POLYCULTURE AND INTEGRATED CULTURE PATTERN OF FRESHWATER PRAWN IN FRESH TO HYPOSALINE WATER

M. ASLAM Ali[1], GAZI SIPAR HOSSAIN[1], M. MASUDUR RAHMAN BISWAS[2], SHYAMAL KANTI BARMAN[3] and KHANDAKER ANISUL HUQ[1]

[1]Fisheries and Marine Resource Technology Discipline, Life Science School, Khulna, University, Khulna-9208, Bangladesh, Agriculture, Rural Development & Research Sector, Implementation Monitoring and evaluation division, Ministry of Planning, Dhaka, Bangladesh, [3]Consultant, Sustainable Development Associates, Banani, Dhaka, Bangladesh.

Accepted for publication on 15 July 2009

ABSTRACT

Ali, M. A., Hossain, G.S., Biswas, M.M.R., Barman, S. K., and Huq, K.A. 2009. *Polyculture and integrated culture pattern of freshwater prawn in fresh to Hyposaline water. Int. J. Sustain. Crop Prod. 4(4):23-27.*

The study was conducted in polyculture and integrated culture farms, six in each at Fakirhat upazilla under Bagerhat district during March to September 2006. In Bagerhat region prawn (galda, *Macrobrachium rosenbergii*) polyculture was practiced with penaeid shrimp (bagda, *Peneaus monodon)* and carps like rohu (*Labeo rohita*), catla (*Catla catla*), silver carp (*Hypophthalmichthys molitrix*) and mrigal (*Cirrhinus cirrhosus*) in fresh to hypo-saline water (0-3 ppt). Some farmers were also practicing integrated culture of all these polycultured species with low salinity tolerant paddy (BR-23; BRRI-27, 40,41) and vegetables on the dike. The study was aimed to focus the cost-benefit effectiveness of galda-bagda-carps polyculture and integrated culture in fresh to hypo-saline water. The size of the surveyed farms varied from 0.67 to 2 ha. The range of stocking density of galda, bagda, rohu, catla, silver carp and mrigal were 6000-9000, 17000-19000, 400-800, 550-700, 350-650 and 400-600 per hectare respectively in polyculture; and 5000-7000,12500-15000, 300-450, 250-400, 180-300 and 200-350/ha respectively in integrated culture. The farmers usually used rice bran, wheat bran, master oil cake, soybean meal, snail meat, low cost rice etc. The production of *macrobrachium rosenbergii*, *penaeus monodon*, *labio rohita*, *catla catla*, silver carp and mrigal were 120, 137, 65, 57, 35 and 31kg/ha respectively in polyculture; and 101, 117, 36, 32, 34 and 25kg/ha respectively in integrated culture. In addition, in the integrated culture, the production of paddy and vegetables were 2446 and 634kg/ha respectively. The net profit of polyculture and integrated culture were 65,306.00 and 67,038.00Tk[1]/ha respectively. The study revealed that both culture systems were profitable. It is concluded that farmers can contribute in the national economy by adopting different types of culture practice depending on their available facilities.

