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Fish culture in ponds by using bio-gas slurry and raw cow dung in carp polyculture system

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Abstract: The effects of biogas slurry and raw cowdung on the growth and production performance of fishes were evaluated in carp polyculture system in twelve earthen ponds at the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh for a period of four months. Four treatments i.e. T_1 (biogas slurry), T_2 (raw cowdung), T_3 (slurry + cowdung) and T_4 (supplementary feed) with three replicates were tested. Catla, Rui, Mrigal, Silver carp, Saur punti and Grass carp were used as experimental species and stocking ratio was 1:1:1:2:2:1 and the stocking density was 11856 fish/ha. The ranges of water quality parameters were found to be more or less within the productive ranges and had no significant ($P>0.05$) difference among the treatments. Significant ($P<0.05$) variations were observed in case of weight gain, SGR, survival and production among the treatments. The highest mean weight (g) gain was obtained in treatment T_4 (232.83±80.00) followed by T_2, T_1 and T_3 respectively. The highest survival rate (%) was found in treatment T_3 (76.48±2.28) in mrigal fish followed by T_4, T_1 and T_2 respectively. The highest production (kg/ha/120 days) was obtained in treatment T_4 (469.26) followed by T_2 (437.57), T_3 (376.22) and T_1 (262.20), respectively. The present study showed that the growth and production performance of carp fish were higher in treatment T_4 (supplementary feed) compared with other treatments. Further study should be needed to evaluate the growth and production performance of carp fish in polyculture system by stocking bottom dwelling fishes specially mrigal, common carp, calbasu etc.
Key words:

Introduction

Polyculture, the simultaneous culture of several species of fish with different feeding, habitat, is an efficient means of increasing fish production. The success of this system lies in the choice of right combination of fish species. The basic principles of the polyculture are applied for the best utilization of natural foods of different strata and zones without any harm to each other. The key techniques of polyculture is based on the natural food utilization is efficient and thus it results in increase fish yield per unit area (Tang, 1970). Raw cattle dung, poultry droppings and slurry have had the widest application for fish culture as organic manure over decades in India, South-east Asian and other countries (Degani *et al*., 1982). Cow dung is commonly used as a fertilizer for fish ponds but fish production is limited to 1500 to 2000 kg/ha (Tripathi and Karma, 2007). These yields can, however, be more than doubled if the dung is first fed to biogass plant and the digested slurry then used instead of the raw dung. Although bio-gas slurry has several advantages like, savings on inorganic fertilizers and feed (60% of operation costs), environment friendly, no oxygen demand, savings on fuel and electricity and cooking activities; but constructive studies on slurry based fish culture are not carried out yet. Slurry is a quick acting fertilizer containing several soluble nutrients and can be used either to culture grow-out fish or to monoculture fingerlings (Ghosh *et al*., 1999). Therefore, it is necessary to address the organic aquaculture by applying bio-gas slurry and cow dung in polyculture system to enhance the fish production with low cost input and pollution free environment. The present study was under taken to observe the effect of low cost organic fertilizers and feed ingredients on the growth and production of fishes in the polyculture system.

Materials and Methods

The experiment was carried out during the period from 16^{th} April to16^{th} August, 2007 (120 days) in twelve earthen ponds situated in the field laboratory of the faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. Aquatic weeds were removed manually from the ponds. Complete eradication of all undesirable fish, insects and other aquatic live forms were done by using repeated netting. After this, lime was administrated @ 250 kg/ ha. Seven days after liming, the ponds were fertilized with urea and triple super phosphate (TSP) @ 24.7 and 18.53 kg/ha respectively. Four treatments in Completely Randomized Design (CRD) i.e. bio-gas slurry $(T_1)_,$ raw cowdung $(T_2)_,$ slurry+cowdung (1:1), (T_3) and supplementary feed $(T_4)_;$ each having three replications were used for the present study. Catla, Rui, Mrigal, Silver carp, Sarpunti and Grass carp were used as experimental species and the stocking ratio and density was 1:1:1:2:2:1 and 11856 fish/ha (48 fish/dec.). The fishes were initially fed (twice in every day) supplementary feed composed by mustard oil cake, rice bran and wheat bran (1:1:1) @ 10% of their body which was reduced gradually to 5% of their body weight in case of treatment T_4. Whereas, in case of treatment T_1, T_2 and T_3; bio-gas slurry, raw-cow dung and slurry+cow dung (1:1) were used @ 1235 kg/ha in every four days interval throughout the experimental period, respectively. The water quality parameters such as temperature, dissolved oxygen and pH were measured and recorded weekly throughout the experimental period using a commercial kit box (Model: FF-3, USA). Monthly sampling was done by using a seine net in order to monitor growth, survival and production of fishes and also to adjust the feeding rate. Growth of fish in each sampling was measured in weight by using a digital electronic balance KERN, Model No. EMB 2000-0 and were calculated by following formula.

