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PARTICIPATORY ON-FARM TRIAL OF FISH CULTURE PRACTICE IN THE COASTAL SEASONAL PONDS

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Abstract: A study was conducted to adapt fish culture technology in the homestead seasonal ponds of coastal fishermen community of Cox's Bazar with four approaches, *viz.* monoculture of GIFT (Genetically Improved Farmed Tilapia) strain of *Oreochromis niloticus* without supplementary feeding (T_1), monoculture of GIFT with supplementary feeding (T_2), mixed culture of GIFT and silver barb (*Barbodes gonionotus*) without supplementary feeding (T_3) and with supplementary feeding (T_4) each with three replications. After six months of rearing, the study revealed that production of fishes was significantly the highest (3,299.38 kg/ha) in T_4, followed by 2,425.33 kg/ha in T_3. Production of both monoculture treatments of 1,240.63 kg/ha in T_1 and 1,406.96 kg/ha T_2 were significantly lower than those of both mixed culture treatments (T_3 and T_4). The gross return was also the highest (1,58,221.67 Tk/ha) with the cost benefit ratio of 2.33 in T_4.

mvi-ms‡¶c: K·evRvi AÂ‡ji DcKjxq †R‡j m¤c`v‡qi emZevoxi †gŝmgx cK‡i gvQPvl chw³ Aw‡f‡hvRb Kivi j‡¶¨ GKwU Kvhµg cwiPvjbv Kiv nq| G Kvhµ‡g evi wU cK‡ii wZb wU‡Z webv Lv‡`¨ wMd‡Ui GKK Pvl (wU1); wZb wU‡Z Lv`¨mn wMd‡Ui GKK Pvl (wU2); wZb wU‡Z webv Lv‡`¨ wMdU I ivRc wUi wgkPvl (wU3) Ges ewK wZb wU‡Z Lv`¨mn wMdU I ivRc wUi wgkPvl (wU4) Kiv nq| Qq gvm Pv‡li ci †`Lv hvq †h, †h wU4 cK‡i gv‡Qi Drcv`b (3299.38 †KwR/†n.) ZvrchcYfv‡e mewaK Ges cieZx mewaK Drcv`b (2,425.33 †KwR/†n.) wU3 cK‡i cvIqv hvq| Dfq GKK Pv‡l gv‡Qi Drcv`b (wU1 cK‡i 1,240.63 wKwR/†n.; wU2 cK‡i 1,406.96 †KwR/†n.) Dfq wgk Pv‡l gv‡Qi Drcv`‡bi Zjbvq ZvrchcYfv‡e †ekx| wU4 cK‡i †gvU Avq (1,58,221.67 UvKv/†n.) Ges Avq-e¨‡qi AbcvZ (2.33) mewaK wQj|

Key words: On-farm trial, small fish, backyard ponds.

INTRODUCTION

Coastal fishing community of the Cox's Bazar area is mainly dependent on marine fish particularly marine dry fish to fulfill their protein requirement. There are considerable number of small ponds and ditches in the vicinity of the households that hold water for certain period of the year. The traditional idea of the local people of Cox's Bazar region is that these small waterbodies are not suitable for any aquaculture. However, these seasonal waterbodies hold potential for the culture of fish species which have short life cycle and faster growth and require low inputs. GIFT (Genetically Improved Farmed Tilapia) strain of Nile tilapia (*Oreochromis niloticus* L.) and silver barb (*Barbodes gonionotus*) may be suitable candidate species for culture in such waterbodies of

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the coastal belt of Bangladesh. Bangladesh Fisheries Research Institute (BFRI) has developed culture technique of GIFT and silver barb in the on-station ponds (Akhteruzzaman 1991, Mazid 2002, Hossain and Kohinnoor 2003) and on farm trial of the same in different freshwater ponds of upland areas (Kohinoor *et al.* 1993, Hossain *et al.* 2000a, Hossain *et al.* 2000b) has been successfully conducted. Wahab *et al.* (2001) optimised the stocking density of silver barb in seasonal ponds. Socio-economic impact and farmers' assessment of tilapia culture in Bangladesh have been studied by Gupta *et al.* (1992). The introduction of GIFT and silver barb in the coastal ponds would not only increase the intake of animal protein in the fishing community but also generate additional income of the community. Hence, it is important to bring these waterbodies under fish cultivation with effective culture systems.

