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Adaptability of polyculture of stinging Catfish (*Heteropneustes fossilis*) in seasonal water bodies of greater northern region, Bangladesh

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Abstract
Present study was carried out to evaluate the growth performance of polyculture *Heteropneustes fossilis* in different stocking density in seasonal ponds of greater Northern region, Bangladesh for a period of 150 days from 30 March 2016 to 30 August 2016. Nine uniform earthen ponds (10decimal) were divided in to three treatments. Three stocking densities of *H. fossilis* such as 1,23,550 (T_1), 148260 (T_2) and 172970 ha-1 (T_3) were tested with three replications each with *C. batratus, O. niloticus and B. gonionotus* commercial pelleted fish feed containing 30% crude protein were supplied 8-6% of the body weight of *H. fossilis*. Sampling of the experimental fishes along with the monitoring of the water quality parameters were measured on fortnightly basis. Over the study period, all the recorded water quality parameters were founded within the acceptable range suitable for fish culture. At the end of the culture period harvested weight of *H. fossilis* were found 65.11± 1.11, 58.0±2.00 and 48.0±0.58 g where T_1 permit significantly (P<0.05) better growth performance followed by T_2 and T3 Significantly (P<0.05) with better nutrient utilizations FCR in T_1 (2.63) followed by T_2 (2.84) and T3 (3.08). Significantly higher survival (%) of the fishes were recorded in T_1 (77.93±1.63) followed by the T_2 (76.12±0.62) and T_3 (72.71±0.14). Considering the survival highest gross production (kg ha^{-1}) in T_2 (7793.82) followed by T1 (7593.39± 235.3) and T_3 (6981.91±62.2). However, BCR in (T1)1.6933 was found to be more efficient and profitable followed by (T_2) 1.4923 and (T3)1.3207). Based on the present findings, polyculture H. *fossilis* might be suggested to the fish farmer as a potential adaption option to utilize the seasonal water bodies. The polyculture technology of shingi may also help to meet the dietary needs and improve the socio-economic status of the people of Bangladesh

Keywords: Adaptability, *Heteropneustes fossilis,* polyculture, stocking seasonal, growth, survival, production, BCR

1. Introduction

Bangladesh is ranked fourth position in Inland fishery production just after China, India, and Mymenmar and fifth position in closed waters [1]. Fisheries sector are inseparable from the life and lifestyle of the people of Bangladesh this contributes 4.37% to the national GDP and almost one-fourth (23.37%) to the agricultural GDP [2]. About 1.5 million people are directly employed by this sector [3] Greater Rangpur region is a climate prone area. Water retention capacity of the pond is decreasing day by day. As a result the number of seasonal pond is increasing in the northern districts of Bangladesh about 55% ponds are seasonal of which 60% retained water for 4-6 months while 40% retained for 6 to 9 months in a year and even more in some areas [4]. These small water bodies are being used mainly for household activities but some are still abandoned due to their derelict and marshy nature. Nilphamari district is such an area where this culture technologies should be emphasis on short life cycle and faster growth and require low inputs, such as Genetically improved farmed tilapia (GIFT), silver barb (*Barbodes gonionotus*), magur (*Clarias batrachus)*, shing *(Heteropneustes fossilis)* etc. [5, 6, 7]. To ensure the proper utilization of seasonal ponds, the culture of short-cycle species should be introduced which enhanced to get maximum production. The demands for those fishes are owing to their taste and medical values [8]. But lack of knowledge of appropriate culture techniques and unavailability of quality fish seed of candidate species at required time are found to be some of the major constrains at present time to disseminate the BFRI evolved culture technologies in northern parts of Bangladesh.

Unfortunately the proper culture technologies of polyculture of *H. fossilis* in seasonal ponds yet not been optimize and evaluated specially in Northern part of Bangladesh and measurements of water quality parameters are very essential for fish culture in Northern region, it's also very essential to showing the benefit cost ratio of the culture technologies to the farmer so fur they can easily understand how much of benefit they can achieved and more interested on such type of culture technologies. Hence, the present research works has been designed and proposed to adopt the polyculture techniques of *H. fossilis* in the seasonal water bodies; to assess the water quality parameters of cultural water bodies; and analyze the benefit cost ratio (BCR) of culture technologies.

2. Material and Methods

Site profile and study period

The experiment was conducted at the, saidpur, Taragonj and Dimla, sitmohol areas of Rangpur and Nilphamari district for a period of 150 days from 30 March 2016 to 30 August 2016.

2.1. Design of the experiment

A total nine (9) uniforms earthen ponds with all equal in size (10 decimal), rectangular shape, similar basin and bottom with average depth (3-4 feet) were used for the experiment. Three (3) treatments of the present experiment (T_1, T_2 and T_3) were designed according to completely randomize design (CRD) in triplicates unit. The experiment has been conducted in farmer's ponds of Rangpur and Niphamari regions. On-farm ponds were selected with the concerning of relevant Senior Upazilla Fishery Officer (SUFO/UFO).

