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ALL-MALE AND MIXED SEX PRAWN (*MACROBRACHIUM ROSENBERGII*) PRODUCTION UNDER POLYCULTURE WITH CARPS

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Abstract: An experiment was conducted at Dumurpota of Satkhira district for six months to compare the production performance of prawn (*Macrobrachium rosenbergii*) under all-male and mixed sex culture systems with carps *(Labeo rohita* and *Catla catla)*. A total of six experimental ghers were used for two treatments in triplicates: carps with all-male prawn (T1) and carps with mixed sex prawn (T2). In both treatments, prawns were stocked at a rate of 10,000 PL/ha while *C. catla* and *L. rohita* were stocked each at a rate of 650 fingerlings ha^{-1}. In T1, the initial average body weight of *M. rosenbergii*, *L. rohita* and *C. catla* was 7.33, 54.83 and 54.5 g respectively, whereas after 180 days of culture period the final average weights became 79.33, 256.5 and 253.47 g, respectively. In T2, the initial average body weight of *M. rosenbergii, L. rohita* and *C. catla* were 7.33, 55.07 and 54.17 g respectively, which resulted in the final average weights of 58.67, 258.87 and 252.57 g, respectively. The average production of prawn, *L. rohita* and *C. catla* in T1 was 745.97, 160.89 and 170.17 kg ha^{-1}, respectively, while that in T2 was 540.81, 159.34 and 162.98 kg ha^{-1}, respectively. The survival rates of *M. rosenbergii, L. rohita* and *C. catla* in T1 were found to be 91.28%, 89.93% and 87.93% respectively, whereas those in T2 were 87.56%, 90.3% and 88.3%, respectively. It was found that the production of carps was similar in both the treatments, but the production of prawn in T1 was substantially higher than that of T2 resulting in a net income difference of 77429.40 Tk ha^{-1}. These results indicate that in polyculture with carps, the sex composition of prawn has no effect on the production of carp species but stocking of all male prawn can significantly increase the production of prawn and the economic return in such type of farming.

Key words: Polyculture, carps, all-male, mixed sex, prawn, gher farming

Introduction

Shellfish culture in Bangladesh is virtually limited to the farming of two species namely, *Macrobrachium rosenbergii* and *Penaeus monodon*. But the giant freshwater prawn (*M. rosenbergii*) has been the most desirable candidate species for freshwater aquaculture in our country like different parts of the Indo-Pacific region (Ranjeet and Kurup, 2002). Knowledge of the biology of this species has revealed that this species possesses some attributes such as omnivorous feeding habit, rapid growth, attainment of bigger size, good disease resistance, etc. The breakthrough in its seed production and larval rearing technology has led to a new wave of enthusiasm among the prawn farmers for its monoculture and polyculture along with some carp species like catla (*Calta catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus cirrhosus*). Fallow

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polders, paddy fields, ghers, homestead ponds, etc. are used for the culture of prawn (*M. rosenbergii*). Several studies have been carried out on nursery rearing, different stocking densities, culture period, stocking of batch graded and size graded population, role of shelters and added substrates, etc. (Smith *et al*., 1981; Karplus *et al*., 1986, 1987; D'Abramo *et al*., 1989, Tidwell *et al.*, 1993 and Kurup *et al*., 1996).

The culture system in which all the stocked prawn are male is called all-male culture system of prawn. In this system, growth performances of male are observed to be better than those of the mixed sex culture system. In mixed sex culture system, the feeding rate of males in reduced as they waste their energy seeking for close contact with the females at the stage of sexual maturity and due to the reduction in feed consumption, the ultimate growth rate of males is disturbed. Moreover, males of *Macrobrachium* sp. grow bigger in size than the females (Mantel and Dudgeon, 2004) and at mature stage, females use much of the energy for gonadal development resulting high FCR. Thus, the production rate of prawn in all-male culture system is higher than that in the mixed sex culture systems. Therefore, farmers are interested to culture only male species of prawn instead of mixed sex in their ghers.

The present study was carried out at Asasuni upazila of Satkhira district to observe the production performances of prawn that are cultured in mixed and all-male culture systems.

Materials and Methods

Study area and duration: The experiment was carried out at Dumurpota of Asasuni upazila in Satkhira district during the period from June 05, 2005 to December 05, 2005.