Weight gain (g) = Mean final weight (g) –mean initial weight (g)

Specific Growth Rate (SGR, % per day)=

$$\frac{Log_e W_2 - Log_e W_1}{T_2 - T_1} \times 100$$

Where, W_1= the initial live body weight (g) at time T_1 (day)

W_2= the final live body weight (g) at time T_2 (day)

T_2- T_1 = Duration of the experiment (day)

Survival rate (%) = $\frac{\text{No. of fish harvested}}{\text{No. of fish stocked}} \times 100$

Production = No of fish harvested × Final weight of fish

For the statistical analysis of data, one-way ANOVA (Analysis of Variance) and DMRT (The new Duncan Multiple Range Test) were applied following Gomez (1984). Computer analysis of the data was done by using the software SPSS (Statistical Package for Social Science) version 11.5 significance was assigned at 5% level.

Results and Discussion

Water quality parameters

Temperature (°C)

During the study period, the water temperature varied from 25.86 to 32.20°C in treatment T_1, 26.23 to 32.80°C in treatment T_2, 26.06 to 33.30°C in treatment T_3 and 26.03 to 32.63°C in treatment T_4, respectively. The mean values of water temperature in treatments T_1, T_2, T_3 and T_4 were 27.24±0.44, 29.07±0.05, 28.80±0.66 and 28.85±0.11°C, respectively (Table 1). The highest temperature (33.3°C) was recorded in treatment T_3 was due to relative high intensity of sunlight and absence of cloud in the sky and the lowest temperature (25.8°C) was recorded in T_1 (Table 1), might be due to low intensity of light as a result of rainfall and cloudy condition and cool air flow. More or less similar results were reported by Masud *et al*. (1996) that was 25.7 to 30°C. The temperature as observed in this study appeared to be suitable for fish culture which agreed with the findings of Hossain *et al.* (1997) and Wahab *et al*. (2001).

Dissolved oxygen (mg/l)

DO is a critical factor in intensive fish culture and success and failure in fish farming often depends upon it (Swingle, 1961). During the study period, the dissolved oxygen content of the water was found to vary from 4.95 to 6.77 mg/l in treatment T_1, 4.8 to 6.60 mg/l in treatment T_2, 4.65 to 6.70 mg/l and 5.22 to 6.66 mg/l in treatment T_4. The mean values of dissolved oxygen content of the water in treatment T_1, T_2, T_3 and T_4 were 5.88±0.55, 8.79±0.66, 5.80±0.22 and 5.84±0.66 mg/l respectively (Table 1). The highest DO concentration 6.25 mg/l was observed in treatment T_2. When the weather was sunny and a mild breeze was blowing from the south-east. The lowest DO concentration 5.06 mg/l was observed in T_1, while the condition was cloudy and there was overnight rainfall in the day before. No significant variation of dissolved oxygen was observed among the treatments. More or less similar results were reported by Hossain (2000) and Kohinoor (2000) where they recorded DO values of fish ponds ranged from 3.8 to 6.9 mg/l and 2.04 to 7.5 mg/l respectively.

pH

pH is considered as an important factor in fish culture. It is called the productivity index of a water body. During the study period, the range of pH values recorded in treatment T_1, T_2, T_3 and T_4 were found to vary from 6.86 to 8.36, 6.80 to 8.56, 6.90 to 8.33 and 6.76 ton 8.36, respectively. The mean values of pH were 7.73±0.72, 7.84±0.55, 7.82±0.16 and 7.79±0.55 recorded in treatments T_1, T_2 and T_3 respectively (Table 1). There was no significant variation of pH values under different treatments. Most natural water has pH values of 6.5 to 9 (Boyd, 1982) which was within the acceptable range required for fish culture 6.5 to 8.5, (DOF 1996).

