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Optimum stocking density of stinging catfish (*Heteropneustes fossilis*) based carp polyculture in homestead ponds in a drought prone area of Bangladesh

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Abstract. An experiment was conducted during July to December, 2020 to optimize the stocking density of *Heteropneustes fossilis* while farming with carps (Rohu, *Labeo rohita*; catla, *Catla catla*; and silver carp, *Hypophthalmichthys molitrix*) in homestead ponds of Tanore upazila (sub district) in Rajshahi district, Bangladesh. Three different stocking densities of stinging catfish were tested under three treatments such as T_1:98800 fish/ha; T_2:123500 fish/ha; and T_3:148200 fish/ha in polyculture ponds stocked with similar density (988 fishes/ha) of carps (*L. rohita* 25%, *C. catla* 25% and *H. molitrix* 50%). Stinging catfish was fed with 35% protein content diet. Water quality was monitored monthly and found within acceptable range for fish culture. Treatment T_2 varied significantly ($P<0.05$) for total fish yield, net return and cost benefit ratio.

Key words: *Heteropneustes fossilis,* Polyculture, Stocking density, Drought

Introduction

Farming of short cycle and high valued species with over wintered carp is important for effective utilization of homestead ponds (Nabi *et al.* 2020). Stinging catfish, *Heteropneustes fossilis* is considered as a high valued aquaculture species in many Asian countries (Akand *et al.* 1991). This species is a highly nutritious, palatable, tasty and well preferred because of its less spine, less fat and high digestibility in many parts of Indian subcontinent (Khan *et al.*, 2003). It is characterized by an accessory respiratory organ (air breathing organ) which enables it to exist for hours when out of water or in indefinitely oxygen-poor water and even in moist mud (Ali *et al.* 2014). This fish was naturally abundant in past but destruction of breeding ground due to environmental pollution and other causes results in less availability at present (Hossain *et al.*, 2015) and has been listed as a threatened species (IUCN 2000). This indicates the necessity of aquaculture of this species through proper utilization of different waterbodies available in the country. Stocking density is one of the most important factors affecting fish growth (Garr *et al.* 2011). The problems of intensive stinging catfish farming are encountered as higher investment, lower survival rates, smaller harvesting sizes and higher feed conversion ratio (FCR) with the increase in stocking densities, deterioration of water quality with higher level of unionized ammonia (Rahman *et al.* 2014) due to release of fish feces and nutrient into water resulting planktonic bloom and natural food organisms that produced in the pond remain unused (Samad *et al.* 2017). There are several research efforts for exploring the potentials of farming of stinging catfish (Chakraborty and Nur 2012, Saokat *et al.* 2017), feed and nutrition (Samad *et al.* 2017) and stocking density (Ali *et al.* 2017; Kohinoor *et al.* 2012, Rahman *et al.* 2014, Samad and Bhuiyan 2017) in the country. Most of the efforts done goes for development of monoculture of stinging catfish, polyculture of this species with popular carp species is rarely addressed, moreover, size and seasonality of the ponds and climate change aspects are also not considered accordingly. Although suitable species combination of carp species in stinging catfish based

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polyculture has been identified by Nabi *et al.* (2020) but effect of stocking densities of stinging catfish yet to be studied. Therefore, the present study aimed at evaluating the production and economics of stinging catfish (*Heteropneustes fossilis*) based carp polyculture at different stocking densities of *H. fossilis* in homestead ponds of drought prone area. The specific objectives of this study were to monitor the water quality and fish growth; to evaluate the production and economics of stinging catfish based carp polyculture under different treatments; and finally, to recommend suitable stocking density of *H. fossilis* for stinging catfish based polyculture in homestead ponds under drought prone area in Bangladesh.

Materials and Methods

Study area and experimental period **:** The experiment was carried out for a period of six months from July to December 2020 in farmer managed homestead ponds (mean area of 0.04ha and depth of 1.36m) located at Jogisho village (N $24^0$35.750-$24^0$35.905, E $88^0$32.004-$88^0$32.427) of Tanore upazila (sub district) under Rajshahi district, Bangladesh.

