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Growth and production of Nile tilapia (*Oreochromis niloticus* Lin.) in irrigated Boro rice under floodplain environment

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Abstract
The experiment was conducted at BRRI Regional Station, Habiganj during 1994-95 to evaluate the growth and economic performance of Nile tilapia, *Oreochromis niloticus*. fish reared in the field of irrigated boro rice with different fertilizer levels. Grain yield of rice was not affected by fish culture. It was observed that fifty percent of recommended fertilizer was enough to produce increased rice yield (8-10 t/ha) at floodplain environment and additional yield was obtained with the increasing fertilizer rates. Results further indicated that *O. niloticus* could successfully be reared in the field of irrigated boro rice with recommended fertilizer level. Larger size of fingerlings at release had improved recovery percent, body weight gain and higher fish yield. Results also revealed that rice + fish production system produced higher net return than the system with rice alone.

Key words : Nile tilapia, Rice-fish farming

Introduction

Rice is the main food of the majority people in Asia, but rice is not a complete food. It must be supplemented by animal protein. Fish is the common and cheapest source of animal protein in the region (Huat and Tan 1980). Fish supplies about 80 percent of animal protein for rural people of Bangladesh (ODA 1995, Karim 1978). However, Bangladesh which was once abound with fishes, is now facing an acute shortage of fish due to rapid growth of human population, the degradation of fish habitat and more recently fish diseases have significantly reduced the fish production which lead to concomitant malnutrition among children and women. In order to improve the sombre situation Gupta and Mazid (1993) estimated that fish production has to increase to some 1.2 million tons from the present 0.8 million tons to maintain a low level per capita consumption of 7.9 kg per year. They also reported that this increased production has to come from aquaculture, specifically from rice field since marine fisheries and fish production from open water bodies are declining as a result of over fishing and degradation of aquatic habitat.

Lightfoot *et al.* (1990) noted that adoption of integrated rice-fish culture could dramatically increase fish production.

The country has 2.35 million hectare of land where irrigated boro rice is cultivated (BBS 1993). During rice growing period water remains at 10-15 cm in most rice fields. *Moss* and *Azolla* are available in this rice field which are excellent fish feeds. To explore the possibilities of fish rearing in the rice field an experiment was conducted to determine the bio-economic performance of Nile tilapia species with different fertilizer levels under floodplain environment during 1994-95 boro season.

Materials and methods

The experiment was conducted at the farm of BRRI Regional Station, Habiganj situated in floodplain environment, during boro season 1994-95. The experimental plots were laid out in Randomized Complete Block Design with 3 Replications each having different fertilizer treatments, i) 0-0-0, ii) 40-30-20 and iii) 80-60-40 kg N-P_2O_5-K_2O/ha. The plots size were 20 m x 15 m. Plots were levelled to maintain uniform water depth in the plot. The border of the individual plots were raised to 50 cm high and 50 cm wide to prevent fingerlings movement from one plot to the other. In addition, 75 cm wide and 50 cm deep drains were made at the two sides of each plots for fingerlings to take shelter at the time of splits application of N and weeding for rice (Fig. 1). This drain helped fingerlings survive for few days when the irrigation pump broke down. Half of N and all P_2O_5 and K_2O were applied before the final land preparation. Forty five and 40-day old seedlings were transplanted on February 11, 1994 and February 01, 1995 respectively. Fingerlings of Nile tilapia (1 fingerling/m^2) were released 2-weeks after (Feb. 25, 1994 and Feb. 15, 1995) boro transplanting in both the years. Rest half of N was applied at 25 days after transplanting (DAT) followed by weeding. Except for the time of weeding and fertilizer application (only for top dressing) about 10-15 cm water depth was maintained throughout the rice growing period. Fish was harvested on June 03, 1994 and June 05, 1995 respectively before the harvest of boro rice for both the years. Data of fish and rice were recorded for comparing the bio-economic performance of the different studied parameters.

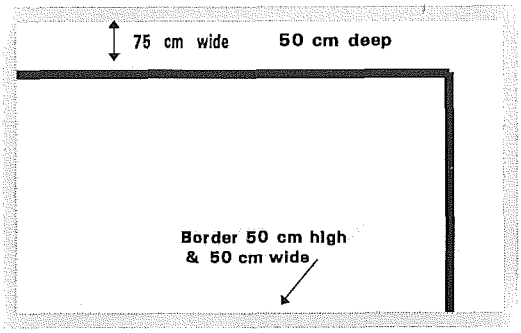

Fig. 1. Lay out of an individual plot.

Results and discussion

Rice yield

The study indicated that yield of boro rice was not affected by fish culture. But the increased fertilizer rate of 80-60-40 kg/ha N-P_2O_5-K_2O produced the highest rice yield in both the years (Table 1). Similarly, 40-30-20 kg/ha N-P_2O_5-K_2O produced significantly higher rice yield than crops grown without fertilizer. The yield of rice did not vary within the fertilizer rates. Rice yield was higher in 1994 than 1995. Higher panicle/m^2 and more grain number/m^2 might have contributed this higher grain yield in 1994. Heslehust (1982) reported an increase grain yield with the relative increase of grain number. Individual grain weight is the only yield component influenced by genotype (Green and Dawkins 1985). In both the years, thousand grain weight remained unaffected by the treatments.