OBJECTIVE

To adapt the BFRI developed culture technology of GIFT and silver barb in the coastal seasonal ponds as an alternate livelihood of the coastal fishermen community of the Cox's Bazar district with the active participation of the pond owners.

MATERIAL AND METHODS

Experimental design: The experiment was conducted with four treatments, *viz.* monoculture of GIFT strain of *Oreochromis niloticus* without supplementary feeding (T_1), monoculture of GIFT with supplementary feeding (T_2), mixed culture of GIFT and silver barb (*Barbonymus gonionotus*) without supplementary feeding (T_3), and mixed culture of GIFT and silver barb with supplementary feeding (T_4) each with three replications. The ponds of T_2 were stocked with GIFT @ 2/m^2, T_3 with silver barb at the same rate and T_4 with GIFT and silver barb @ 1/m^2 each.

Selection of ponds: To adapt culture technology of GIFT and silver barb, twelve ponds from two fishermen villages, *viz.* Chaufaldandi village of Cox's Bazar sadar and Maijghona village of Chakoria of Cox's Bazar district were selected for the study. All the selected ponds are seasonal retaining 90~120 cm water for 6~7 months of the year. The area of the ponds was 45~381 m^2 as shown in Table 2. The status of the selected ponds was conducted through a baseline survey.

Preparation of ponds and stocking: The selected twelve ponds were cleaned and embankments were repaired, aquatic macrophytes (both submerged and floating) were removed from the ponds. It was very difficult to motivate the pond owners to cut down the unwanted trees. However, unwanted canopy of the tree

branches were cut off around the periphery of the ponds, so that sunlight can penetrate into the pond at least for a short period. Due to the scarcity of water for filling the ponds, the ponds were not drained out and the unwanted fishes of the ponds were killed using 1.5 ppm rotenone and removed by repeated netting. After 10~12 days, the ponds were limed with dolomite @ 250kg/ha. After three days of liming, all ponds were fertilized with cattle dung @ 3 t/ha and made ready for stocking of fishes. After seven days of fertilization, the ponds were stocked with fishes in June. Average weight of the stocked GIFT was 8.70±0.12 g and that of silver barb was 5.35±0.14 g.

Post stocking management: Rice bran @ 3~4% body weight of the stocked fishes was applied as supplementary feed once daily to the ponds wherever applicable following the design as given in Table 1. Feed to be administered was adjusted fortnightly after growth monitoring through fish sampling. All the ponds were limed monthly with dolomite @ 150 kg/ha. The ponds were also fertilized weekly with cattle dung @ 1 t/ha in treatments T_1 & T_3, where no supplementary feed was given and @ 0.5 t/ha in treatments T_2 & T_4, where supplementary feed was given. Basic water quality variables, *viz.* temperature, pH, Secchi transparency, total alkalinity and dissolved oxygen of the ponds were checked weekly following standard methods (APHA 1992). Growth of fishes was checked fortnightly through sampling. After six months of rearing, fishes from all ponds were harvested by netting followed by dewatering the ponds, and growth and production were estimated. The harvested fishes were sold in the local market, and cost and benefit were analysed.

To give hands on experience to the pond owners, all pond owners were involved in all the culture management activities including pond preparation and stocking in their respective pond. Besides, farmers' rally was organized at the pond site to exchange views and experience of the pond owners among themselves.

RESULTS AND DISCUSSION

Status of the selected ponds: The collected data as presented in Table 1 revealed that none of the twelve selected ponds was ever used for fish culture. Due to scarcity of fresh water, water of all these ponds was used for household purposes of the community. The idea of pond owners including the neighbours in regard to fish culture was very negative and limited. They thought that these small seasonal ponds are not suitable for culture of any fish. Most of the ponds were covered with aquatic macrophytes. Embankment of all the ponds was partially broken. Unwanted plants on the bank encircled most of the peripheral areas of the ponds hindering entrance of sunlight into the ponds.

