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## Extensive Culture of Red Tilapia with Four Stocking Densities at Beel Kodalia, Bagerhat, Bangladesh

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**Abstract:** An experimental culture of red tilapia was carried out at four stocking densities (0.75, 1.0, 1.5 and 2 fry m<sup>-2</sup>) using fries of 2.12 inches in length and 5.37 g in weight in four freshwater ponds providing supplementary feed, periodical fertilization and liming during May and February. After 10 months of stocking the average growth rate, survival rate, production rate and FCR were found to be 50 g/month, 74.75%, 1890.67 kg acre<sup>-1</sup> and 1:1.42, respectively. The stocking density 1.5 was found to be the best in terms of production rate in extensive method. While stocking density of 2 fry m<sup>-2</sup> produced highest biomass. The highest growth rate was found with the lowest density. However, stocking density had no remarkable effect on production rate as maximum production rate was achieved with the density of 1.5. On average net profit was achieved at 41.65%.

**Key words:** Mutant, hybrid, red tilapia, stocking density, production and profit

### INTRODUCTION

To meet protein demand, tilapia (*O. mossambicus*) was introduced in Bangladesh in 1954 from Thailand (Hussain, 2004). This species mature early, breed frequently and has slow growth rate. Because of this region, the species has become unpopular to the farmer. In 1974 *O. niloticus* was introduced from Thailand through UNICEF but was not established as a culture species since neither management practices were developed nor its biology understood. Subsequently, *O. niloticus* was again introduced into Bangladesh in 1986 from Thailand (Hussain, 2004) as previous stock of the two species had mixed. One of the problem by farmer with regard to the culture of *O. niloticus* is its prolific pond breeding resulting in over population on leading to stunted growth (Gupta and Shah, 1992). To overcome this problem, red tilapia, a mutant hybrid *O. niloticus* and *O. mossambicus* was introduced for the first time in Bangladesh from Thailand in 1988 (Kohinoor *et al.*, 1996). The red strain of tilapia was first discovered in Taiwan in 1968 (Kuo, 1988). A number of biological characteristics make red tilapia important as a potential cultivable species such as high adaptation capability to adverse environmental condition, high resistant to disease,

omnivores feeding behavior, short generation time, lucrative market in home and abroad, delicious test and presence of cartilaginous bones and its beauty and prettiness. It is rather easier culture and therefore over 30 countries in the world introduced red tilapia as an exotic fish species. Such introduction serves one or more of the following purposes: Utilization of a vacant niche in the native water bodies with an appropriate imported species. Increase fish production as a source of food. Improvement of the quality of sports fishing. Control of undesirable aquatic weeds by voracious herbivorous species. Control of mosquito larvae and insects through suitable larvaevorous and insect feeding fish species. Decoration of aquaria with ornamental varieties of pet fish species. The ponds were selected inside a water logged wetland locally known as 'Beel Kodalia' near to village kodalia of p.s. Mollarhat, dist. Bagerhat.

### MATERIALS AND METHODS

A case study of red tilapia culture was carried out in the farm of Inter Export International Ltd. at Beel Kodalia, Mollahat, Bagerhat in four newly excavated freshwater earthen ponds (pond No. A<sub>2</sub>, D<sub>1</sub>, E<sub>2</sub> and G<sub>1</sub>). The size of the ponds A<sub>2</sub>, D<sub>1</sub>, E<sub>2</sub> and G<sub>1</sub> were 90×80 m

Table 1: Proximate composition of the feed stuffs

Feed stuffs	Proximate composition (%)							
	Protein (%)	Fat (Min.)	Ash (Max.)	Fibre (Max.)	Moisture (Max.)	Carbohydrate	Calcium	Phosphorus
Saudi Bangla grower	26.00	4.00	6	18	11	33.80	1.0	0.8
Rice bran	11.88	10.45	-	-	-	44.42	-	-
Oil cake	30.33	13.44	-	-	-	34.38	-	-