Table 1. Grain yield and yield components of boro rice (BR3) as influenced by fish culture at different fertilizer levels, BRRI Regional Station, Habiganj

Production systems	Fertilizer levels (kg/ha) N-P_2O_5-K_2O	Yield (t/ha)	Panicle/m^2 (No.)	Grain/ panicle (No.)	1000-grain wt.(g)
1994					
Rice alone	0 - 0 - 0	6.95 ^{c}	379 ^{cd}	66 ^{b}	27.74 ^{c}
Rice+Fish	0 - 0 - 0	7.06 ^{c}	374 ^{d}	67 ^{b}	28.25 ^{b}
Rice alone	40 – 30 - 20	8.29 ^{b}	403 ^{bc}	74 ^{a}	27.90 ^{c}
Rice+Fish	40 – 30 - 20	8.61 ^{ab}	417 ^{b}	74 ^{a}	27.92 ^{c}
Rice alone	80 – 60 - 40	9.23 ^{a}	442 ^{a}	75 ^{a}	27.77 ^{c}
Rice+Fish	80 – 60 - 40	9.10 ^{a}	458 ^{a}	68 ^{b}	28.46 ^{a}
1995					
Rice alone	0 - 0 - 0	4.25 ^{b}	192 ^{d}	79 ^{b}	27.43 ^{ab}
Rice+Fish	0 - 0 - 0	4.33 ^{b}	164 ^{e}	96 ^{a}	27.73 ^{a}
Rice alone	40 – 30 - 20	6.28 ^{a}	257 ^{ab}	78 ^{b}	27.50 ^{ab}
Rice+Fish	40 – 30 - 20	6.41 ^{a}	261 ^{a}	89 ^{ab}	27.43 ^{ab}
Rice alone	80 – 60 - 40	6.46 ^{a}	241 ^{c}	98 ^{a}	27.52 ^{ab}
Rice+Fish	80 – 60 - 40	6.75 ^{a}	244 ^{bc}	102 ^{a}	27.33 ^{b}

Means followed by common letter did not differ significant at 5% level by DMRT.

Fish yield

Body weight grain, recovery percentage and fish yield were similar between plots fertilized with 80-60-40 and 40-30-20 kg/ha N-P_2O_5-K_2O but these parameters from these two fertilized treatments were significantly higher ($P<0.05$) than the treatment without fertilizer (Table 2). Fertilized plots probably had more feed like *Azolla, Lemna spp.* and various kinds of phytoplankton etc. which might have enhanced the body weight gain of the fishes reared in those plots. Kim *et al.* (1992) reported 92 percent survivability of *O. niloticus* fish species in rice field. The body weight gain, recovery percentage and fish yield in 1995 were higher than that of 1994. Larger size fingerlings that were released in 1995 might have contributed to this higher recovery percentage and body weight gain and greater fish yield. However, results indicated that 136-320 kg/ha fish was harvested when Nile tilapia was

reared in boro rice field with and without fertilizer level. Haroon *et al.* (1992) reported fish yield of 400 kg/ha when *O. niloticus* was reared in the transplanted Aman rice field with 60-40-40 kg N-P_2O_5-K_2O/ha. Dela Cruz *et al.* (1988) harvested a fish yield of 300 kg/ha of which 180 kg/ha was Nile tilapia and 120 kg/ha of common carp from irrigated rice crop. Results of this trial suggest that *O. niloticus* fish could be profitably reared in the irrigated boro rice field with recommended fertilizers without affecting rice yield.

Table 2. Body weight gain, recovery percentage and yield of *O. niloticus* with boro rice under different fertilizer levels, BRRI regional station, Habiganj

Fertilizer (kg/ha)	At release		At harvest		Number released	Number harves- ted	Reco very (%)	Yield (t/ha)
N-P_2O_5-K_2O	Length (cm)	Weight (g)	Length (cm)	Weight (g)				
1994								
0 - 0 - 0	4.18	1.40	9.70[a]	26.00[b]	300	156	52	0.13[b]
40- 30 - 20	4.18	1.40	10.27[a]	29.53[a]	300	183	61	0.17[a]
80- 60 - 40	4.18	1.40	10.23[a]	28.09[ab]	300	186	62	0.17[a]
1995								
0 - 0 - 0	5.60	10.85	13.33	46.11[b]	300	184	62	0.22[b]
40- 30 - 20	5.60	10.85	15.50	61.43[a]	300	190	63	0.32[a]
80- 60 - 40	5.60	10.85	14.67	60.13[a]	300	192	64	0.31[a]

Means followed by common letter did not differ significant at 5% level by DMRT.