Table 1. Status of the selected ponds in two fishermen villages of Cox's Bazar district.

Pond No.	Area (m^2)	Location	Status of the ponds before stocking fish
1	216	Chaufaldandi, Cox's Bazar sadar	Excavated 10~12 years back. No culture of fish after excavation. Ponds covered with aquatic weeds and unwanted plants in the bank, 50% embankment of the pond was broken.
2	212	Chaufaldandi, Cox's Bazar sadar	Excavated fifteen years back. No culture of fish after excavation. Unwanted plants surrounded the bank. 30% embankment of the pond broken.
3	245	Maijghona, Chokoria	Excavated eight years back. No culture of fish after excavation. Ponds fully covered with aquatic weeds and surrounded by plants.
4	50	Chaufaldandi, Cox's Bazar sadar	Excavated five years back. No culture of fish after excavation. No aquatic weeds and unwanted plants in the embankment. No embankment.
5	142	Chaufaldandi, Cox's Bazar sadar	Excavated seven years back. No culture of fish after excavation. Pond covered with aquatic weeds and unwanted plants in the bank. 30% embankment of the pond was broken.
6	120	Maijghona, Chokoria	Excavated fifteen years back. No culture of fish after excavation. Ponds partially covered with aquatic weeds and embankment was partially broken.
7	381	Chaufaldandi, Cox's Bazar sadar	Excavated sixteen years back. No culture of fish after excavation. Ponds covered with aquatic weeds and unwanted trees in the bank.
8	162	Chaufaldandi, Cox's Bazar sadar	Excavated twelve years back. No culture of fish after excavation. Ponds partially covered with aquatic weeds and unwanted plants in the bank.
9	45	Maijghona, Chokoria	Excavated nine years back. No culture of fish after excavation. Ponds partially covered with aquatic weeds.
10	200	Chaufaldandi, Cox's Bazar sadar	Excavated six years back. No culture of fish after excavation. Ponds covered with aquatic weeds and banks were surrounded by unwanted plants. 60% embankment of the pond was broken.
11	215	Chaufaldandi, Cox's Bazar sadar	Excavated two years back. No culture of fish after excavation. 50% embankment of the pond was broken.
12	146	Maijghona, Chokoria	Excavated eight years back. No culture of fish after excavation. Ponds partially covered with aquatic weeds. Embankment of the pond was partially broken.

Water quality parameters: The water quality variables of different ponds are recorded shown in Table 2. The temperature of the water of the ponds varied from 24.0 to 29.0°C, which decreased with the progress of culture period. The water of all ponds was neutral to alkaline except pond No. 11, which was below neutral level at some particular period of culture. The acidic nature of water was due to acid sulfate contained in the underlying soil of the studied area. Pond No. 11, which was excavated two years back was more acidic than other ponds. As a result, liming of water during pond preparation though increased pH, but with

Table 2. Water quality variables of the ponds under different treatments in two fishermen villages of Cox's Bazar district.