(1.8 acre), 85×70 m (1.48 acre), 70×70 m (1.22 acre) and 70×70 m (1.22 acre), respectively. As the ponds were excavated in a waterlogged wetland, therefore, it was not possible to dry out all the water for ploughing and leaving prior to start culture. A layer of water was present during preparation. To eliminate pests, predators and wild fish from the ponds, rotenone powder was applied at the rate of 3 ppm. Three days after rotenone application, the ponds were limed at the rate of 100 kg acre<sup>-1</sup> maintaining a water level at 10 cm. One week later, Urea and TSP were applied at the rate of 10 and 6 kg acre<sup>-1</sup> respectively. After completion of liming and fertilization, the water levels in all four ponds were increased up to 80 cm by using water from the supply canal. After starting of monsoon no water was supplied into the ponds from the canals. The fry were carried by using oxygenated polythene bag at a density of 500-700 fry bag<sup>-1</sup>. The fry were acclimatized in the concrete tanks for 24 h. During acclimatization oxygen was supplied into the tank water using air blower. one week long nursing was carried out in the same tank fed with commercial nursery feed. Nursed fries having a size of 5-6.5 g in weight and 2-2.5 inches in length were released into the ponds D<sub>1</sub>, G<sub>1</sub>, A<sub>2</sub> and E<sub>2</sub> during early in the morning between 6 and 8 am. at a density of 0.75, 1, 1.5 and 2 m<sup>-2</sup>, respectively. Commercial pelleted feed "Saudi Bangla Grower" 50 and 50% of hand made of rice bran (60%) and oil cake (40% mixture) were used. The fish were fed two times per day according to the ratio. The proximate of the feeds are shown in Table 1. Feeding ration throughout the culture period were varied depending on body weight of red tilapia such as 1-20, 20-50 and 50-250 g and above for 10-20, 4-6.5 and 2-3% of total biomass.

Water temperature, pH, depth, transparency and Dissolved Oxygen Content (DO) were monitored six times a day at 8 am, 11 am, 2 pm, 5 pm, 8 pm and 11 pm. The absolute growth in weight was calculated by the following formula (Hossain *et al.*, 1992):

$$\text{Growth} = \text{Weight(g) at "Xth" sampling} - \text{Weight(g) at "(X-1)th" sampling}.$$

Where, X represent the sampling month. To measure the survival rate, the total stock of red tilapia in a pond was calculated by the following formula:

$$X = \frac{\text{Mean number of fish caught in the net}}{\text{Dimension of cast net}} \times \text{pond size}$$

Where, X = Stock in pond. The dimension of the selected cast net was calculated by the formula: Dimension of the net =  $\pi r^2$ ,

Where, r = radius of the net. The survival rate was calculated by using the following formula:

$$\text{Survival rate (\%)} = \frac{\text{Stock of fish at sampling time}}{\text{Total number of fish stocked}} \times 100$$

Partial harvesting method was followed to reduce excessive density and to avoid stress on under size fishes in the ponds. Final harvesting was made through draining of water by gravitation or by water pump.

## RESULTS

**Water quality parameters:** The DO values were varied between 5.1 mg L<sup>-1</sup> and 8.9 mg L<sup>-1</sup> in pond D<sub>1</sub> and G<sub>1</sub>, respectively. The temperature was varied between 21.3 and 24.5°C. The highest temperature 24.5°C and lowest temperature 21.3°C were found in pond A<sub>2</sub> and G<sub>1</sub>, respectively. The maximum pH values of water were recorded in pond G<sub>1</sub> (8.6) while the minimum was recorded in pond D<sub>1</sub> (7.4). The pattern of pH fluctuation in four ponds showed similar trend. The Secchi disk readings were found to be varied between 43 cm in pond G<sub>1</sub> and 60 cm in pond A<sub>2</sub>. The highest (110 cm) and lowest (94 cm) water depth were found in the pond E<sub>2</sub> and pond G<sub>1</sub> and D<sub>1</sub>, respectively.

**Growth rate and survival:** The highest growth rate 53.5 g/month was found in the pond D<sub>1</sub> where as the lowest growth rate 44 g/month was found in the pond E<sub>2</sub>. The overall average survival rate of red tilapia in four ponds was found to be 74.75%. The maximum (81%) and the minimum (68%) survival rate were found in the pond G<sub>1</sub> and E<sub>2</sub>, respectively (Fig. 1).