Keywords: polyculture, integrated culture, hypo saline water

INTRODUCTION

Fisheries resources play a vital role in the socio-economic development of the country and supply about 80% animal protein of our meal. About 5% GDP (Gross Domestic Product), 15% total foreign exchange and about 12 million people are engaged in the exploitation and conservation of fish and fisheries products (Matsya pakkaha, 2004). Among fisheries products, golda (*Macrobrachium rosenbergii*) and bagda (*Penaeus monodon*) are very important and is known as "White Gold" or "Dollar". The amount of shrimp exploitation from the sea in 2003-2004 is 35,500 metric ton and from the coastal water-body is 40,403 metric ton. Besides, from the inland water-body, the amount is 57, 530 metric ton (Matsya pakkaha 2004). In world market, shrimp is very attractive product for its nutrition and taste. For increasing the demand of shrimp in international market shrimp culture have been increasing from the 70th decades and now it is known as a large commerce. Bagda is cultured in brackish water area where water (salinity 5-25 ppt). Its optimum salinity ranges from 10 to 25 ppt. But it can survive as low as 1 ppt and as high as 37 ppt salinity. On the other hand, golda is a freshwater species (0-5 ppt). During spawning time they need saline water (salinity 5 to 20 ppt). Both the two species has a number of advantages if compared with other crustaceans, it adapts with wide range of temperature (20^oC-32^oC), fast growing individuals reach marketable size in about 4-6 months, high nutritional value, omnivorous feeding habits thus being an excellent species for polyculture. The main shrimp farming areas are the districts of Khulna, Satkhira, Bagerhat, Barisal, Potuakhali, Bhola, Chittagong, Cox`s Bazar, Noakhali and Pirojpur. Statistical data shows that in 1996, there were about 13270 golda farms and 10153 Bagda farms in these areas and its area was 8439.67 ha and 133670.70 ha respectively (Anonymous, 1999). With the increasing of demand the numbers of farms are increasing at a high rate because golda live in freshwater. So beside coastal area it can easily be cultured. In 1999 the number of Golda farm was 19,798 where Bagda farm was 11324 (Anonymous, 1999). It was found that tiger shrimp (bagda) is cultured with other fin fishes (Paul, 1996) and with parse *Liza parsia* (Shofiquzzuha and Ahmmod, 1999). An experiment inducted on environment friendly polyculture of tiger shrimp (*P. monodon*) with milk fish (*Chanos chanos*), carpio (*Cyprinus carpio*), rajputi (*Puntius gonionotus*), rohu (*Labeo rohita*), and catla (*Catla catla*) in hyposaline water condition (0-15 ppt) at Cox's Bazar (BFRI) from April to December 1997 (BFRI, 1997) where it was found that carps could survive up to 10 ppt. On the other hand the culture of freshwater giant prawn (golda) with fin fishes such as Indian major carps, common carps and other exotic fishes are well

[1] Tk. Means Bangladeshi currency (BDT). USD 1 = BDT 69.58 (as on September 2006)

established (Hoq *et al*. 1996). Though golda and bagda are cultured in separate condition but when these two species are cultured together with other fin fishes in freshwater to hypo-saline condition then the farmers will be greatly benefited. Integrating shrimp farming is another type of shrimp culture which is practiced in Bagerhat district, where penaeid shrimp is cultured with paddy. In culture fisheries, integrated shrimp farming is a new concept in Bangladesh because shrimp produces in saline water but saline water is harmful for paddy. But both two crops are cultured successfully in brackish water.

MATERIALS AND METHODS

Six polyculture and six integrated culture ghers were selected for the study from Fakirhat upazila under Bagerhat District during March to September, 2006. All the information was collected from the gher owners through a structural questionnaire. The ghers have been using for the brackish water shrimp (*Penaeus monodon*) culture together with prawn (*Macrobrachium rosenbergii*) and carp species (*Labeo rohita, Catla catla, Hypophthalmichthys molitrix and Cirrhinus cirrhosus*) and integrated culture between shrimp, prawn and carp species with paddy. The size of the ghers varied from 0.67 to 2 ha. During pond preparation they used lime after ploughing at the rate of 150-200 kg/ha. After 15 days subsequent to liming they used cow-dung, urea and TSP at the rate of 35, 25 and 20 kg/ha respectively. Then they stocked the PL of golda and bagda which were collected from natural sources (Local River) and carp fry were hatchery produced. The farmers stocked shrimp fry into the ghers in the month of February-March. The stocking rate of shrimp (*P. monodon*), prawn (*M. rosenbergii*), rohu (*L. rohita*), catla (*C. catla*), silver carp (*H. molitrix*) and mrigal (*C. cirrhosus*) in case of polyculture (Annexure 1, Table 1) and integrated cultures described in Annexure 1, Table 2.

After stocking, the farmers used cow dung, TSP, urea to increase the natural food and used supplementary feed to provide the nutrition. They used special feed, such as meat and bone meal, soybean meal, snail meat, master oil cake, wheat bran, rice bran and rice.

RESULTS AND DISCUSSION

Hydrographical parameters

Some common hydrographical parameters e.g., water temperature, water transparency, water depth, dissolved oxygen, pH, salinity were recorded and they were in the acceptable range.