Treatments (T)	Pond No.	Temperature (°C) (Mean ± SD)	pH (Mean ± SD)	Transparency (cm) (Mean ± SD)	Total alkalinity (mg/l) (Mean ± SD)	Morning dissolved oxygen (mg/l)
T_1 Monoculture of GIFT without feed	1	24.0~29.0 (26.22±0.21)	7.0~8.5 (7.71±0.05)	22~32 (26.89±0.33)	75.45~95.56 (85.20 ±1.82)	2.00~4.05 (2.89±0.12)
	2	25.0~29.0 (26.32 ±0.22)	7.0~8.0 (7.70±0.02)	15~26 (22.22±0.34)	55.45~75.45 (65.54±2.20)	2.50~5.12 (3.56±0.15)
	3	24.0~26.0 (24.38±0.12)	6.8~8.0 (7.80±0.11)	20~28 (26.58±0.25)	54.72~75.40 (68.12±1.89)	2.40~4.45 (3.45±0.12)
T_2 Monoculture of GIFT with feed	4	22.0~27.0 (24.23±0.24)	7.50~8.5 (8.20±0.12)	23~35 (30.18±0.45)	100.23~110.24 (105.24±1.89)	2.12~4.00 (3.45±0.14)
	5	24.0~29.0 (26.00 ±0.2)	7.5~8.0 (7.77±0.02)	18~28 (26.21±0.38)	66.45~110.24 (98.65±3.21)	2.10~3.64 (3.35±0.14)
	6	24.0~26.0 (24.87±0.18)	7.0~8.5 (7.78 ±0.02)	22~34 (28.88±0.46)	59.89~80.40 (72.56±1.84)	2.65~3.78 (3.32±0.12)
T_3 Mixed culture of GIFT and silver barb without feed	7	24.0~29.0 (26.88 ±0.22)	7.0~8.5 (7.89±0.03)	18~25 (22.28±0.46)	55.36~68.92 (63.87±1.22)	2.20~3.60 (3.18±0.12)
	8	24.0~29.0 (26.57 ±0.24)	7.5~8.52 (8.18±0.05)	26~33 (29.46±0.45)	60.12~88.78 (81.45±2.40)	2.34~5.20 (4.20±0.14)
	9	24.0~27.0 (25.68±0.25)	7.0~7.7 (7.22 ±0.02)	22~28 (26.00±0.46)	68.24~88.00 (78.20±1.88)	2.72~3.80 (3.25±0.13)
T_4 Mixed culture of GIFT and silver barb with feed	10	24.0~29.0 (26.49 ±0.16)	7.0~8.5 (7.85±0.04)	15~27 (24.56±0.29)	85.45~110.43 (92.62±2.10)	2.00~4.25 (3.50±0.14)
	11	24.0~29.0 (26.78±0.24)	6.0~7.5 (6.86±0.03)	25~35 (31.25±0.46)	85.45~102.45 (95.46±1.45)	2.00~3.64 (3.00±0.12)
	12	24.0~29.0 (27.12±0.26)	7.5~8.5 (8.21±0.03)	24~36 (29.78±0.50)	91.12~118.45 (105.52±2.00)	2.40~3.85 (3.32±0.12)

the progress of culture pH of water decreased to neutral level. Transparency data indicate that the ponds were highly productive. This low transparency was not due to the production of plankton but due to the presence of suspended sediment. Most of the ponds (Pond No. 1, 2, 5, 7 & 11) remained turbid throughout the culture period. As a result, the dissolved oxygen content of the

ponds was also low varying from 2.00~ 5.20 mg/l. But, alkalinity data indicate that the ponds have high potential for primary production.

Growth and production of fishes: Growth and production performance of both GIFT and silver barb in ponds with different treatments are shown in Table 3. The average growth of GIFT, which was 8.70 g during stocking, increased to the highest of 198.63 g after six months of rearing in T_4 stocked with silver barb and provided with supplementary feed (rice bran). This growth of GIFT was significantly higher than that of 148.98 g in T_3, stocked with silver barb but without supplementary feed. Between T_1 & T_2 where only GIFT was stocked, the growth of GIFT was higher in T_2 (115.48 g) with supplementary feed than that in T_1 (105.65 g) without supplementary feed. But the difference between them was not significant. Survival might have some negative impact on growth. But the present findings indicate that average growth of GIFT in different treatments was higher despite higher survival. Average survival of GIFT was 59.40%, 62.26%, 81.65% and 88.46% in T_1 to T_4, respectively. Both growth of 179.03 g and survival of 84.03% of silver barb were also higher in treatment T_4 supplied with feed than that of 148.90 g and 73.31 % in T_3 without supplementary feed. But the differences in both growth and survival between these two treatments were not significant.