***Experimental design*:** Three different densities of stinging catfish, *H. fossilis* was tested under three treatments like T_1:98800 fish/ha, T_2:123500 fish/ha, and T_3:148200 fish/ha in polyculture ponds stocked with similar density (988 fishes/ha) of carps (*L. rohita* 25%, *G. catla* 25% and *H. molitrix* 50%). All the treatments replicated thrice.

***Pond management*:** Aquatic weeds were removed manually from all the experimental ponds. Unwanted fishes and predatory species were also removed from the ponds through repeated netting using seine net. All the ponds were disinfected through liming at the rate of 500 kg/ha during pond preparation and 50 kg/ha/fortnight as periodic dose after stocking according to Hossain (2011). Only inorganic fertilizers were applied (urea @ 1.2 kg/ha/day; and TSP, Triple Super Phosphate @ 1.2 kg/ha/day) to increase the natural food organisms. After three days of liming, basal fertilization was done. TSP was wetted overnight to be diluted and spread over the ponds at following sunny day whereas urea was applied instantly. All the ponds were left for 5 days to allow stabilization of pond water's primary productivity. Wild Indian major carps (Rohu, *L. rohita* and catla, *G. catla*) and hatchery produced stinging catfish (shing, *H. fossilis*) and exotic carp (Silver carp, *Hypophthalmichthys molitrix*) fingerlings were stocked in the ponds under different treatments. Overwintered carp fingerlings were used in the present experiment whereas stinging catfish fingerlings were shifted from nearby nursery rearing to experimental ponds for stocking. Floating pelleted feed having 35% protein content (Table I) was given to stinging catfish @ 7.0% of the body weight. Feeding was done twice daily at morning (10:00 am) and afternoon (5:00 pm).

Table I. Proximate composition of the feed used for stinging catfish

Moisture (%)	Crude Protein (%)	Fat (%)	Fiber (%)	Ash (%)	Calcium (%)	Phosphorus (%)	Metabolic energy (Kcal)
11	35	4	7	12	2.5	0.6	2850

***Monitoring of water quality parameters*:** Water quality parameters such as temperature, transparency, pH, dissolved oxygen (DO), alkalinity, carbon di-oxide (CO_2), ammonia-nitrogen

(NH_3-N), total dissolved solids (TDS) and plankton concentration of the experimental ponds were measured between 09:30 am and 10:30 am at pond sites in each month. Water temperature (^{0}C) was recorded with the help of a Celsius thermometer at 20-30 cm below the water surface while water transparency (cm) was recorded with the help of a Secchi disk. Alkalinity (mg/l) and NH_3-N (mg/l) were measured by a HACH kit (FF2, USA). DO (mg/l), pH and TDS (mg/l) were determined by a Multimeter (HQ 40 D, HACH, USA). Phytoplankton and zooplankton were identified according to Ward and Whipple (1959), Prescott (1962) and Bellinger (1992) and their concentration in water (number/l) was determined using a microscope after Stirling (1985) in laboratory.

***Monitoring of fish growth and yield*:** Fortnightly sampling was done to monitor growth performance and adjust the feeding ration. During sampling, about 10% of the stocked individual fish species were caught from each pond using a cast net to assess the growth performances of the fishes. Just after harvesting, all fishes were counted and weighted from each pond. Growth, survival and production performances of fishes under all the treatments were analyzed according to Brett and Groves (1979) as follows:

i. Initial weight (g) = Weight of fish at stock

ii. Final weight (g) = Weight of fish at harvest

iii. Weight gain (g) = Mean final weight (g)- Mean initial weight (g)

iv. $\text{SGR } (\%, \text{bwd}^{-1}) = \dfrac{\text{L}_n \text{ final weight - L}_n \text{ initial weight}}{\text{Culture period}} \times 100$

v. $\text{Survival rate } (\%) = \dfrac{\text{No. of fish harvested}}{\text{No. of fish stocked}} \times 100$