Table3. Range of hydrographical parameters in polyculture and integrated culture system

Parameters	Measured value		Recommended range
	Polyculture	Integrated culture	
Water temperature (^{o}C)	22 – 34	20 – 35	22 – 32 (Ling, 1969)
Water transparency (cm)	35 – 41	30 – 35	34 – 40 (Humayun *et al.*, 1986)
Water depth (m)	0.9 – 1.4	1 – 1.3	1.0 – 1.5 (Huq and Islam, 2003)
Dissolve Oxygen (mg/l)	4.33- 8.00	4.7 – 8.5	4.5 – 9.9 (George, 1961)
pH	7.8 – 8.9	7.5 – 8.4	7.5 – 8.5 (Humayun *et al.*, 1987)
Salinity (ppt)	0 – 3	0 – 3	0- 3 (Andrew *et al.*, 1972)

Performance

In case of polyculture the total production of shrimp, prawn, rohu, catla, silver carp and mrigal were 137, 120, 65, 57, 35 and 31 kg/ha respectively. Total income was 119880 Tk. per hectare (Table 05). The production cost including purchasing of shrimp fry, prawn and other fin fish species. It was also included purchasing of lime, fertilizer, feed etc. Production cost also considered for labor management, house repairing, harvesting gears, basket, night guard and transport. The total production cost or total input was 54574 Tk/ha. The net profit was 65306 Tk/ha. In case of integrated culture the total production of shrimp, prawn, rohu, catla, silver carp, mrigal and paddy were 117, 101, 36, 32, 34, 25 and 2446kg/ha respectively and dike vegetables was 634kg/ha. Total income was 112721Tk. per hectare. The total production cost was 45683Tk/ha. The net profit was 62111Tk/ha. Farmers used to consume white fish (fin fish) as their daily food. So, they didn't know exact what income came from the finfishes. They sold prawn and paddy and earned money. During dry season, when water availability was comparatively lower, then the farmers used to culture low salinity tolerant paddy (BR-23; BRRI-27, 40, 41) in the middle portion of the pond while they cultured shrimp including prawn and fin fishes in the boundary line of the pond by preparing proper dike. It is called integrated shrimp farming. In integrated shrimp farming the stocking rate of shrimp and other species were lower than polyculture shrimp farming because the area of ghers were limited. But at present in rainy season the integrated culture occurred.

Table 4. Production of shrimp, prawn, rohu, catla, silver carp and mrigal per hectare in polyculture and integrated culture system

Number of ghers	Area (ha)		Production (kg)												
			Shrimp		Prawn		Rohu		Catla		Silver carp		Mrigal		Paddy
	PC	IC	PC	IC	PC	IC	PC	IC	PC	IC	PC	IC	PC	IC	IC
1	0.67	0.80	200	177	175	150	120	55	90	38	52	48	37	30	2400
2	1.34	1.34	205	175	180	145	100	65	92	45	60	38	55	40	3350
3	1.60	1.34	220	170	185	155	125	62	80	65	55	50	40	42	3618
4	1.60	1.60	195	180	180	148	65	45	82	52	60	55	50	38	3840
5	2.00	2.00	225	172	190	152	70	48	95	42	35	52	55	45	4600
6	2.00	2.00	215	182	200	160	120	52	85	45	58	60	52	35	4350
Total	9.21	9.08	1260	1056	1110	910	600	327	524	287	302	303	289	230	22158
Average	1.54	1.51	210	176	185	152	100	55	87	48	54	51	48	38	3693
Production /ha			137	117	120	101	65	36	57	32	35	34	31	25	2446

PC= Poly culture, IC= Integrated culture.

Paul (1996) found mean production of fish and shrimp was, 980 kg/ha. Over an average culture period of 240 days with a benefit of Tk. 47,041/ha.

Table 5. Total income per hectare in polyculture and integrated culture system

Serial number	Items	Amount (kg)		Rate: Tk/kg		Total income (Tk.)	
		PC	IC	PC	IC	PC	IC
1	Shrimp	137	117	400	360	54800	42120
2	Prawn	120	101	450	400	54000	40400
3	Rohu	65	36	65	60	4225	2160
4	Catla	57	32	60	55	3420	1760
5	Silver carp	35	34	45	45	1575	1530
6	Mrigal	31	25	60	55	1860	1375
7	Paddy		2446		8		19568
					Total	**1,19,880**	**108913**

Table 6. Production and income per hectare from dike vegetables in case of integrated culture system