Table 1: Layout of the experimental design with species composition, and stocking density in three treatments

Treatments	Species composition	Stock. density (nos dec^{-1})	Initial length (cm)	Initial weight (g)	Feeding
T_1	Shing	500	8.21	2.9	8-6%
	Magur	50	4.00	2.03	
	GIFT	10	4.36	4.99	
	Shorpunti	05	8.5	5.01	
T_2	Shing	600	8.22	2.9	
	Magur	50	4.05	2.01	
	GIFT	10	4.36	4.99	
	Shorpunti	05	8.4	4.99	
T_3	Shing	700	8.22	3.0	
	Magur	50	4.0	1.99	
	GIFT	10	4.37	5.00	
	Shorpunti	05	8.5	4.99	

2.2. Pond preparation, Liming, Fertilization, stocking and feeding management:

The selected ponds were prepared by drained and drying. Aquatic weeds was removed from the ponds manually and harmful and unwanted fish species removed by using rotenone 25-35 g dec^{-1}ft^{-1} and ponds have been liming @1 kg dec^{-1}. After 5 days of liming, cow-dung 6 kg dec^{-1}, urea 100 g dec^{-1} and TSP 75 g dec^{-1} have been applied at initial stage during pond preparation. The short-cycle fishes like as *H. fossilis, C. batrachus,* and GIFT and *B. gonionotus* have been selected for adaptive trial in the listed ponds. After collection about 7-10 cm fingerlings of *H. fossilis* and other fishes were stocked as per experimental design (Table 1) during early April 2016. Fish are being fed commercially available fish feed 8-6% BW day^{-1} (containing 30- 35% protein).

Table 2: Proximate composition of feed use to fed fishes in the current experiment over 150 days

Feed component	Dry mater	Crude protein	Crude lipid	Ash	Crude fiber	NFE*
Amount (%)	89.96±0.48	30.32±0.12	9.95±0.16	18.28±0.58	9.35±0.46	32.1±0.20

Values are shown as mean ± Std. Deviation (SD). * Nitrogen free extract (NFE) calculated as [100 - % (protein + lipid+ ash + fiber)] (Wet wt. basis).

2.3. Sampling of the experimental fish and monitoring water quality parameters: sampling of fishes were made by using a ber jal and weight of fishes were measured by using a digital electronic balance (OHAUS) every fifteen days interval Monitoring of water quality parameters viz. temperature, dissolved oxygen (DO) water *p*H,, transparency total ammonia (NH_3) were observed and recorded on spot throughout the experimental period by using standard procedures and methods. The water temperature (°C) was measured by using a standard mercury thermometer, DO (mgl^{-1}) by DO meter (YSL, Model 58, and USA), water *p*H by digital *p*H meter (Elico-Li-120ammonia (mgl^{-1}) and ammonia y by using ammonia test kit.

2.4. Statistical analysis

One-way analysis of variance (ANOVA) (Duncan, 1993) was conducted by SPSS 20 (Chicago, USA) to detect the significance differences among the treatments at 5% significance level. The values were given with means ±SD, and differences were considered significant at subset for alpha = 0.05 ($p \leq 0.05$).

3. Results

3.1. Water quality parameters

Except ammonia (NH3) all water quality parameters measured had no significant differences among treatments ($P>0.05$). In the present experiment, the recorded water temperature and DO were ranged from 33.00°C to 24.58°C and 7.34 to 4.5 mgl^{-1}, respectively in different treatments. Though mean water temperature and DO did not vary significantly ($P>0.05$), however, the overall pH of water (8.30-6.80) and transparency (33-22.10cm) in different treatments were within the acceptable range for the fish culture (Table 3). Although the values of Ammonia (NH_3) in T_2 (0.21) and T_3 (0.21) showed significantly ($P<0.05$) higher value over T_1, however T_2 and T_3 did not vary significantly when compared using ANOVA (Table 3).

Table 3: Summary of the variations in water quality parameters (mean ± SD) observed in different ponds of T_1, T_2& T_3 during the study

Water quality parameters	T_1	T_2	T_3
Temperature (°C)	27.79±2.83	28.35±2.88	27.94± 2.25
D.O (mgl^{-1})	5.64±0.5028	5.49±0.39	5.77±0.65
*p*H (Water)	7.31±0.23	7.49±0.38	7.46± 0.25
Transparency (cm)	27.41± 2.75	27.623± 2.45	27.55± 2.39
Ammonia (NH_3) (mgl^{-1})	0.17±0.026^{a}	0.206±0.026^{b}	0.208± 0.04^{b}