vi. Yield (kg/ha) = Fish biomass at harvest – Fish biomass at stock

***Economic analysis*:** A simple cost-benefit analysis was done to evaluate the economics of stinging catfish based carp polyculture under different treatments in homestead ponds. After termination of the study, all the fishes were sold in a local market. The actual prices of inputs and fish linked to the market prices in Rajshahi, Bangladesh in 2020 were expressed in Bangladesh currency (Taka) as BDT (1 US$= 83.2863 BDT, as of 21 January 2021). Data on fixed (lime, fertilizer and labor) and variable costs (seed and feed) were recorded at the time of purchase to determine the total cost (BDT ha^{-1}). Total return was determined from the market price of fish at the time of sale and was expressed as BDT ha^{-1}. Net benefit was calculated by deducting the total cost from total return and was expressed as BDT ha^{-1}. Cost benefit ratio (CBR= Net benefit/total cost) was also determined following Shang (1990) for the present study.

***Data analysis*:** Data on water quality parameters, fish growth and yield, and economics of stinging catfish based carp polyculture under different treatments were exposed to one way ANOVA (Analysis of Variance) using computer software SPSS (Statistical Package for Social Science, version-20) (IBM Corporation, Armonk, NY, USA). Before analysis, the normality of data was checked. The mean values were also compared by Duncan Multiple Range Test (DMRT) following Gomez and Gomez (1984) at 5% level of significance when a mean effect was significant. All data were expressed as mean ± standard error (S.E.).

Results

***Water quality parameters*:** Treatments varied significantly ($P<0.05$) in the mean values of DO, NH_3-N, zooplankton and total plankton concentration (Table II). Lowest DO content, highest values of CO_2 and ammonia-nitrogen were measured with treatment T_3. Highest concentration of total plankton were found with T_1.

Table II. Mean water quality parameters under different treatments during the study

Water quality	Treatments			F-value	P-value
	T_1	T_2	T_3		
Temperature (°C)	30.49 ± 0.08^a	30.68 ± 0.15^a	30.61 ± 0.06^a	0.82	0.48
Transparency (cm)	26.16 ± 0.28^a	25.55 ± 0.38^a	25.83 ± 0.48^a	0.72	0.52
pH	6.84 ± 0.12^a	6.86 ± 0.08^a	6.84 ± 0.15^a	0.01	0.99
DO (mg/l)	5.64 ± 0.14^a	5.50 ± 0.15^a	5.20 ± 0.13^b	2.96	0.04
Alkalinity (mg/l)	95.22 ± 3.26^a	93.83 ± 3.52^a	89.33 ± 1.43^a	1.21	0.36
CO_2 (mg/l)	1.98 ± 0.10^a	2.09 ± 0.09^a	2.18 ± 0.11^a	0.93	0.44
NH_3-N (mg/l)	0.04 ± 0.00^b	0.05 ± 0.00^a	0.06 ± 0.00^a	10.76	0.01
TDS (mg/l)	261.33 ± 5.87^a	267.55 ± 8.87^a	259.72 ± 2.19^a	0.44	0.66
Phytoplankton	99000.00 ± 629^a	97211.11 ± 515^a	99016.66 ± 2335^a	0.53	0.62
Zooplankton	87888.88 ± 811^a	87238.89 ± 505^a	81705.56 ± 2056^b	6.73	0.03
Total plankton	186888.89 ± 1084^a	184450.00 ± 231^{ab}	180722.22 ± 2156^b	4.92	0.04

Figures bearing common letter(s) in a row as superscript do not differ significantly ($p>0.05$)

***Fish growth and yield*:** No significant difference ($p>0.05$) in growth of *H. molitrix* and *L. rohita* was found among the treatments (Table III). Significantly ($p<0.05$) lower survival rate of *H. fossilis* was recorded in treatment T_3 (highest density). Comparatively lower growth (in terms of weight gain) of stinging catfish was recorded in winter period (Figs. 1 & 2). Significantly ($p<0.05$) highest yield of stinging catfish and of total fish yield were obtained with treatment T_2 (Table IV).