Experimental Ponds: A total of six ghers were taken for the study. Three of these ghers were stocked with all-male prawn and carp (AM1, AM2 and AM3) and the remaining three others were stocked with mixed sex prawn and carps (MS1, MS2 and MS3). Water area of AM1, AM2 and AM3 ghers was 0.49, 0.40 and 0.30 ha, respectively while that of MS1, MS2 and MS3 was 0.30, 0.45 and 0.61 ha, respectively.

Liming and fertilization: During gher preparation, liming was done after 7-10 days of ploughing with CaO at the rate of 125 kg ha^{-1}. Cowdung, urea and TSP were applied at the rate of 500, 30 and 25kg ha^{-1}, respectively. After fish stocking, cowdung, urea and TSP were applied once a month at the rate of 125, 15 and 10 kg ha^{-1}, respectively.

Nursing of prawn PL: Prawn fry (PL 20) were collected from the local suppliers and stocked in all the rearing ponds at the stocking rate of 50,000 individuals ha^{-1}. The rearing period was 45 days. After one and half month of rearing, male prawns were sorted out from the rearing ponds and stocked in the all-male ghers. The male prawns were sorted by observing their head. The head of male prawn was larger than that of the female.

Stocking: In both the culture systems, prawns PL were stocked at 10,000 individuals ha^{-1} and *C. catla* and *L. rohita* fingerlings were stocked each at a rate of 650 individuals ha^{-1} in all the ghers. The average initial weights of *M. rosenbergii, L. rohita* and *C. catla* stocked in AM1, AM2 and AM3 ghers were 7.33, 54.83 and 54.50 g respectively, whereas those in MS1, MS2 and MS3 ghers were 7.33, 55.07 and 54.17g, respectively.

Grow-out management

Feeding: Feeding of post larvae (PL) was carried out from the following day of stocking in both the treatments. In the rearing ponds, rice bran and wheat flour were supplied at a rate of 7-10 kg ha^{-1} day^{-1}. Subsequently, rice bran and wheat flour were supplied at 8-12 kg ha^{-1} day^{-1} for the first month followed by chopped snail meat only supplied at 25-37 kg ha^{-1} day^{-1} until harvesting.

Monitoring of water quality parameters: The five major water quality parameters (water temperature, water depth, dissolved oxygen, pH and salinity) of the experimental ghers were recorded fortnightly at 10-12 A.M. All the parameters were recorded by using a HACH water testing kit box (Model: FF-3, USA).

Growth and production monitoring: The growth (in terms of gain in weight) of prawn and carps were recorded fortnightly through random sampling. Weight of prawn was measured with a simple balance. The growth rate of prawn was calculated using the formula of Mahmud *et al.* (1993):

Growth rate (g day^{-1}) = W2 – W1/ T2 – T1. Where, W2 =Weight at time T2; W1 = Weight at time T1; T2 = Date of last sampling; T1 = Date of previous sampling

The gross and net production (kg ha^{-1}) was calculated by the following formula:

$$\text{Gross production (kg ha}^{-1}) = \frac{Survival\ rate\ x\ stocking\ density\ x\ Final\ weight\ (g)}{1000}$$

$$\text{Net production (kg ha}^{-1}) = \frac{Survival\ rate\ x\ stocking\ density\ x\ Net\ weight\ (g)}{1000}$$

Survival rate: The survival rate of prawn/fish in a pond was calculated by the following formula:

$$\text{Survival rate} = \frac{Total\ catch\ of\ fishes}{Initial\ release\ of\ fishes} x100$$

Results

During the culture period of the present study, the mean temperature range is recorded as 28.62±2.33 to 28.96±2.47 ^{0}C; the mean highest pH is 8.05±0.19 and the mean lowest is 7.96±0.17; the mean dissolved oxygen level to range from 6.95±0.52 to 7.29±0.45 mg/L and the mean water depth to range from 121.92±17.47 to 127.85±15.3 cm in the experimental ghers.