3.2. Growth performances and nutrient utilization

Although there is no significant difference in initial weight and initial length of fishes in different treatments but the final weight of *H. fossilis* in T_1 (65 g) were varied significantly rather than T_2 (58 g) and T_3 (49 g) (table 3). During the investigation, mean final length of *H. fossilis* was recorded as 21.05 cm, 20.58 cm and 19.05cm; in treatments T1, T2 and T3, respectively. The mean final weight gain and % weight gain of *H. fossilis* in different treatment was also varied significantly and the value of T_1 (62 g) was significantly higher than T_2 (55 g) and T_3 (45 g) (Table 4). The % weight gain of *H. fossilis* in T_1 (2135.40) was highest and significantly varied ($P<0.05$) over T_2 (1839.59) and T_3 (1500.00) (Table 4). Significantly higher average daily gain (ADG) & health condition (HC) ($P<0.05$) was also recorded in T_1 (0.41& 3.08) followed by T_2 (0.36&2.81) and in T_3 (0.29& 2.51). Specific growth rate (SGR % day^{-1}) in T_1 (2.04) was significantly higher ($P<0.05$) than in $T_2$and T_3.Significantly ($P<0.05$) better nutrient utilizations i.e. apparent feed conversion ratio (AFCR) were recorded in T_3 (3.08) followed by T_2 (2.84) and T_1 (2.63) values respectively) (Table 4). FCR were best for fish in T_1 where lowest number of fingerlings was reared (1, 23550 nos ha^{-1}). Highest survival rate was also observed inT_1 (79.57) and the lowest in T_3. (72.56)There was a significant variation ($P<0.05$) in the survival rate of *H. fossilis* in T_1 compared to T_2 and T_3 but there is no differences between T_2 and T_3 (Table 4). The mean productions of *H. fossilis* were 253.79, 264.99 and 244.31kg treat-1 day-150 in treatments T_1, T_2 and T_3, respectively. The total production of *H. fossilis in* T_2 differed significantly ($P<0.05$) with the T_3 (Table 3).

Table 4: Growth performances and nutrient utilization observed in different treatments of the experiment over 150 days culture in ponds

Morphometric Parameters	Fish Species	T_1	T_2	T_3
Average initial weight (g)	*H. fossilis*	2.9±0.00^{a}	2.9±0.01^{a}	3.0±0.00^{a}
	C. batratus	2.003±0.0005	2.01±0.04	1.99±0.01
	O. niloticus	4.99±0.01	4.99±0.015	5.00±0.00
	B. gonionotus	5.01±0.01	4.99±0.01	4.99±0.02
Av. final weight (g)	*H. fossilis*	65.11± 1.11^{c}	58.0±2.00 ^{b}	48.0±0.58 ^{a}
	C. batratus	62.50±1.50c	56.00±2.0b	51.50±1.50a
	O. niloticus	309.20 ±13.20b	293.00±7.00b	263.50±3.50a
	B. gonionotus	192.50±8.50 c	180.00 ±4.0b	163.50±1.50a
initial length(cm)	*H. fossilis*	8.21±0.1	8.22±0.02	8.22±0.005
	C. batratus	4.00±0.0	4.05±0.05	4.00±0.0
	O. niloticus	4.36±0.005	4.36±0.00	4.37±0.005
	B. gonionotus	*8.50*±0.00	*8.49*±0.01	*8.50*±0.01
final length(cm)	*H. fossilis*	21.05b±0.08^{b}	20.58± 0.08^{b}	19.05±0.37^{a}
	C. batratus	19.50±0.30^{c}	18.25±0.15^{b}	17.50±0.0 ^{a}
	O. niloticus	25.00±0.00^{c}	24.22±0.10^{b}	23.790.09±0.09^{a}
	B. gonionotus	*23.50*±0.50^{c}	*22.65*±0.35^{b}	*21.68*±0.28^{a}
Weight gain[1] (g)	*H. fossilis*	62.15±1.15c	55.01±1.99^{b}	45.00±0.58^{a}
	C. batratus	60.49 ±1.49^{c}	54.00± 2.04^{b}	49.51 ±1.49^{a}
	O. niloticus	304.21±13.19^{b}	288.00±7,01^{b}	258.50±3.50^{a}
	B. gonionotus	187.89± 8.49^{c}	175.01±4.01^{b}	158.50±1.47^{a}
% weight gain[2]	*H. fossilis*	2135.40±12.25^{c}	1839.59±60.40^{b}	1500.00±33.35^{a}
	C. batratus	3017.05±67.03 ^{b}	2689.15±155.01^{a}	2487.62±62.37^{a}
	O. niloticus	6095.88±252.11^{b}	5766.33±157.75^{b}	5170.00±70.00^{a}
	B. gonionotus	3741.99±161.99^{c}	3507.38±87.38^{b}	3173.20±13.65^{a}
ADG (% day^{-1})[3]	*H. fossilis*	0.415±0.005^{c}	0.3667±0.015^{b}	0.2967±0.005^{a}
	C. batratus	0.40±0.01^{c}	0.36±0.005^{b}	0.33±0.01^{a}
	O. niloticus	2.02±0.08^{b}	1.91±0.045^{b}	1.39±0.031^{a}
	B. gonionotus	1.24±0.058^{c}	1.16±0.025^{b}	1.05±0.01^{a}
HC($^{g-1}$cm)[4]	*H. fossilis*	3.08±0.04^{c}	2.81± 0.08^{b}	2.516±0.03 ^{a}
	C. batratus	3.20±0.12	3.10±0.17	2.93±0.08
	O. niloticus	12.36±0.52^{b}	12.10±0.34^{b}	11.07±0.10^{a}
	B. gonionotus	8.15±0.22^{b}	7.94±0.05^{b}	7.54±0.17^{a}
SGR (% day^{-1})[5]	*H. fossilis*	2.04± 0.02^{c}	1.98±0.02 ^{b}	1.84± 0.015^{a}
	C. batratus	2.28±0.018 ^{c}	2.21±0.035^{b}	2.16±0.015^{a}
	O. niloticus	2.74±0.025^{b}	2.71±0.021^{b}	2.64±0.01^{a}
	B. gonionotus	2.41±0.035^{b}	2.38±0.015^{b}	2.32±0.00^{a}
FCR[6]	*H. fossilis*	2.63±0.09 ^{a}	2.84±0.02 ^{b}	3.08± 0.03^{c}
Sruvival (%) [7]	*H. fossilis*	77.93±1.63^{b}	76.12±0.62^{a}	72.71±0.14^{a}
	C. batratus	62.00±2.00^{b}	63.20±2.00^{b}	53.90±0.10^{a}

