1728.17/ha in the Angrail floodplain, both of which contributed an average of 2.77 percent to overall costs **(Akter *et al.*, 2013)**. The net return (Tk./dec.) species were found T_1 (1,687.95) statistically significant (P<0.05) than T_2 (1,276.08) and T_3 (833.44). In 1999 and 2000, respectively, the total revenue (i.e., income from both paddy and fish) was US$991/ha and US$958/ha **(Dey & Prein, 2005)**. The BCR species were found T_1 (1.26) statistically significant (P<0.05) higher than T_2 (1.21) and T_3 (1.12). The average BCR for the Khirai wetland was 1.33, while it was 1.79 for the Angrail wetland, indicating that fish culture in periodic wetlands is lucrative under the existing set of planning practices **(Akter *et al.*, 2013)**.

CONCLUSION

It is necessary to acquire knowledge about stocking operation and proper use of surplus nutrients and fish food in the wetland. Fish production from floodplains may need to be increased by scientific management practices such proper fish keeping programs, acceptance of fisheries based on culture, restoration of current fish ecosystems in wetlands, and fish populations management. The total production (kg/dec.) species were found T_1 (63.06±15.60) significantly (P<0.05) higher than T_2 (47.76±23.04) and T_3 (49.31±42.36). The total expenditure (Tk/dec.) species were found T_3 (6,683.76±5.95) statistically significant (P<0.05) than T_1 (6,379.25±8.12) and T_2 (5,955.12±9.07). The BCR species were found T_1 (1.26) statistically significant (P<0.05) higher than T_2 (1.21) and T_3 (1.12). The finding of this experiment was that lower stocking density produces high production with low expenditure.

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