In both carps with all-male prawn ghers (T1) and carps with mixed sex prawn ghers (T2) treatments, prawns were stocked at a rate of 10,000 PL/ha while *C. catla* and *L. rohita* were stocked each at a rate of 650 fingerlings ha^{-1}. In T1, the initial average body weight of *M. rosenbergii*, *L. rohita* and *C. catla* was 7.33, 54.83 and 54.5 g respectively, whereas after 180 days of culture period the final average weights became 79.33, 256.5 and 253.47 g, respectively. In T2, the initial average body weight of *M. rosenbergii, L. rohita* and *C. catla* were 7.33, 55.07 and 54.17 g respectively, which resulted in the final average weights of 58.67, 258.87 and 252.57 g, respectively. The average production of prawn, *L. rohita* and *C. catla* in T1 was 745.97, 160.89 and 170.17 kg ha^{-1}, respectively, while that in T2 was 540.81, 159.34 and 162.98 kg ha^{-1}, respectively. The survival rates of *M. rosenbergii, L. rohita* and *C. catla* in T1 were found to be 91.28%, 89.93% and 87.93% respectively, whereas those in T2 were 87.56%, 90.3% and 88.3%, respectively. The highest and the lowest growth rate of prawn in T1 is recorded as 0.416 (AM2) and 0.388 (AM1) g/day, respectively while that in T2 is 0.294 (MS2) and 0.272 (MS1) g/day, respectively.

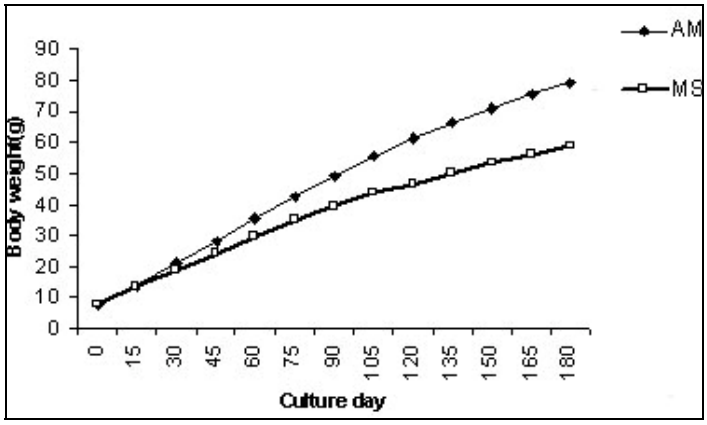

Fig. 1. Fortnightly increase in weight of *M. rosenbergii* by weight (g) in all-male (AM) and mixed sex (MS) ghers.

Table 1. Range, average and SD/SE of the water quality parameters as recorded from the experimental ghers during the study period.

Parameter	Ghers	Culture Period													Mean
		June		*July*		*August*			*September*		*October*		*November*		
		0	15	30	45	60	75	90	105	120	135	150	165	180	
Temperature (°C)	AM1	29.5	30	31	30.5	30.5	31	30	29	28	27	26.5	26	25	28.776±2.05
	AM2	29	29.5	30.5	30	30.5	30	29.5	28.5	28.5	28	27	26.5	25.5	28.69±1.58
	AM3	29	30	30.5	30.5	30	30	29.5	29	28	27.5	27	26	25.5	28.65±1.7
	MS1	30	30.5	30.5	31.5	32	31	30.5	29.5	28	27	26	25	25	28.96±2.47
	MS2	29.5	30	31	31	31.5	32	30	29	28	27.5	26	25.5	25	28.92±2.34
	MS3	30	30	30.5	31	31.5	30.5	30	28.5	27.5	26.5	25	25.5	25.5	28.62±2.33
pH	AM1	8	8	8.1	8.2	8	7.9	7.8	7.9	8	7.9	7.5	7.7	7.8	7.91± 0.18
	AM2	7.8	7.9	8.2	8.3	8.1	8	7.9	7.7	7.6	7.8	8	8.2	8	7.96±0.21
	AM3	8.1	8.1	7.9	8	7.8	8.1	8	7.9	7.7	8	7.9	8.1	8.4	8±0.17
	MS1	8.2	8.3	8.5	8.2	8.3	8	8.2	8	7.8	7.5	7.7	7.8	8	8.04±0.28
	MS2	8	8.2	8.1	8	8.2	8.1	7.9	7.7	7.7	7.9	8	7.9	7.8	7.96±0.17
	MS3	8.4	8.2	8.1	7.9	8	7.9	8	8.1	7.9	7.7	8	8.1	8.3	8.05±0.19
DO (mg l^{-1})	AM1	7	7.5	8	7.4	7.5	7.2	7	6.8	7.4	6.6	7	6.8	7.5	7.21±0.39
	AM2	7.4	7.6	7.5	7.2	7.5	7	7.4	7.2	7	7	6.8	6.4	6	7.08±0.46
	AM3	6.8	7.2	7.4	6.9	6.5	6.8	7	7.6	8	7.1	6.4	6.1	6.5	6.95±0.52
	MS1	6.5	6.8	7	6.9	6.5	7.2	8	7.6	7.4	7	6.8	6.7	6.1	6.96±0.5
	MS2	7	7.2	7.3	7.5	8.2	7.6	7	7.3	7.8	7.5	7	6.8	6.5	7.29±0.45
	MS3	7.2	7.5	8	7.2	7.5	7.3	7.8	7	6.9	7.2	7.2	6.6	6.2	7.2±0.47
Water Depth (cm)	AM1	114	121	133	140	140	143	143	133	121	114	109	107	101	124.54±14.87
	AM2	109	119	127	135	148	143	143	140	130	123	118	113	109	127.46±13.53
	AM3	117	127	134	139	144	148	148	138	124	118	115	109	101	127.85±15.3
	MS1	101	114	124	134	144	144	148	138	122	118	115	108	104	124.15±16.01
	MS2	109	117	127	137	148	150	150	135	128	121	111	104	101	126±17.25
	MS3	99	112	123	130	142	144	148	135	128	116	108	101	99	121.92±17.47