	O. niloticus	87.00±3.0^{b}	86.00±6.0^{b}	74.00±2.0^{a}
	B. gonionotus	79.00±1.00^{b}	78.00±4.00^{b}	68.00±2.00^{a}
Production(kg^{-1}Treat)[8]	*H. fossilis*	253.79±9.63^{ab}	264.99±11.31^{b}	244.31±4.61^{a}
	C. batratus	19.22±0.025^{c}	17.67±0.07^{b}	13.87±0.37^{a}
	O. niloticus	28.86±0.22^{b}	25.24±2.36^{b}	19.49±0.27^{a}
	B. gonionotus	7.39±0.035^{c}	7.00±0.21^{b}	5.55±0.11^{a}

Values are means of data obtained ± Std. Deviation (mean ± SD) of monthly determinations. Values in the same row with same superscripts are not significantly different (*P*>0.05). Absence of superscripts indicates no significant difference between treatments.

[1]Mean final weight gain (g) = {Mean final fish weight (g) - Mean initial fish weight (g)}

[2] % weight gain= [{(Mean final fish weight (g) - Mean initial fish weight (g)}/ Mean initial fish weight (g)] x100.

[3]ADG (Average Daily Gain)=mean final weight-mean initial weight/days

[4] HC (Health Condition)=weight of fish/ length of fish

[5]Specific growth rate (SGR % day^{-1}) = [{(Log$_e$ W_2 - Log$_e$ W_1)/ (T_2-T_1)} ×100], Where, W_1 is the initial live body weight (g) at time T_1 and W_2 is the final live body weight (g) at time T_2 (day) (after Brown, 1957, Cited from Hossain, 2009). [9].

[6]Apparent feed conversion ratio (AFCR) = Total dry feed fed / Total live weight gain (after Castell and Tiews 1980).

.[7]Survival rate (%) = (Final number of fish harvested / Initial fish number) x 100.

[8]Production (kg ha^{-1}) = [{Final number of fish harvested x individual weight of fish (g)} / 1000] x 247.1

3.3. Economic analysis

A simple cost-benefit analysis was performed to estimate the benefit cost ratio (BCR) and profitability that had been generated from these three types of culture systems. Though the expenditures in three different treatments vary significantly (*P*<0.05) among themselves, Combined production of the fishes as recorded in T_1, T_2, T_3 were 7593.39± 235.31, 7793.82±239.72, 6981.91±62.22 kg ha-1, respectively. The production of fish was higher in T_2 but did not vary significantly with T_1.However the lowest production costs (BDT ha^{-1}) was recorded in T_1 (1377276.07±2032.47) followed by T_2 (1553971.71±32266.22) and highest in T_3 (1603744.23±33774.92) (Table 5). Furthermore, consistently higher net profit (BDT ha^{-1}) in T_1 (959116.04±77423.63) over T_2 (634499.00±179774.55) and T_3 (516434.02±14802.88) together with significantly (*P*<0.05) higher BCR were recorded in T_1 (1.69±0.055) followed by T_2 (1.49±0.046) and T_3 (1.32±0.003) (Table 5).