**Production:** The overall average production and production rate were found 2711.47 kg and 1890.67 kg acre<sup>-1</sup>, respectively. Among four ponds, A<sub>2</sub> showed highest production (4035.9 kg) while production rate was maximum in pond E<sub>2</sub> (2403.3 kg acre<sup>-1</sup>). The minimum production (1814.1 kg) and production rate (1225.7 kg acre<sup>-1</sup>) were found in pond D<sub>1</sub> (Fig. 2). The maximum production rate (2403.3 kg acre<sup>-1</sup>) was found

Table 2: Weekly mean±SD values of water temperature, dissolved oxygen, pH of four red tilapia ponds at Beel Kodalia, Mollahat, Bagerhat

pond no.	water temperature		Dissolved oxygen (mg L <sup>-1</sup> )		pH		Transparency (cm)		Depth (cm)	
	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range
D <sub>1</sub>	22.73±0.89	21.9-24.2	6.56±0.80	5.1-7.2	7.77±0.28	7.4-8.1	52.83±2.48	50-56.5	95.58±1.49	94-97.5
G <sub>1</sub>	22.37±0.71	21.3-23.3	8.28±0.38	17.9-8.9	8.20±0.24	8.0-8.6	41.50±1.61	39-43	96.16±1.72	94-98
A <sub>2</sub>	23.50±0.69	22.5-24.5	5.97±0.03	5.5-6.2	8.00±0.14	7.9-8.1	53.10±5.24	45.5-60	102.0±1.41	101-103
E <sub>2</sub>	22.62±1.08	21.3-24.16	7.08±0.31	6.6-7.4	7.96±0.22	7.6-8.3	53.25±3.61	46.5-56	108.5±1.37	107-110

Table 3: Pond size, stocking density, initial and final length and weight, FCR, total harvest (pieces) and amount of feed used in four ponds

Item	Ponds No.				Average
	D <sub>1</sub>	G <sub>1</sub>	A <sub>2</sub>	E <sub>2</sub>	
Pond size (acre)	(85×70) m <sup>2</sup> = 1.48	(70×70) m <sup>2</sup> = 1.22	(90×80) m <sup>2</sup> = 1.8	(70×70) m <sup>2</sup> = 1.22	1.43
Stocking density (fry m <sup>-2</sup> )	0.75	1.0	1.5	2.0	1.31
Average weight of fry during stocking (g)	5.0	5.0	6.5	5.0	5.37
Average size of fry (inches)	2.0	2.0	2.5	2.0	2.12
Average weight during harvest (g)	535	520	505	440	500
FCR	1:1.30	1:1.34	1:1.45	1:1.60	1:1.42
Feed used through out the crop	2358.3	2765	5852	4691	3916.57
Tilapia harvested (pieces)	3391	3969	7992	6664	5504

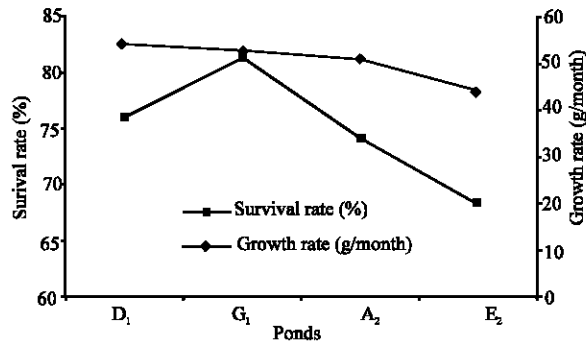


Fig. 1: Average growth rate (g/month) and survival rate (%) in four ponds

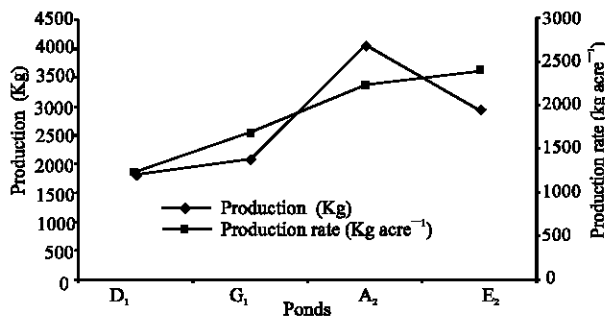


Fig. 2: Average production and production rate (Kg acre<sup>-1</sup>) in four ponds

in pond E<sub>2</sub> where stocking density was 2 fry m<sup>-2</sup>. While it was the minimum (1225.7 Kg acre<sup>-1</sup>) in pond D<sub>1</sub> where stocking density was 0.75 fry m<sup>-2</sup>.

Pond size, stocking density, initial and final length and weight, FCR, total harvest (pieces.) and amount of feed used in four ponds is shown in Table 3.