The average investment in both of the carps with all-male prawn ghers (T1) and carps with mixed sex prawn ghers (T2) is recorded as 1,30,210 Tk. ha^{-1} while the net average income from T1 and T2 is 1,69,345.80 Tk. ha^{-1} and 91,916.40 Tk. ha^{-1} respectively resulting a cost benefit ratio of 1.84.

The water quality parameters, growth performances and production of cultured prawn and carps and economic analysis of the experimental ghers of the present study are summarized in Table 1, 2 and 3.

Discussion

Water quality parameters: Arithmetic means of the physico-chemical parameters measured are shown in Table 1. It is evident from the table that, the water quality parameters of theexperimental ghers were almost similar throughout the experimental period and were optimum for prawn culture as reported by different researchers (Mondal *et al.,* 2005 and Huq *et al.,* 2004).

Growth

All-male ghers (AM1, AM2, AM3): The growth of prawn in all-male culture ghers was found to increase throughout the culture period (Table 2). The initial average body weight of *M. rosenbergii*, *L. rohita* and *C. catla* in AM1, AM2 and AM3 ghers was 7.33, 54.83 and 54.50 g, respectively which became 79.33, 256.50 and 253.47 g after 180 days of culture period. Therefore, the overall average absolute growths (final weight-initial weight) of *M. rosenbergii*, *L. rohita* and *C. catla* in three all-male culture ghers were found to be 72.00, 201.67 and 199.30 g, respectively.

Table 2. Growth performance and production of prawn and carps.

Treatments	Replications	Species	Stocking density (no./ha)	Average body weight (g)		No. of fish harvested	Survival rate (%)	Net production (kg/ha.)	Growth rate (g/day)
				Initial	Final				
Carps with all-male	AM1	*M. rosenbergii*	10000	7.0	77.0	9112	91.12	768.91	0.388
		L. rohita	650	52.4	256.3	585	90.0	160.94	-
		C. catla	650	53.8	252.6	572	88.0	174.66	-
	AM2	*M. rosenbergii*	10000	8.0	82.0	8997	89.97	728.59	0.416
		L. rohita	650	53.5	250.4	591	90.9	155.99	-
		C. catla	650	56.9	257.5	578	88.9	169.43	-
	AM3	*M. rosenbergii*	10000	7.0	79.0	9275	92.75	740.41	0.399
		L. rohita	650	58.6	262.8	578	88.9	165.73	-
		C. catla	650	52.8	250.3	565	86.9	166.42	-
Carps with mixed sex	MS1	*M. rosenbergii*	10000	7.0	56.0	8981	89.81	556.30	0.272
		L. rohita	650	54.7	260.3	578	88.9	155.65	-
		C. catla	650	53.0	255.6	578	88.9	171.74	-
	MS2	*M. rosenbergii*	10000	8.0	61.0	9030	90.3	573.98	0.294
		L. rohita	650	56.3	256.3	598	92.0	166.45	-
		C. catla	650	56.7	252.3	572	88.0	159.32	-
	MS3	*M. rosenbergii*	10000	7.0	59.0	8257	82.57	492.16	0.288
		L. rohita	650	54.2	259.7	585	90.0	155.93	-
		C. catla	650	52.8	249.8	572	88.0	157.89	-

Mixed sex ghers (MS1, MS2, MS3): The growth of prawn in mixed sex ghers was found to increase throughout the culture period (Table 2). The initial average body weight of *M. rosenbergii, L. rohita* and *C. catla* in MS1, MS2 and MS3 ghers were 7.33, 55.07 and 54.17 g, respectively which became 58.67, 258.87 and 252.57 g respectively after 180 days of culture period. Therefore, the overall average absolute growths (final weight-initial weight) of *M.*

rosenbergii, *L. rohita* and *C. catla* in three mixed sex culture ghers were found to be 51.34, 203.80 and 198.40 g, respectively.