Table III. Fish growth under three different treatments during study from July to December, 2020

Species	Treatment	Initial weight (g)	Final weight (g)	Weight gain (g/6 months)	SGR (%, bwd^{-1})	Survival rate (%)
H. fossilis	T_1	1.55 ± 0.11^a	93.48 ± 48.86^a	91.93 ± 4.83^a	2.27 ± 0.04^a	80.05 ± 1.49a
	T_2	1.57 ± 0.08^a	88.05 ± 4.10^{ab}	86.48 ± 4.13^{ab}	2.23 ± 0.04^a	78.75 ± 1.74a
	T_3	1.56 ± 0.11^a	78.21 ± 3.37^b	76.65 ± 3.48^b	2.17 ± 0.07^a	70.03 ± 2.00b
H. molitrix	T_1	216.00 ± 3.21^a	1141.68 ± 39.45^a	910.35 ± 41.13^a	0.88 ± 0.02^a	74.08 ± 4.16^a
	T_2	219.33 ± 2.02^a	1093.73 ± 48.50^a	865.40 ± 55.07^a	0.86 ± 0.04^a	70.78 ± 3.51^a
	T_3	220.67 ± 4.25^a	1026.93 ± 40.25^a	801.60 ± 35.79^a	0.84 ± 0.01^a	67.74 ± 1.47^a
C. catla	T_1	231.33 ± 3.75^a	927.11 ± 30.34^a	711.11 ± 29.27^a	0.80 ± 0.01^a	72.60 ± 4.19^a
	T_2	228.33 ± 6.56^a	872.50 ± 32.42^{ab}	653.17 ± 34.42^{ab}	0.76 ± 0.02^{ab}	69.50 ± 3.80^a
	T_3	225.33 ± 8.37^a	811.82 ± 29.22^b	$591.16+\pm 27.34^b$	0.72 ± 0.02^b	66.53 ± 3.80^a
L. rohita	T_1	117.66 ± 4.05^a	773.49 ± 23.42^a	655.83 ± 26.86^a	1.04 ± 0.03^a	70.04 ± 2.63^a
	T_2	113.67 ± 2.84^a	732.35 ± 51.25^a	618.68 ± 48.83^a	1.03 ± 0.02^a	67.88 ± 2.70^a
	T_3	115.33 ± 2.84^a	684.18 ± 28.38^a	568.85 ± 31.20^a	0.98 ± 0.04^a	64.91 ± 2.22^a

*Means followed by different alphabet superscripts in the same row are significantly different ($p<0.05$).

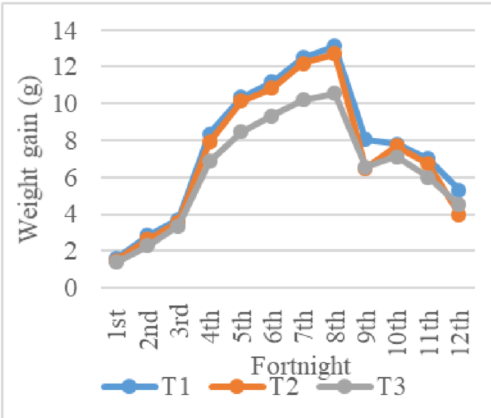

Fig. 1. Fortnightly variation in weight gain of stinging catfish under different treatments.

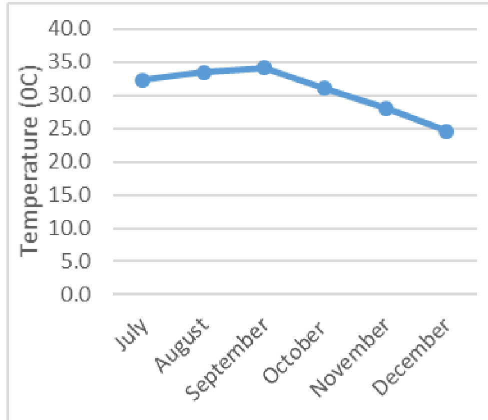

Fig. 2. Monthly variation in water temperature of the study ponds (irrespective of treatments).