Between two monoculture treatments, average production of 1240.63 kg/ha of GIFT in T_1 without supplementary feed was lower than that of 1406.35 kg/ha in T_2 with supplementary feed. Again between two mixed culture ponds, total production of both GIFT and silver barb of 2423.33 kg/ha in T_3 without supplementary feed was significantly lower than that of 3299.38 kg/ha in T_4 with supplementary feed. Individual production both of GIFT and silver barb was also higher in T_4 with feed than that of T_3 without feed. Total production of fish was significantly lower in treatments with monoculture of GIFT than that of treatments with mixed culture of GIFT and silver barb. The differences in survival among replications of different treatments were different (Table 3). This might be due to mortality of fish invaded by Otter and piscivorous reptiles as reported by the pond owners. Another remarkable observation is that total production of fish in pond No. 8 of T_3 was exceptionally higher and more than double than that of other replications of the same treatment. This might be due to the grazing of both GIFT and silver barb on duckweeds and feeding on kitchen wastes supplied by the pond owner frequently. Lower production of fish in pond No. 11 might be due to low values of pH of water of this pond in comparison to other ponds on the same treatment (Table 2).

Table 3. Growth and production of genetically improved farmed tilapia (GIFT) and silver barb (*Barbodes gonionotus*) in different ponds of the fishermen villages of Cox's Bazar district.

Treatments (T)	Pond No.	Area (m^2)	GIFT			Silver barb			Total Produc -tion (kg/ha)
			Final [1]ABW (g)	Survival (%)	Produc -tion (kg/ha)	Final [1]ABW (g)	Survival (%)	Produc -tion (kg/ha)	
T_1 Monoculture of GIFT without feed	1	216	98.35	69.44	1366.20	-	-	-	1366.20
	2	212	94.20	58.96	1110.81	-	-	-	1110.81
	3	245	125.00	49.80	1244.90	-	-	-	1244.90
	Mean		**[a]105.85± 9.65**	**59.40± 5.67**	**[a]1240.63± 73.74**	-	-	-	**[a]1240.63± 73.74**
T_2 Monoculture of GIFT with feed	4	50	112.68	71.00	1600.00	-	-	-	1600.00
	5	142	90.96	66.20	1204.22	-	-	-	1204.22
	6	120	142.80	49.58	1416.67	-	-	-	1416.67
	Mean		**[a]115.48± 15.03**	**62.26± 6.49**	**[a]1406.96± 114.35**	-	-	-	**[a]1406.96± 114.35**
T_3 Mixed culture of GIFT and silver barb without feed	7	381	105.15	58.79	618.21	138.25	56.96	787.42	1405.63
	8	162	207.66	95.06	1974.07	208.46	96.30	2007.41	3981.48
	9	45	134.15	91.11	1222.22	100.00	66.67	666.67	1888.89
	Mean		**[b]148.98± 30.51**	**81.65± 11.48**	**[a]1271.50± 392.18**	**[a]148.90± 31.56**	**73.31± 11.83**	**[a]1153.83± 428.21**	**[b]2425.33± 790.08**
T_4 Mixed culture of GIFT and silver barb with feed	10	200	235.19	94.50	2222.55	197.30	89.00	1756.00	3978.55
	11	215	140.17	80.46	1127.86	129.46	78.14	1011.58	2139.44
	12	146	220.52	90.42	1993.84	210.34	84.94	1786.30	3780.14
	Mean		**[c]198.63± 29.53**	**88.46± 4.17**	**[b]1781.42± 333.38**	**[b]179.03± 25.07**	**84.03± 3.17**	**[b]1517.96± 253.24**	**[c]3299.38± 582.79**

[1]ABW, average body wt. (Mean ± SE)

Economics of production: Cost of different inputs and income from different treatments are shown in Table 4. Cost of seed, fertilizer, feed and other costs (*i.e.,* cost of piscicide, lime and harvest) are included to the total cost of production. As the pond owner himself did all the culture activities and no regular labour was involved, cost of labour is not considered for calculating total cost. Of course, some casual labour was involved only for harvesting fishes and

Table 4. Expenditure and income of culture of genetically improved farmed tilapia (GIFT) and silver barb (*Barbodes gonionotus*) in different ponds of the fishermen villages of Cox's Bazar district.