From Fig. 1 it is evident that *M. rosenbergii* showed higher growth in all-male culture system than the mixed sex culture system. This is presumably due to the fact that the absence of females resulted in increased consumption of feed by the males.

Huq and Nandi (2003) conducted an experiment from October 2002 to March 2003 on polyculture prawn with *rohu* and *catla* using only fertilizer at the stocking density of 10, 15 and 20 individuals dec^{-1}, respectively and obtained the average final weight of 58, 120 and 60 g, respectively. In the present study, the final average weight of prawn in all-male culture ghers (72 g) is higher than that of the result of the above study (58 g), but lower in mixed sex culture ghers (51.34 g).

Alam *et al*. (2001) worked on polyculture of *M. rosenbergii* with carps for 8 months and obtained the highest growth of 460, 388, 717, 185 and 67 g in case of *Hypophthalmicthys molitrix*, *C. catla*, *Ctenopharyngodon idella*, *Barbodes gonionotus* and *M. rosenbergii* with the stocking density of 10, 6, 1, 2 and 35 individuals dec^{-1}, respectively. The final growth of *M. rosenbergii* (67.91 g) was lower than that of the all-male culture ghers (72 g), but it was also higher than the mixed sex culture ghers (51.34 g) of the present study.

Production: The average production of *M. rosenbergii*, *L. rohita* and *C. catla* in AM1, AM2 and AM3 ghers was 745.97, 160.89 and 170.17 kg ha^{-1} respectively, while that in MS1, MS2 and MS3 ghers these were 540.81, 159.34 and 162.98 kg ha^{-1}, respectively (Fig. 2).

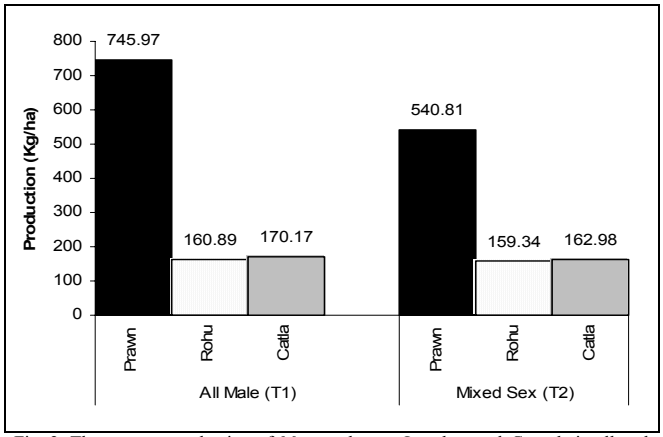

Fig. 2. The average production of *M. rosenbergii, L. rohita* and *C. catla* in all-male and mixed sex culture ponds.

Mondal *et al.* (2005) found the average production of *M. rosenbergii, L. rohita*, *C. catla, H. molitrix* and *Puntius gonionotus* were 432.11, 385.81, 303.44, 1,373.67 and 308.27 kg ha^{-1}, respectively. The production of prawn in the above experiment was lower than that of the both the culture systems (745.97 kg ha^{-1} and 540.81 kg ha^{-1}) in the present study.

Huq *et al.* (2004) reported that the total production of prawn in monoculture and polyculture systems was 906.8 and 605.18 kg ha^{-1} respectively, whereas the production of rohu and catla in polyculture system was 619.1 and 584.2 kg ha^{-1}, respectively. The production of prawn in the above experiment (605.18 kg ha^{-1}) is lower than that of the all-male culture system (745.97 kg ha^{-1}) in the present study, but higher than that of the mix sex culture system (540.81 kg ha^{-1}) of the present study.

Siddique *et al.* (1999) while conducting an experiment to find out a suitable supplemental feed for polyculture of *M. rosenbergii* with Indian major carps recorded the total production to range from 1,976 to 2,445 kg ha^{-1} 105 $days^{-1}$ which is higher than that of the present study. This is because of the use of special feed in the above experiment. Jose *et al.* (1992) reported the production of prawn in polyculture experiment to range from 62.5 to 123 kg ha^{-1} 105 $days^{-1}$ which is lower than that of the present study.