Table IV. Fish yield (kg/ha/6 months) under three different treatments during study

Species	Treatments			F- value	P- value
	T_1	T_2	T_3		
H. fossilis	7252.34±500b	8368.65±437.69a	7867.99±178b	2.98	0.04
H. molitrix	304.77±36a	269.69±28.91a	232.88±18.87a	1.52	0.28
G. catla	112.35±4a	95.94±9.98a	81.29±7.29a	2.73	0.14
L. rohita	104.58±5a	94.90±9.98a	81.29±7.29a	2.29	0.18
All species	7774.06±494b	8829.19±444a	8261.41±181ab	2.75	0.04

Figures bearing common letter(s) in a row as superscript do not differ significantly (P >0.05)

***Economics of stinging catfish based carp polyculture at different densities*:** Mean values of total cost varied significantly ($p<0.05$) among the treatments and increased total cost was noted with increased stocking density (Table V and Fig. 3). Treatment T_2 varied significantly ($p<0.05$) for the mean values of total return, net benefit and CBR.

Discussion

***Water quality parameters*:** Water quality parameters under the different treatments were found more or less within suitable range for fish culture (Boyd, 1998). Mean water temperature with the treatments ranged from 30.49±0.08 to 30.61±0.06 ˚C and transparency ranged from 25.55±0.38 to 26.16±0.28 cm during study. Boyd (1998) recommended suitable water temperature of 25 to 32˚C for tropical and subtropical aquaculture species and transparency ranged from 30 to 45 cm as good for fish culture. The pH values of the different treatments were found to be slightly acidic ranged from 6.84±0.12 to 6.86±0.08 with the treatments. Rahman *et al.* (2014) reported mean values of pH ranged from 7.62±0.63 to 7.81±0.62 in stinging catfish farming ponds. DO content (5.20±0.13 to 5.64±0.14 mg/l) obtained with the treatments was found suitable for fish farming. Rahman *et al.* (1992) opined that DO content of a good productive pond should be 5 mg/l or more. Kohinoor *et al.* (2012) measured dissolved oxygen at 4.23 to 5.32 mg/l in stinging catfish cultured ponds. DO content in the present study agrees with above authors. Comparatively lower alkalinity was measured with the treatments (89.33±1.43 to 95.22±3.26). Reason for comparatively lower values of water pH, transparency and alkalinity obtained with the treatments in the present study might be due to the characteristic soil-water quality of the study area (Hossain 2011). Comparatively lower mean values of CO_2 were measured (1.98±0.10 to 2.18±0.11 mg/l) in the pond water under different treatments. Reasons of lower CO_2 values could be lower organic decomposition and higher rate of photosynthesis (Rahman *et al.* 2017). The mean values of ammonia-nitrogen (NH_3-N) was found (0.04±0.00 to 0.06±0.00 mg/l) similar to the values (0.033±0.012 to 0.055±0.031) reported by Kohinoor *et al.* (2012) while working on stinging catfish in ponds. Rahman *et al.* (2014) reported ammonia-nitrogen contents from 0.08 to 0.12 mg/l in the mono culture of stinging catfish farming ponds which was higher than the present study. This might be due to use of carps as co-species which improved the water quality of the experimental ponds. The mean TDS values (259.72±2.19 to 267.55±8.87 mg/l) recorded with the treatments found to be suitable range of fish culture as Rana and Jain (2017) mentioned fishes were not affected by standard concentrations of TDS of 2000 mg/l. Mean total plankton concentration was found lower in T_3 (180722.22±2156.01) as compared to T_1 (186888.89±1084.58) and T_2 (184450.00±231.14). Reasons might be utilization of planktons by carps especially silver carp having ability to control plankton bloom, increase DO level and decrease ammonia level in ponds (Milstein *et al.* 2008).