Economic analysis

Economic analysis of the production system showed that rice+ fish at 80-60-40 kg/ha N-P_2O_5-K_2O gave the highest net return followed by 40-30-20 kg/ha N-P_2O_5-K_2O in both the years whereas rice+ fish gave the lowest net return when the crops was grown without fertilizers (Table 3). Results also indicated that growing fishes with rice had profoundly helped to obtain a higher economic return than a system without fish.

Table 3. Economic analysis of integrated rice-fish production system during boro season under floodplain environment, Habiganj

Production system	Fertilizer (kg/ha)	Yield (Tk/ha)		Production cost (Tk/ha)		Gross return (Tk/ha)		Net return (Tk/ha)
	N- P_2O_5 - K_2O	Rice -	Fish	Rice -	Fish	Rice -	Fish	
1994								
Rice alone	0 - 0 - 0	6.95		13651		34750		21099
Rice+Fish	0 - 0 - 0	7.06	0.13	13651 -	3000	35300 -	5200	23849
Rice alone	40 - 30 - 20	8.29		14276		41450		27174
Rice + Fish	40 - 30 - 20	8.61	0.17	14276 -	3000	43050 -	6800	32574
Rice alone	80 - 60 - 40	9.23		15500		46150		30650
Rice + Fish	80 - 60 - 40	9.10	0.17	15500 -	3000	45500 -	6800	33800
1995								
Rice alone	0 - 0 - 0	4.25		13651 -		21250 -		7599
Rice+Fish	0 - 0 - 0	4.33	0.22	13651 -	3000	21650 -	8800	13799
Rice alone	40 - 30 - 20	6.28		14276 -		31400 -		17124

Rice+Fish	40 - 30 - 20	6.41	0.32	14276 -	3000	32050 -	12800	27574
Rice alone	80 - 60 - 40	6.46		15500 -		32300 -		16860
Rice+Fish	80 - 60 ? 40	6.75	0.31	15500 -	3000	33750 -	12400	30350

Price (Tk/kg): Urea=5, TSP=8, MP=7.57, Fish=40, Rice=5, Fingerlings = Tk 300/1000.

Conclusions

The results of two years study revealed that in the floodplain environment Nile tilapia could be reared successfully in the irrigated boro rice field without sacrificing rice yield. This rice-fish systems provide a great source of protein and add additional income to the farmers. Results also suggests that larger size of fingerlings at stocking release could increase the recovery percentage and body weight gain and higher fish yield and consequently higher net return. The rice-fish production systems if practised with careful management would make much needed protein easily available to the resource poor farmers and would raise their income, as well.

References

BBS, 1993. Yearbook of Agricultural Statistics, Dhaka, Bangladesh.

Dela Cruz, C.R., N. Thongpan and S. Koesoemadinata, 1988. Potential of rice-fish farming systems in Asia. Paper presented at the International Rice Research Conference, 7-11 Nov. 1988. International Rice Research Institute, Los Banos, Laguna, Philippines. 25pp.

Haroon Yousuf, A.K., S. Dewan and S.M.R. Karim, 1992. Rice-fish production systems in Bangladesh. *In*: Rice-fish Research and Development in Asia (eds. C.R. Dela Cruz, C. Lightfoot, B.A. Costa-Pierce, V.R. Carangal and M.P. Bimbao). ICLARM Conf. Proc. 24. pp. 165-171.

Green, C.F. and T.C.K. Dawkins, 1985. Radiation and absorption analysis of factors limiting the yield of temperate cereal crops. *Crop Res.*, **25**: 13-20.

Gupta, M.V. and M.A. Mazid, 1993. Feasibility and potentials for integrated rice-fish system in Bangladesh. Twelfth session of the FAO Regional Farm Management Commission for Asia and the Far East, Dhaka, Bangladesh, 11-14 December 1993.

Heslehust, M.R.,1982. Modelling seasonal grain sorghum yields in sub-tropical Australia. *Agric. System*, **9**: 281-300.

Huat, K.K. and E.S.P. Tan, 1980. Review of rice-fish culture in Southeast Asia. *In*: Integrated Agriculture-Aquaculture Farming Systems (eds. R.S.V. Pullin and Z.H. Shehadeh). ICLARM Conf. Proc. 4. International Centre for Living Aquatic Resources Management. Manilla, Philippines. pp. 1-14.

Karim, M., 1978. Status and potential of Bangladesh fisheries. Ministry of fisheries and live-stock, Dhaka, Bangladesh.

Kim, B.H., H.D. Kim and Y.H. Kim, 1992. Rice-fish farming systems and future prospects in Korea, *In*: Rice-fish Research and Development in Asia (eds. C.R. Dela Cruz, C. Lightfoot, B.A. Costa-Pierce, V.R. Carangal and M.D. Bimbao). ICLARM Conf. Proc. 24. pp. 63-67.

Lightfoot C.C.R., C.R. Dela Cruz and V. Carangal, 1990. International Research Collaboration in Rice-Fish Research. *Naga*, **13**(4). 10-11.

ODA, 1995. Strategy Paper - Support for Natural Resources in Bangladesh. ODA-AID Management Office, Dhaka, Bangladesh.

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