Survival rate: The average survival rates of *M. rosenbergii*, *L. rohita* and *C. catla* in AM1, AM2 and AM3 ghers was found to be 91.28%, 89.93% and 87.93% respectively, whereas the same was found 87.56%, 90.3% and 88.3%, respectively in MS1, MS2 and MS3 ghers (Table 2). Mondal *et al.* (2005) observed that the average survival rate of *M. rosenbergii, L. rohita*, *C. catla, H. molitrix* and *Puntius gonionotus* was 57.23%, 83.24%, 88.58%, 91.66% and 84.46%, respectively. Huq *et al.* (2004) found that the survival rate of *M. rosenbergii* was 75% and the survival of both *rohu* and *catla* was 90%. Huq and Islam (2003) found the survival rate of *Pangasius hypophthalmus*, *C. catla* and *L. rohita* to range from 95-97% while that of *M. rosenbergii* as 78%. Alam *et al.* (2001) observed the survival rate of prawn to range from 66 to 70% in polyculture with carps. The result of the present study is better than that of the above experiments. One of the reasons behind obtaining high survival rate in the present study might be due to the fact that prawn juveniles were stocked in the experimental ghers after nursing for one and half month whereas the above scientists stocked prawn fry at early stage.

Economic analysis: The average expenditure, income and profit of all-male ponds were 130,210, 299,555.80 and 169,345.80 Tk. ha^{-1}, respectively while those in mixed sex ponds these were 130,210, 222,126.40 and 91,916.40 Tk. ha^{-1}, respectively (Table 3).

Table 3. Economic analysis of the experimental ghers.

Item	Carps with all-male prawn (T_1)			Carps with mixed sex prawn (T_2)		
	AM1	AM2	AM3	MS1	MS2	MS3
	Investment cost (Tk. Ha^{-1})					
1. Pond preparation						
Rotenone	12.5	12.5	12.5	12.5	12.5	12.5
Netting	100.0	100.0	100.0	100.0	100.0	100.0
Lime	250.0	250.0	250.0	250.0	250.0	250.0
Poultry	210.0	210.0	210.0	210.0	210.0	210.0
Urea	12.5	12.5	12.5	12.5	12.5	12.5
TSP	25.0	25.0	25.0	25.0	25.0	25.0
Cow dung	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0
2. Stocking						
PL of prawn	120000	120000	120000	120000	120000	120000
Carp fingerlings	2600	2600	2600	2600	2600	2600
3. Feeding	4000	4000	4000	4000	4000	4000
4. Harvesting	500	500	500	500	500	500
5. Labour etc.	500	500	500	500	500	500
Total cost	130210	130210	130210	130210	130210	130210
Treatment wise Ave. Cost:		130210			130210	
	Income (Tk/ha)					
1. Prawn	288341.30	273221.30	277653.80	208612.50	215242.50	184560.00
2. Rohu	10461.10	10139.35	10772.45	10117.25	10819.25	10135.45
3. Catla	9606.30	9318.65	9153.10	9445.70	8762.60	8683.95
Gross Income	308408.70	292679.30	297579.35	228175.45	234824.35	203379.40
Gross Ave. Income:		299555.80			222126.40	
Net Income	178198.70	162469.30	167369.40	97965.45	104614.40	73169.40
Ave. Net Income:		169345.80			91916.40	
Cost Benefit Ratio:				1.84		

Mondal *et al.* (2005) reported that the average expenditure income and profit to be 120,310, 248,192.50 and 127,882.50 Tk. ha^{-1}, respectively.

Huq *et al.* (2004) obtained the net profit in the experimental monoculture and polyculture ponds as 106,139.3 Tk. ha^{-1} and 145,008.5 Tk. ha^{-1}, respectively which is nearly similar to the result of all-male culture system, but higher than that of the mixed sex culture system of the present study. Huq and Islam (2003) obtained the highest income of 122,220.83 Tk. ha^{-1} from the polyculture of *P. hypophthalmus* with *C. catla*, *L. rohita* and *M. rosenbergii* which is lower than that of the results of the present study. Siddique *et al*. (1999) reported to obtain a net profit 72, 885 Tk. ha^{-1} 105days^{-1}through polyculture of *M. rosenbergii* with Indian major carps which is nearly similar to the result of mixed sex culture system, but lower than that of all-male

culture system. It may be concluded from this study that in polyculture with carps, all-male culture of *M. rosenbergii* is more profitable than the mixed sex culture system.

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