Table V. Economics of stinging catfish based carp polyculture under different treatments of stocking densities (calculated for 1 ha pond) for six months culture period

Items	Treatments			F-value	P-value
	T_1	T_2	T_3		
Variable cost (BDT/ha)					
Feed	716118.33±27079.71^{b}	742617.33±20660^{ab}	802270.33±13627^{a}	4.34	0.04
Seed	267077.39±153.35^{b}	328651.20±305^{ab}	390359.62±468.21^{a}	3392.71	0.00
Fixed cost (BDT/ha)					
Lime	15000.00±0.00	15000.00±0	15000.00±0.00	-	-
Fertilizer	7440.00±0.00	7440.00±0.00	7440.00±0.00	-	-
Labour	23500.00±0.00	23500.00±0.00	23500.00±0.00	-	-
Harvest	19500.00±0.00	19500.00±0.00	19500.00±0.00	-	-
Total cost (BDT/ha)	1045935.72±27014.32^{b}	1134008.54±20883.45^{ab}	1255369.95±13185^{a}	24.76	0.01
Total return (BDT/ha)	2708732.00±19990.41^{b}	3085799.51±15083.06^{a}	2856863.31±569779^{b}	2.87	0.04
Net benefit (BDT/ha)	1662796.24±15099.85^{b}	1951790.97±17130.52^{a}	1601493.35±43792^{b}	2.94	0.04
CBR	1.58±0.10^{ab}	1.73±0.19^{a}	1.28±0.02^{b}	3.52	0.04

Figures bearing common letter(s) in a row as superscript do not differ significantly ($p>0.05$)

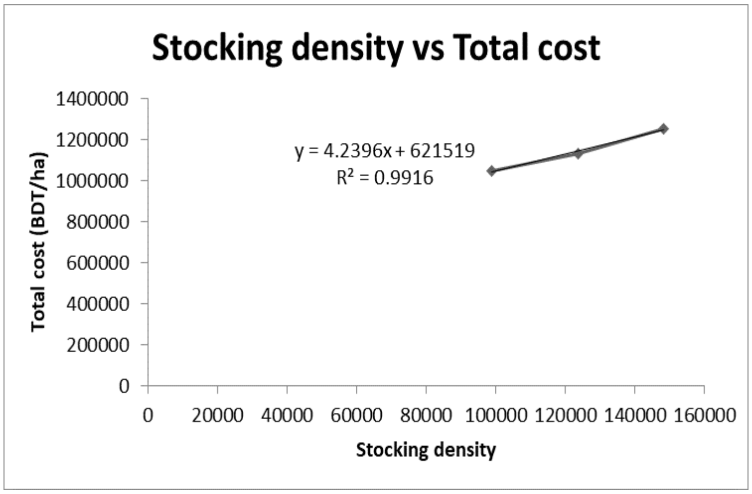

Fig. 3. Relation between stocking density and total cost.

***Fish growth and yield*:** comparatively lower weight gain of *H. fossilis* was found at the beginning of the experimental period (Fig. 3). Reason might be due to lower weight of fries at stocking (below the catch up growth) and then rapid weight gain in the next fortnights might be due to higher metabolic rate at suitable temperature and other favorable water quality parameters (Fig. 2). Generally, increasing the prevailing temperature leads to exponentially increasing growth starting from a certain point of size to up to a certain point after which growth starts to rapidly decrease (Jobling *et al.* 1994). Significant variation was found with the treatments for mean final weight, weight gain and SGR of *H. fossilis*. Chakraborty and Mirza (2008) reported final weight of *H. fossilis* as 53.72 to 37.28g at density 98800 to 123500/ha fed on 32.2% protein feed @ 3-5% of fish body weight. While Samad *et al.* (2017) mentioned final weight of *H. fossilis* as 34.50 to 48.10g using formulated feed with 27-31% dietary protein level @ 5% of fish body weight. The findings of the present study was higher than above authors. This might be due to use of higher protein content feed applied at appropriate rates and better pond management practices. Highest mean vale of SGR was recorded in treatment T_1 (2.27 ± 0.04) followed by T_2 (2.23 ± 0.04) and T_3 (2.17 ± 0.07) which was closer to Kohinoor *et al.* (2012) reporting SGR range of 2.13 to 2.33 in mono culture of *H. fossilis*. Mean values of survival rate of stinging catfish (70.03 ± 2.00 to 80.05 ± 1.49%) found during the experimental period was almost closer to the range reported by Chakraborty and Nur (2012) who obtained survival rate of *H. fossilis* between 67.74 and 90.76% in semi-intensive polyculture with *Anabas testudineus*. Highest value of survival rate (80.05 ± 1.49%) of stinging catfish was gained with treatment T_1 which received lowest stocking density. Higher survival rate with lower stocking density was also reported by Ali *et al.* (2018), Kohinoor *et al.* (2012) and Rahman *et al.* (2014) working on stinging catfish farming in ponds.