Particulars	T_1 (Monoculture of GIFT without feed)			T_2 (Monoculture of GIFT with feed)		
	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6
			Expenditure			
Seed	324.00	318.00	367.50	75.00	213.00	180.00
Fertilizer	301.20	275.40	339.00	40.00	113.50	84.00
Feed	0.00	0.00	0.00	96.00	192.00	225.00
*Others	336.60	300.20	317.00	79.75	255.50	168.00
Total/pond	961.80	893.60	1023.50	290.75	774.00	657.00
Total/ha	44527.78	42150.94	41775.51	58150.00	54507.00	54750.00
Average		42818.08			55802.33	
			Income/ha			
GIFT	1366.20 kg x 46/- =62845.20	1110.85 kg x 45/- =49988.25	1244.90 kg x 52/- =64734.80	1600.00 kg x 50/- =80000.00	1204.22 kg x 49/- =59006.78	1416.67 kg x 50/- =70833.50
Average		59189.42			69946.76	
****BCR**	1.41	1.19	1.55	1.38	1.08	1.29
Average		1.38			1.25	

Contd.

Particulars	T_3 (Mixed culture of GIFT & sliver barb without feed)			T_4 (Mixed culture of GIFT & sliver barb with feed)		
	Pond 7	Pond 8	Pond 9	Pond 10	Pond 11	Pond 12
			Expenditure			
Seed	571.50	243.00	67.50	300.00	322.50	219.00
Fertilizer	526.20	222.40	61.00	160.00	171.00	110.00
Feed	0.00	0.00	0.00	660.00	410.00	560.00
*Others	275.00	217.50	50.00	250.00	289.50	213.00
Total/pond	1372.70	682.90	178.50	1370.00	1193.00	1102.00
Total/ha	36028.87	42129.63	39666.67	68500.00	55488.37	75479.45
Average		39275.06			66489.27	
			Income/ha			
GIFT	618.21 kg x 43/- =26583.03	1974.07 kg x 55/- =108573.85	1222.22 kg x 50/- =61111.00	2222.55 kg x 52/- =115572.60	1127.86 kg x 45/- =50753.70	1993.84 kg x50/- =99692.00
Silver barb	787.42 kg x 40/- =31496.80	2007.41 kg x 45/- =90333.45	666.67 kg x 40/- =26666.80	1756.00 kg x 50/- = 158221.67	1011.58 kg x 40/- =40463.20	1786.30 kg x 45/- =80383.50
Total	58079.83	198907.30	87777.80	203372.60	91216.90	180075.50
Average		114921.64			158221.67	
****BCR**	1.61	4.72	2.21	2.95	1.64	2.39
Average		2.85			2.33	

*Other cost, cost of piscicide, lime and fertilizer.

this cost is included to the cost of harvest. Average cost (Tk/ha) of production was 42,818.08, 55,802.00, 39,275.06 and 66,489.27 in T_1, T_2, T_3, T_4, respectively. The higher cost of production in T_2 and T_4 in comparison to that of T_1 and T_3, respectively is due to the additional cost of supplied supplementary feed. Gross income (Tk/ha) from sale of fish was 59,189.42, 69,946.76, 1,14,921.64 and 1,58,221.67 with the cost benefit ratio (BCR) of 1.38, 1.25, 2.85 and 2.33 in T_1, T_2, T_3, T_4, respectively. Highest BCR in T_3 without supplementary feed is due to exceptionally high production of fishes in one of the replication of this treatment as already mentioned. Excluding this replication, the average BCR will be 1.91 in this treatment. In that case, net return will be highest in T_4 with mixed culture and fed with supplementary feed.

CONCLUSION

The findings indicate that the backyard seasonal ponds, which remained fallow for a long period, can be easily brought under productive fish culture system with some intervention for the improvement of the structure and ecology of the pond. The findings motivated the community to realize that the backyard seasonal ponds can be a source of their livelihood through fish culture. The technology should be further disseminated to the coastal areas through the participation of fishermen community and resource poor marginal people for their empowerment and improvement of livelihood and socio-economic condition.

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