Number of ghers	Area of ghers (ha)	Production (kg)							
		Papaya	Brinjal	Bitter Melon	Lady's finger	Tomato	Pepper	Bottle-gourd	Pumpkin
1	0.80	240	-	-	84	-	36	-	-
2	1.34	-	300	160	-	171	-	-	-
3	1.34	300	-	-	-	-	-	400	500
4	1.60	-	-	-	168	192	72	-	-
5	2.00	-	450	240	269	225	-	-	-
6	2.00	600	-	-	-	-	-	598	748
Total	9.08	1140	750	400	521	588	108	998	1248
Production Kg./ha									634
Price (Tk/kg)		4	8	10	8	8	20	4	4
Income (Tk.)		4560	6000	4000	4168	4704	2160	3992	4992
Total income (Tk.)									34576
Income (Tk/ha)									3808

Paul (1996) worked on carp-galda polyculture In Kishoregang. Pond management input and cost-benefit data were recorded by the farmers and were then analyzed by fish experts. The mean production cost was estimated to be Tk. 18,772 ha^{-1}.

The present findings did not agree with above-mentioned findings because BAFRU's menu of production was for semi-intensive culture system. The farmers of study area did not maintain this system appropriately; feeding rate, feeding frequency, fertilization, stocking density etc. That was something improved traditional culture system. So the production cost varied.

Table 6. Total production cost per hectare in polyculture and integrated culture system

Items	Rate (Tk.)	Cost (Tk.)											
		G1		G2		G3		G4		G5		G6	
		PC	IC	PC	IC	PC	IC	PC	IC	PC	IC	PC	IC
Shrimp PL	0.80	9619	9620	18169	15008	24365	15008	22441	18560	29659	20000	28857	20800
Prawn PL	1	7515	4812	10720	8710	8040	8710	8710	8800	11390	11000	12060	10000
Rohu	2	1002	640	1608	1206	2144	1206	1280	1120	2000	1800	3200	1600
Catla	2	800	480	1742	670	1340	670	1760	1280	2800	1200	2400	1400
Silver carp	1	267	160	603	241	804	241	1040	400	700	400	1100	600
Mrigal	1.5	400	300	1005	402	905	402	1320	720	1800	1050	1650	600
Paddy plant	-	-	500	-	850	-	850	-	1200	-	1400	-	1350
Lime	10	750	300	1000	600	1000	600	1200	800	1500	1200	1500	1250
Fertilizer	10	1000	2000	1500	2200	1500	2200	1700	2300	2000	2300	1800	2500
Feed	20	15500	13500	20000	15000	19500	15000	21000	17000	25000	18500	22000	19000
Labor	100	4000	3500	4000	3500	4000	3500	4000	3500	4000	3500	4000	3500
House repairing		1000	500	1000	500	1000	500	1000	500	1000	500	1000	500
Harvesting		1000	1000	1500	1500	1700	1500	1600	1600	2000	2000	1800	1800
Night guard (6 months)	2000	12000	9000	12000	9000	12000	9000	12000	9000	12000	9000	12000	9000
Transport		1500	2000	2000	2300	2200	2300	2000	2700	2500	3000	2300	2800
Others		3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	2500	3000
Total cost (Tk.)		59353	51312	79847	64687	83498	64687	84051	72480	101349	79850	96167	79700
Average cost (Tk.)												84044	68982
Cost Tk./ha												**54574**	**45683**

Table 7. Net profit (Tk. /ha) in polyculture and integrated culture system

Total income Tk./ha (X)		Total cost Tk./ha (Y)		Net profit Tk./ha (P = X-Y)	
Poly culture	Integrated culture	Poly- culture	Integrated culture	Poly- culture	Integrated culture
119880	112721	54574	45683	65306	67038

Siddique *et al.* (1999) conducted an experiment to find out a suitable supplementary feed kg/ha for polyculture prawn with Indian major carps where the total production range between 1976 and 2445 kg/ha/105 days. Jose *et al.* (1992) found the production of prawn in polyculture experiment range between 62.5 – 123 kg/ha/105 days. Hossain *et al.* (2000) stated that the highest production ranging from 304.5 to 563.3 kg/ha/105 days in monoculture of prawn. Huq *et al.* (2004) found that the average production in polyculture with Indian major carps is 605.18 and monoculture of prawn is 909.8 kg/ha. Shah and Khan (2003) found that the production in prawn-fin fish polyculture is 300 kg/ha and the net profit is 101072 Tk./ha.