In the present study, the yield of *H. fossilis* of treatment T_2 was found to be 15.39% and 6.36% higher than treatments T_1 and T_3, respectively. While the yield of carps in treatment T_1 was 13.28% and 31.92% higher than treatments T_2 and T_3, respectively. However, the combined fish yield (kg/ha/6 months) of treatment T_2 was measured at 13.57% and 6.87% higher compared to treatment T_1 and T_3, respectively. Although the mean weight gain was highest in treatment T_1 but total yield was highest in T_2. The reasons behind the highest fish yield with treatment T_2 (density of *H. fossilis* 123,500/ha with carp polyculture) might be the suitable stocking density of *H. fossilis*. Chakraborty and Mirza (2008) found that the production of *H. fossilis* in monoculture system was 3676 to 55150 kg/ha/8 months fed on 32.2% protein feed at the stocking densities from 74,100 to 123,500/ha in earthen ponds. While Khan *et al.* (2003) evaluated the production of *H. fossilis* under stocking densities of 80,000 and100,000 fishes/ha and recorded the gross production range of 3189 to 3364 kg/ha/4 months. The yield obtained in the present experiment was much higher than the above mentioned results. Saokat *et al.* (2017) also reported that the growth, survival rate and production of stinging catfish was significantly influenced by the density at which they were stocked. Findings of the study clearly indicated that increase in stocking density did not produce increased yield. Comparatively moderate growth and highest yield were obtained with treatment T_2 and that of lowest growth and yield was obtained with treatment T_3. Lower growth and yield performance with higher stocking density might be due to the competition for food, space and DO concentration with stress on the fishes. Assumption almost agreed with Houde (1975) reporting that higher stocking density in presence of abundant feed might produce a comparative interaction among the population causing a stressful situation. Such a lower yield with higher density was also recorded well by Ali *et al.* (2018), while working with *H. fossilis* farming in pond.

***Economics of stinging catfish based carp polyculture*:** Comparatively higher cost noted in treatment T_3 might be due to the higher stocking density and thereby higher cost involvement of fish seed and feed with that treatment. Strong correlation between stocking density and total cost (Fig. 3) indicated that the total cost of production for stinging catfish based polyculture increased with the increase in densities of *H. fossilis.* Rahman *et al.* (2014) also reported lower total cost of production with lower stocking density of stinging catfish in ponds. Significantly highest net benefit was found in treatment T_2 which was 17.34% and 21.87% higher than the treatments T_1 and T_3, respectively. Ali *et al.* (2018) obtained net benefit as 636,779 to 1,517,771 BDT/ha/180 days while working with *H. fossilis* under different stocking densities ranging from 148, 200 to 197,600/ha with GIFT and silver barb in ponds. The net benefit obtained in the present study was much higher than Saokat *et al.* (2017) and Rahman *et al.* (2014) reporting the net benefit of BDT 959,116.04/ha/5months and 9,277.32 BDT/ha/6 months respectively. Significantly highest CBR was found in treatment T_2 (1.73 ± 0.19) than that of treatment T_1 (1.58 ± 0.10) and T_3 (1.28 ± 0.02). The CBR obtained with treatment T_2 (1.73 ± 0.19) was almost closer to the CBR (1.69) obtained by Saokat *et al.* (2017) working on *H. fossilis* farming in seasonal ponds at density of 123550 fishes/ha.

Overall findings indicated that treatment T_2 (density 123500/ha of *H. fossilis*) was found best in terms of water quality; fish growth and yield; and economics of stinging catfish based carp polyculture in homestead ponds in drought prone area. This study used only one feed having 35% protein content for stinging catfish based carp polyculture. Further study is required for optimizing the dietary protein content for stinging catfish in polyculture of carps in homestead ponds under drought prone area.

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