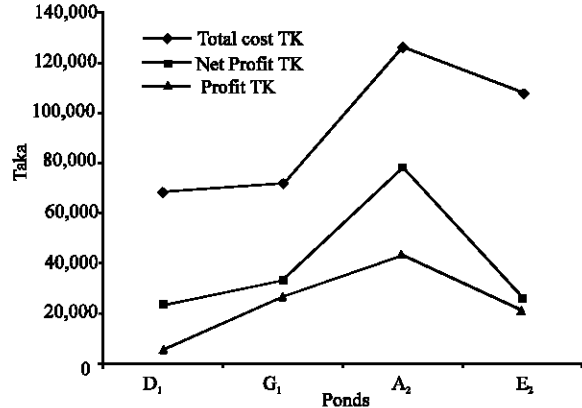


Fig. 3: Total production cost (Tk.), net profit (Tk./pond) and net profit (Tk./acre) in four ponds

**Cost-benefit analysis:** Production cost for the ponds D<sub>1</sub>, G<sub>1</sub>, A<sub>2</sub> and E<sub>2</sub> were Tk.67384, Tk.70780, Tk.24608 and Tk.106196, respectively. The total selling price of the above mentioned ponds were Tk.90705, Tk.103190, Tk.201795 and Tk.131944, respectively. The selling price of red tilapia of the ponds D<sub>1</sub>, G<sub>1</sub>, and A<sub>2</sub> was Tk.50 Kg<sup>-1</sup> while it was Tk.45 kg<sup>-1</sup> for the pond E<sub>2</sub> (Fig. 3). The highest net profit was found from the pond A<sub>2</sub> (Tk.77187) and the lowest from the pond D<sub>1</sub> (Tk.23321). The net profit from another two ponds G<sub>1</sub> and E<sub>2</sub> were Tk.32410 and Tk.25748, respectively. The percentage of profit to the total cost of the ponds D<sub>1</sub>, G<sub>1</sub>, A<sub>2</sub> and E<sub>2</sub> were 34.60, 45.78, 61.94 and 24.27%, respectively (Fig. 3).

## DISCUSSION

Generally four parameters i.e., temperature, DO, pH and transparency are considered to be of primary

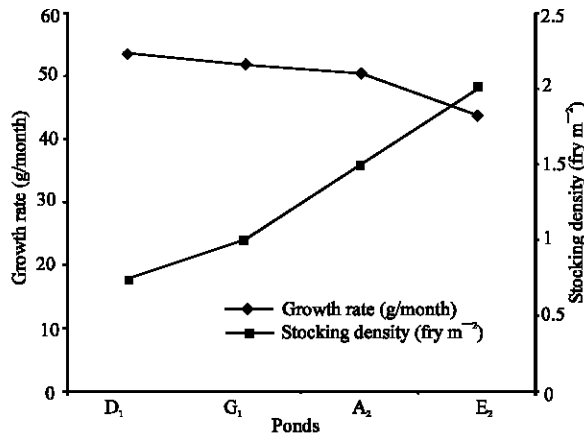


Fig. 4: Effect of stocking density on the growth rate of red tilapia

importance in fish culture. The temperature reported to be the optimum for red tilapia is 20-30°C or above (Kungvakij and Pudadera, 1984). The water temperature in four culture ponds was more or less stable during the present study (Table 2). However, the temperature of pond A<sub>2</sub> was slightly higher than that of others. The ideal DO level for fish culture is 4-5 mg L<sup>-1</sup> In the present study the DO level was found between 5.1 and 8.9 mg L<sup>-1</sup> which attributes good environment for red tilapia. The optimum pH range for fish is between 6.5 and 11. The pH of four ponds were between this permitted level (pH 5.1-8.9). The lowest pH value (pH 5.1) was found in pond D<sub>1</sub>. The ideal transparency values for pond culture is said to be 30-60 cm. In the present investigation the transparency was found to vary between 39 and 60 cm. The suitable water depth for red tilapia is 1-2 m (Mazid, 1996). The depth of the pond water was not maintained due to poor soil quality of the beel area. However, it was varied between 94 and 110 cm. The maximum growth rate (53.5 g/month) was found in pond D<sub>1</sub> with a stocking density of 0.75 fry m<sup>-2</sup> while the minimum growth rate (44 g/month) was observed in pond E<sub>2</sub> with stocking density of 2 fry m<sup>-2</sup> According to Pillay (1993) the growth rate of red tilapia varies 170-250 g in 4-5 months which is similar to this experiment. This result clearly indicates an inverse relationship between growth rate and stocking density (Fig. 4).

Production rate was found highest in pond E<sub>2</sub> (2403.3 kg acre<sup>-1</sup>) and the minimum in pond D<sub>1</sub> (1225.7). This result indicates a significant relationship between stocking density and production rate (Fig. 5).