Table 5: Benefit and cost analysis of Shing (*H. fossilis* (per hectare) of the experimental ponds for a period of 150 days

Items wise expenditures/ operational costs	T_1	T_2	T_3
Pond preparation	3000	3000	3000
Price of fry[1](BDT treatment^{-1})	36450	42450	48450
Lime, fertilizer, Cow dung (BDT treatment^{-1})	1500	1500	1500
Feed costs(BDT treat^{-1})	1,20262.77	1,35,269.94	1,35757.98
Transport, labor etc.(BDT treatment^{-1})	6000	6000	6000
Total production costs (BDT ha^{-1})[2]	1377276.07±2032.47^{a}	1553971.71±32266.22^{b}	1603744.23±33774.92^{b}
Incomes and outputs			
Total production (kg ha^{-1})	7593.39± 235.31^{b}	7793.82±239.72^{b}	6981.91±62.22^{a}
Gross production value (BDT ha^{-1})[3]	2336392.12±45780.99^{b}	2317804.04±121428.26^{b}	2120178.25±48303.72^{a}
Net profit (BDT ha^{-1})[4]	959116.04±77423.63^{b}	634499.00±179774.55^{a}	516434.02±14802.88^{a}
Benefit cost ratio (BCR)[5]	1.6933±0.055^{c}	1.4923±0.046^{b}	1.3207±0.003^{a}

not significantly different (*P*>0.05). Absence of superscripts indicates no significant difference between treatments.

* 1 US Dollar ($) equivalent to eighty (80) Bangladeshi Taka (BDT).

[1] Prce of fry (BDT per pieces) *H .fossilis* 2.0, O. niloticus (Tilapia) 1.0, *C. batratus* 4.0, *B. gonionotus* 1.0

[2]The cost of physical labor involved was not considered

[3] Gross production values were estimated on the basis of sell values of produce crops. Market price of *H .fossilis* 330, *O. niloticus* (Tilapia) 120, C. batratus 350, and B. gonionotus 115 (BDT kg^{-1}).

[4] Net profit (BDT treatment^{-1}) = Gross production value – Total production costs.

[5]BCR= Total production value / total production costs (BDT).

4. Discussions

4.1. Water quality parameters

The highest water temperature were found, 33 º C due to relative high intensity of sunlight and absence of cloud in the sky and the lowest and 25.1º C in the month of July and March might be due to low intensity of light as a result of rainfall and cloudy condition and cool air flow on the other hand highest and lowest dissolved oxygen were found 7.34 mgl^{-1} in June and 4.5 mgl^{-1} in April respectively However, there was no significant (*P*>0.05) variation among the treatments. [10] Reported a surface water temperature ranged from 26.93 to 27.41 in monoculture of Thai koi (*Anabas testudineus).* [11]. also observed temperature ranged of 28 to 30 º C in cultured ponds water. The pH values of the different treatments ponds water were found to be slightly alkaline and highest water pH were recorded 7.68 in theT_2 and lowest pH was recorded7.19 in the T_1. [12] Reported that average values of *p*H ranged from 6.5 to 8.1 in Kailla beel. More or less similar *p*H values were also recorded by [13, 14, 15] in the aquaculture ponds in Mymensingh. Water transparency was 22-33cm in T_1 and T_2 without significant difference (Table 3), which was more or less similar with the findings of [16] as recorded values ranging from 15-58 cm. The present findings were relevant with [17, 18, 19, 20]. Maximum ammonia content were recorded in T_3(0.23) due to high stocking density and more amount of fecal materials were release in the ponds and minimum in the T_1(0.15) due to low density compared to T_2 and T_3.Thus it might be concluded that all of water quality parameters were within suitable range for fish culture. [21, 22, 23, 24] also recorded of 0.01 to 0.99 mgl^{-1} in BAU campus; Mymensingh.