CONCLUSION

Shrimp farming areas in Bangladesh are increasing rapidly day by day in Bagerhat, Khulna, and Satkhira region and new sites of Bhola, Barguna, Patuakhali and Noakhali are also coming up for shrimp farming. Present production rate is low in general. Shrimp production in our country ranges from 250-300kg/ha. There is a huge scope of shrimp farming in the Bagerhat region. In the Bagerhat region culture is carried out by the traditional method. If the ghers were properly managed the output and production would increase and improve the earnings as well as socio-economic condition of the rural people.

REFERENCES

Andrew, A.W., Moore, K. D. and Leroy, A.C., 1972. A guide to the study of environment pollution. Prentice-Hall. Inc., Englewood Cliffs, New Jerscy. 23-32pp.

Anonymous 1999. DoF (Department of Fisheries), Khulna.

Anonymous 1997. BFRI (Bangladesh Fisheries Research Institute), Cox's Bazar.

Hoq, M.E., Islam M.M. and Hossain, M.M., 1996. Poly culture of freshwater prawn (*M. rosenbergii*) with Chinese and Indian carps in farmer's pond. J. Aqua. Trop., 11: 135-141pp.

Hossain, M.A., Siddique, M.A.I. and Miaje, M.A.H., 2000. Development of low-cost feed for culture of giant freshwater prawn (*M. rosenbergii*) in ponds. Bang. J. Fish. Res., 4 (2): 127-124pp.

Humayun, N.M., Alam, A.K.M.N. and Islam, M.A., 1986. Culture and production of *Macrobrachium rosenbergii* in a freshwater pond with *Catla catla.* Bangladesh J. Fish, 9. 1-7pp.

Huq, K.A. and Islam M.S., 2003. Suitable species composition in the poly culture technique of Thai pangush with carps and prawn, A thesis by Masters of Science in Fisheries and Marine Resource Technology Discipline, Khulna University, 75p.

Huq, K.A., Islam M.S. and Rahman, M.M., 2004. Growth performance of *Macrobrachium rosenbergii* (De Man) in monoculture and poly culture systems, Jahangirnagar University Journal of Science, Vol. 27. 369-381pp.

Jose, S., Nair, C.M. and Thampy, D.M. 1992. culture of *M. rosenbergii* in homestead ponds. In: E.G. Silas ed. Freshwater prawns, Kerala Agricultural University, Thrissure, India. 200-204pp.

Ling.S.W.1969. Methods of rearing and culturing *Macrobrachium rosenbergii* (De Man)

Matsya Pakkha, 2004. A publication on the occasion of Fisheries Fortnight 2004, Department of fisheries, Matsya Bhaban, Park Avenue, Ramna, Dhaka. 69p.

Paul, S.K., 1996. Chingri Adhunik Chash Projukti O Upkulio Paribesh Babosthapana (Modern Shrimp Culture Technology and Coastal Environment Management), Momin offset press, Dhaka-1205. 69-79pp.

Shah, S. and Khan, F.A., 2003. Present status of galda – finfish polyculture in Dumuria Upazella, Khulna. A thesis by Bachelor of Science in Fisheries and Marine Resource Technology Discipline, Khulna University, 25-27pp.

Siddique, M.A.I., Hossain, M.A. and Miaje, M.A.H., 1999. Poly culture of giant freshwater prawn, *M. rosenbergii* with Indian major carps in ponds with supplemental feed. Bang. J. Fish. Res. (1999), 22 (2): 67-74pp.

ANNEXURE-1

Table1. Stocking rate of shrimp, prawn, rohu, catla, silver carp and mrigal per hectare in polyculture system

Number	Shrimp		Prawn		Rohu		Catla		Silver carp		Mrigal	
of ghers	PC	IC	PC	IC	PC	IC	PC	IC	PC	IC	PC	IC
1	18,000	15,000	7,500	6,000	750	400	600	300	400	200	400	250
2	17,000	14,000	8,000	6,500	600	450	650	250	450	180	500	200
3	19,000	13,500	6,000	7,000	800	300	500	350	600	200	450	275
4	17,500	14,500	6,500	5,500	400	350	550	400	650	250	550	300
5	18,500	12,500	8,500	5,500	500	450	700	300	350	200	600	350
6	18,000	13,000	9,000	5,000	800	400	600	350	550	300	550	200

Table 2. Rate of feeding of different supplementary feeds in shrimp ghers

Average weight of shrimp (gm)	Feeding rate (% of total body weight)
00.0-01	15-13
01-02	13-11
02-03	11-9
03-05	9-7
05-13	7-5
13-20	5-3
20-30 or above	3-2.5