The survival rate was found to be the highest in pond G<sub>1</sub> (81%) while it was the lowest in pond E<sub>2</sub> (68%). Liao and Chen (1983) found 90% survival rate in intensive culture of red tilapia which is near to this experiment. From

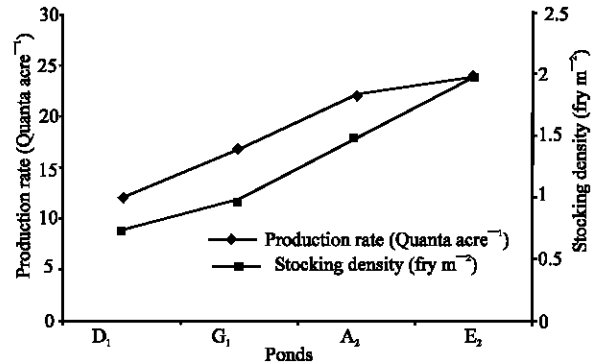


Fig. 5: Effect of stocking density on production rate

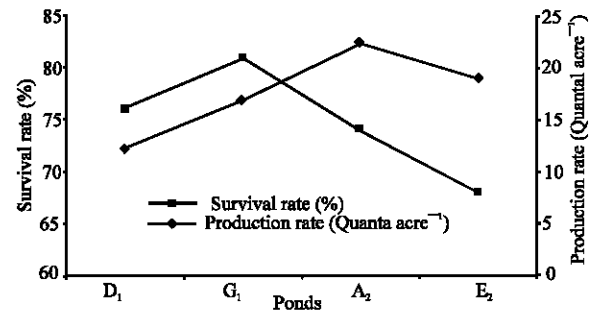


Fig. 6: Effect of survival rate on the production rate in red tilapia culture

Fig. 6, it clear that the production rate is inversely related with survival rate and vice versa.

The cost-benefit analysis was carried out to evaluate the validity of red tilapia culture in freshwater ponds at beel Kodalua during the study period. The result of cost-benefit analysis indicates its feasibility as net profit and total cost ratio was 1:2.32. The net profitability of red tilapia culture was found 42.65% which is quite reasonable. The results of present study have been compared with other workers. In an experimental extensive culture, Mazid (1996) found a production rate of 800-1000 kg acre<sup>-1</sup> within 4-6 months with a stocking density of 80 fry/decimal using fingerlings of 2-3 inch in length and 8-10 g in weight. The present production rate (1890.67 kg acre<sup>-1</sup>) was found to be 52.89% higher than that of Mazid (1996). However, production of present study was lower than that of Kohinoor *et al.* (1996). They studied the effect of feeding on red tilapia in semi-intensive system and found a production rate of 10510.66 kg acre<sup>-1</sup> and 7709.68 kg acre<sup>-1</sup> using feed and fertilizer and feed only respectively at a stocking density of 49400 fry/acre. A comparison of the results of red tilapia culture through extensive method is given Table 4.

Table 4: Comparison of red tilapia culture in extensive system. (BFRI = Bangladesh Fisheries Research Institute)

Attributes	BFRI <sup>a</sup> , Bangladesh	Philippines <sup>b</sup>	India <sup>c</sup>	Present study
Stocking density (Fry acre <sup>-1</sup> )	8000	750-1250	-	1310
Initial weight (g)	8-10	60-63	5-10	5-6.5
Initial length (inch)	2-3	-	9	2-2.5
Harvesting weight (g)	-	240	400-450	500
Production rate (kg acre <sup>-1</sup> )	800-1000	7904	-	1890.67
Culture period (month)	5-6	6	4-6	10

Source: a = Mazid (1996); b = Lovshin (1977); c = Prince (1985)

## CONCLUSIONS

The results of an experimental culture of red tilapia with four different stocking densities (0.75, 1.0, 1.5 and 2 fries m<sup>-2</sup> each fry 2.12 inches in length and 5.379 g in weight) in four freshwater ponds providing supplemental feed period fertilizer and liming have been presented. The effect of stocking density on production rate was found positive at a density of 1.5 fry m<sup>-2</sup>. Therefore it could be recommended that farmers may release fry of 2-2.5 inches in length at the above mentioned density. The density is closely related with the water depth, productivity of the ponds, food supply, oxygen supply and other physico-chemical parameters like ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, hydrogen sulphide, temperature, pH, hardness, alkalinity etc.

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