4.2. Growth parameters
The effect of stocking density on growth and survival and production of *H. fossilis* was conducted and observed that the growth performance in term of final weight, final length, final weight, weight gain and percent weight gain, ADG, HC, and SGR of *H. fossilis, C. batratus, B. gonionotus,* and *O. niloticus* in earthen ponds varied on different stocking densities. T_1 showed significantly highest growth (P<0.05) than those of T_2 and T_3 This is because a relatively less number of fish of similar size in a pond could get more space, food, less competition and dissolved oxygen etc. Although same feed was supplied in all the treatments at an equal ratio. The results also indicated that higher growth rate was always observed at lower stocking densities in the experiment. More or less similar types of growth were observed by [25]. Who recorded the growth 49.50 to 69.42 g from six months cultured of *H. fossilis*. The lower growth performances *H. fossilis* were in T_3 and T_2 than T_1 that might be due to competition for food and habitat for higher number of fingerlings. Stocking density is known to be one of the important parameters in fish culture. The present results coincide with the findings of [26] who achieved best growth at lower stocking densities in shing farming. There was a general decrease in FCR for the population of treatment T_1 (2.63) than that of the T_2 (2.84) and T_3 (3.08) which is supported by [27]. The FCR values of different treatments were acceptable and indicated better food utilization, which is agreed by [28]. Significantly, higher survival was recorded in T_1 (77%) and no significant difference in T_2 and T_3, where, the stocking density was lower than treatment T_2 and T_3 Survival was found to be negatively influenced by stocking densities The reason for reduced survival rate in treatment T_2 might be due to higher stocking density of individuals as well as competition for natural food and space in the water area of pond which is supported by [29, 30, 31]. Although Fish production *H. fossilis* were found higher in T_2 (7793.82 kg ha^{-1}) followed by T_1 (7593.39 kg ha^{-1})) and T_3 (6981.91 kg ha^{-1}) but there were no significant difference (P>0.05) between T_2 and T_1. It might be due relatively higher numbers of fry stocked in T_2 than those of T_1 but highest individual growth were high in T_1. Hence, the observed poor growth at higher stocking densities could be due to space limiting effect, stressful situation caused by supplementary feed, some variations in environmental parameters and less availability of natural food. The present result agreed with the findings of [32, 33, 34] they obtained the highest production from higher stocking density but individual growth high in lower stocking density.

4.3. Economic analysis
The economic analysis of the culture systems was carried out to assess the economic return under low input management. Though the expenditures in T_2 and T_3 did not vary significantly (P>0.05), however the lowest production costs (BDT ha^{-1}) was recorded in T_1 (1377276) followed by T_2 (1377276.) and T_3 (1603744) (Table 5). However, significantly higher net profit (BDT) was found in T_1 (959116.04) followed by T_2 (634499.00) and T_3 (516434.02) due to lower stocking density of *H. fossilis* and highest individual weight of *H. fossilis* were found in T_1 then others treatments. [35] Recorded the cost and benefit of Monosex Tilapia (*Oreochromis niloticus*) in monoculture system and got the net benefit of BDT 69,277.32/ha/6 months where fish were fed formulated feed. [36] Observed that monoculture of Raj punti (*Puntius gonionutus)* gave a net benefit BDT 68,135 to 75,028/ha from 6 months cultured. The net benefit BDT 1, 00,784 to 4, 43,458/ha/6 months in monoculture of Thai koi *(A. testudineus*) in northern Bangladesh [36] While Significantly (P<0.05) higher BCR were also recorded in T_1 (1.69) followed by the T_2 (1.45) and lowest in T_3 (1.32) this is due to lower FCR and less production cost then T_2 and T_3. [37, 38, 39, 40] found more or less results of our findings. In the present experiment, the net benefit was higher than the above findings. Among the treatments in five months of culture of Shing (*H. fossilis*), individuals 1, 23,550/ha stocking density would be the best recommendation for fish farmers in northern regions.

5. Conclusions
The survival, growth and production were inversely related to the stocking densities of fingerlings of *H. fossilis* in earthen ponds although feeding frequency and other species combination were same in different treatments However, stocking density of 1,23550 fry ha-1 may be suggested for polyculture of (*H. fossilis*) in seasonal ponds in northern region of Bangladesh. Therefore, rural communities can use this technology as a way of coping measure (adopt) to climatic extremities, for better utilization of vast unused ponds and increase production of fishes in drought prone areas of Northern districts, Bangladesh. However, prior to the make a solid decision further research are needed to optimize the culture technique such as nutrient requirements, effects of physiochemical parameters and feeding frequency for better growth performance

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7. References
1. FAO. The State of World Fisheries and Aquaculture, Opportunities and challenges. Food and Agriculture Organization of The United Nations, Rome. 2014. (ISBN 978-92-5-108275-1 (print) E-ISBN 978-92-5-108276-8 (PDF) (ISSN 1020-5489) http://www.fao.org/3/d1eaa9a1-5a71-4e42-86c0-f2111f07de16/i3720e.pdf
2. DoF. National Fish Week. Compendium (In Bangla). Department of Fisheries (DoF), Ministry of Fisheries and Livestock, Bangladesh. 2013, 144.
3. DoF. National Fish Week. Compendium (In Bangla). Department of Fisheries (DoF), Ministry of Fisheries and Livestock, Bangladesh. 2012, 142.
4. Bangladesh Bureau of Statistics (BBS). 2000. http://www.bbs.gov.bd/home.aspx (available at 25/12/2014, 10.25 pm).
5. Gupta MV. Low input techniques for rural aquaculture development in Bangladesh. In: Aquaculture schistosomiasis: Proceeding of network meeting in Manila, Philippines. National Academy Press, Washington, D.C. 1991, 6(11):26-35.
6. Borthakur S, Goswami UC. Cage culture of magur,

Clarias batrachus (Linnaeus) with selected non-conventional diets in a floodplain wetland of Assam. Indian J. Fish. 2007; 54(4):357-363.
7. Shah MM, Younus Mia RM, Alam MJ. Performance of genetically improved farmed tilapia (GIFT) under mono and mixed culture with silver barb (*Barbodes gonionotus*) in South-west Bangladesh. Bangladesh J. Fish. 2008; 12(1):75-80.
8. Mookerjee HK, Mazumdar SR. Some aspect of the life history of *Clarias batrachus* (Linn.) Proc. Zool. Soc. Bangal. 1950; 3:71-84.
9. Castell JD, Tiews K. Report of the EIFAC, IUNS and ICES working group on the standardization of methodology in fish nutrition research. EIFAC Technical Paper 36, Hamburg, Federal Republic of Germany. 1979; 36:24.
10. Rahman S, Monir MS, Khan MH. Culture potentials of climbing perch, Thai koi, *Anabas testudineus* (Bloch) under different stocking densities in northern regions of Bangladesh. J. of Exp. Bio. and Ag. Sci. 2013; 1(3):203-208.
11. Roy NC, Kohinoor AHM, Wahab MA, Thisted SH. Evaluation of performance of carp-SIS Polyculture technology in the rural farmer's pond. Asian Fisheries Science. 2002; 15:41-50.
12. Hossain MM, Hassan MM, Ahamed S, Mostafiz M, Akter T, Islam MM *et al.* In relation to climate change adaptation: culture potential of long whiskerscatfish, *Mystusgulio* in greater Noakhali region, Bangladesh. *In:* A.F.M S. Islam, S. Paul and D. Shah (eds.), Sylhet Agricultural University Research Progress Report. Proceedings of the annual workshop (July 2013 – June 2014), Sylhet Agricultural University Research System (SAURES), held on January26, 2015, Sylhet Agricultural University, Sylhet, Bangladesh. 2015, 57-63.
13. Kader MA, Bulbul M, Hossain MS, Hossain MM, Ahmed GU, Hossain MA *et al*. Effect of total replacement of fishmeal with fermented soybean and squid by-product blend in practical diets for climbing perch *Anabas testudineus*. In: Proceedings of symposium 'Aquaculture America 2009', organized by the 'World Aquaculture Society' February 15-18, 2009 Seattle, Washington, USA. 2009, 169. http://intranet.sisal.unam.mx/avisos_pasados_files/AQUACLT.pdf. athttps://www.was.org/documents/MeetingPresentations/AA2009/AA2009_0145.pdf.
14. Rahman MO, Ali H, Hossain MM, Anisuzzaman M, Miah MJU. Impacts of goat and sheep manures alone and in combination with urea on the polyculture of Indian and chinese carps. J. Environ. Sc. & Natural Resources. 2009; 2(1):49-53.
15. Shariful ME, Ali H, Alam MS, Hossain MM, Rahman MO. Depth wise abundance of benthic fauna in a selected pond of Mymensingh district. Bangladesh J. of Agri. 2009; 2(1):29-34.
16. Kohinoor AHM, Wahab MA, Islam ML, Thilsted SH. Culture potentials of mola, *Amblypharyngodon mola*; Chela, *Chela cachius* and Punti, *Puntius sophore* under mono culture system. Bangladesh. J. Fish. 2001; 5(2):123-134.
17. Hossain MM. Effects of partial replacement of fishmeal by fermented soybean meal and squid by-product blend in the diet of climbing perch, *Anabas testudineus* (Bloch).MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. 2009, 48.
18. Ahmed GU, Akter MN, Nipa SA, Hossain MM. Investigation on health condition of a freshwater eel, *Monopterus cuchia* from Ailee Beel, Mymensingh, Bangladesh. J. Bangladesh Agril. Univ. 2009; 7(2):419-424. http:// www.banglajol.info/index.php/JBAU/article/*download/4755/3789*
19. Ahmed GU, Hossain MM, Hossain MS. Histopathology of diseases of an air breathing teleost, *Anabas testudineus* (Bloch) from fresh water fisheries of Bangladesh. Int. J. Sustain. Agril. Tech. 2009b; 5(4):75-81.
20. Ahmed GU, Hossain MM, Hassan MM. Seasonal variation of disease and pathology of a perch, *Nandus nandus* (Hamilton) from oxbow-lake fisheries of Bangladesh. Eco- Friendly Agril. J. 2009; 2(8):761-767.
21. Kohinoor AHM, Islam ML, Wahab MA, Thilsted SH. Effect of mola (*Amblypharyngodon mola*) (Hamilton) on the growth and production of carps in polyculture, Bangladesh. Journal of Fisheries Research. 1998; 2(2):119-126.
22. Paul S. Comparison between carp poly culture system with silver carp (*Hypophthalmichthys molitrix*) and with small indigenous fish mola (*Amblypharyngodon mola*), MS dissertation, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. 1998, 85.
23. Kohinoor AHM. Development of culture technology of three small indigenous fish mola (*Amblypharyngodon mola*), punti (*Puntiussophore*), and chela (*Chela cachius*) with nites on some aspect of their biology, PhD Thesis, Department of Fisheries Management, Mymensingh. 2000, 287.
24. Wahid MI, Haq MS, Wahab MA, Ahmed ZF. Effects of fertilizer treatments on the water quality and fish production in semi-intensively managed ponds. Progress in Agriculture. 1997; 8(1-2):61-65.
25. Kohinoor AHM, Khan MM, Yeasmine S, Mandol P, Islam MS. Effects of stocking density on growth and production performance of indigenous stinging catfish, *Heteropneustes fossilis* (Bloch). Int. J. Agril. Res. Innov. and Tech. 2012; 2(2):9-14.
26. Narejo NT, Salam MA, Sabur MA, Rahmatullah SM. Effect of stocking density on growth and survival of indigenous catfish, *Heteropneustes fossilis* (Bloch) reared in cemented cistern fed on formulated feed. Pakistan J. Zool. 2005; 37(1):49-52.
27. Pechsiri J, Yakupitiyage A. A comparative study of growth and feed utilization efficiency of sex-reversed diploid densities on the growth and survival of mrigal (*Cirrhinus mrigala*) fry in rearing ponds. Bangladesh J. Zool. 2005; 21:51-58.
28. Islam MS. Evaluation of supplementary feeds for semi intensive pond culture of Mahaseer, *Tor putitora* (Hamilton). Aquaculture. 2002; 212:263-276.
29. Tripathi SD, Dutta A, Sen Gupta KK, Pattra S. High density rearing of rohu spawns in village ponds. In: Symposium of Inland Aquaculture (Abstracts).CIFRI Barrack pore, India. 1979, 12-13.
30. Haque MZ, Rahman MA, Hossain MM, Raman MA. Effect of stocking densities on the growth and survival of mirror carp, *Cyprinus carpio* var. specularis in rearing ponds. Bangladesh Journal of Zoology. 1994; 22:109-

116.
31. Chakraborty SC, Bhattacharja NC, Mansur MA. Compensatory growth in tilapia (*Oreochromis niloticus*) fed on formulated diet at restricted and satiation ration. Bangladesh J. Fisheries. 2005; 28(1-2):1-8.
32. Mollah MFA. Effects of stocking density and water depth on the growth and survival of Mahaseer, *Tor putitora* (Hamilton). Aquaculture. 1985; 212:263-276.
33. Narejo NT, Salam MA, Sabur MA, Rahmatullah SM. Effect of stocking density on growth and survival of indigenous catfish, *Heteropneustes fossilis* (Bloch) reared in cemented cistern fed on formulated feed. Pakistan J. Zool. 2005; 37(1):49-52.
34. Siddik MAB, Khan MMR. Over-wintering performance of mixed sex and monosex tilapia (*Oreochromis niloticus* L.) in Bangladesh. Bangladesh J. Fish. 2007; 11(2):153-162.
35. Rahman S, Monir MS, Khan MH. Culture potentials of climbing perch. Thai koi, *Anabas testudineus* (Bloch) under different stocking densities in northern regions of Bangladesh. Journal of Experimental Biology and Agricultural Sciences. 2013; 1(3):203-208.
36. .Kohinoor AHM, Akhteruzaman M and Saha MS. Production of *Puntius gonionotus* (Bleeker) in ponds. Bangldesh J. Zool. 1993; 21(2):77-83.
37. Noor Khan M, Saiful Islam AKM, Hussain MG. Marginal analysis of culture of stinging catfish (*Heteropneustes fossilis*, Bloch) effect of different stocking densities in earthen ponds. Pakistan J. Biol. Sci. 2003; 6:666-670.
38. Usmani N, Jafrim AK, Khan MA. Nutrient digestibility studies in *Heteropneustes fossilis* (Bloch), *Clarias batrachus* (Linnaeus) and *C. gariepinus* (Burchell). Aquaculture. 2003; 34:1365-2109.
39. Chakraborty BK, Miah MI, Mirza MJA, Habib MAB. Growth, yield and returns to Puntius sarana (Hamilton) Sarpunti, in Bangladesh under semi intensive aquaculture. Asian Fish. Sci. 2005; 18:307-322.
40. Kunda M, Shah MNA, Mazumder SK. Production Potential of Nutrient Rich Small Indigenous Species Dhela (*Osteobrama cotio*) In Carp Polyculture System. J.of Fish and Marine Sci. 2014; 6(5):453-460.