Growth, survival and production of fish

Weight gain (g)

There was no significant different in case of initial weight of fishes in various treatments. The lowest and highest weight gain of cultured fishes were varied from 45.43±32.92 (T_1) to 109.48±96.14 (T_4), 21.75±12.37 (T_1) to 87.73±5.62 (T_4), 163.77±20.37 to 230.63±54.15 (T_2), 41.03±12.56 (T_1) to 116.17±65 (T_3), 73.03±12.16 (T_3) to 232.83±80.00 (T_4) and 98.01±0.42 to 137.16±75.34, respectively among the treatments (Table 2). Observation on the growth rate of fishes in various treatments showed that in 120 days culture period, the highest weight (g) gain (232.83g) was attained in treatment T_4 in case of Rui with a supplementary feeding followed by Mrigal (230.63 g), Grass carp (137.16 g) in treatment T_2 with application of slurry and raw cow dung as feed and fertilizer, Catla (116.17 g) in treatment T_3, Saur punti (109.48 g) in treatment T_4 and Silver carp (87.73 g) in treatment T_4, respectively. There was significant ($P<0.05$) different among the treatments as well as fishes. The present results supported by Mitra *et al*., 1987 and Kohinoor *et al*., 1998. Kausar and Khan (1992) reported the weight of rui and mrigal were 289.5 g and 343 g by using biogas waste and fertilizer, which not agreed the present findings. The highest weight gain in T_4 might be due to the fact that the fishes had received the complete feed with balanced dietary requirements.

Table 1 Mean value of water quality parameters under different treatments throughout the study period

Treatments	Parameters		
	pH	Dissolved oxygen (mg/l)	Temperature (°C)
T_1	7.73±0.72	5.88±0.55	27.24±0.44
T_2	7.84±0.55	8.79±0.66	29.07±0.05
T_3	7.82±0.16	5.80±0.22	28.80±0.66
T_4	7.79±0.55	5.84±0.66	28.85±0.11

Figure indicates mean values ± standard deviation

Specific Growth Rate, SGR (% per day)

The significant variations were observed among the fishes and treatments in case of SGR % per day (Table 2). The SGR % per day of Saurpunti, Silver carp, Mrigal, Catla, Rui and Grass carp were varied from 0.60±0.15 (T_3) to 1.03±0.33 (T_4), 0.59±0.11 to 1.05±0.06 (T_3), 1.19±0.24 (T_4) to 1.35±0.06 (T_2), 0.77±0.17 (T_1) to 1.14±0.24 (T_3), 0.97±0.04 (T_3) to 1.27±0.42 (T_4) and 0.33±0.06 (T_1) to 0.99±0.18 (T_2), respectively. The highest SGR % per day were found in Mrigal (1.35±0.06) in treatment, T_2, and lowest was in Grass carp (0.33 ± 0.06) in treatment, T_1. Similar results (0.56 %) also observed by Akand, 1986 and Miah *et al.*, 1998. On the other hand, Ridha (2006) reported the SGR value of fish was 1.10 and 0.87% per day which also more or less similar to the present study.

Survival rate (%)

The survival (%) of fishes was varied among the treatments (Table 2). The survival (%) of Saurpunti, Silver carp, Mrigal, Catla, Rui and Grass carp were varied from 63.40 (T_2) and 68.81 (T_1), 64.85 (T_2) and 72.24 (T_1), 66.81 (T_2) and 76.48 (T_3), 39.11 (T_4) and 45.46 (T_1), 39.43 (T_4) and 46.21 (T) and 44.13 (T_4) and 50.00 (T_1), respectively. There was significant ($P<0.05$) variation in the survival rate (%) of fish in different treatments. Similar results were observed by Saha *et al*. (1989) and they found the survival rate of fishes were 52.1 to 73.3 %. The survival rate recorded in present study is lower than the survival rate (82 to 90%) recorded by Raihan (2001) and Ridha (2006), which might be attributed to the relatively application of organic fertilizers in the present study.

Production (kg/ha/120 days)

There was significant difference ($P<0.05$) were found of production of fishes (kg/ha/120days) among the treatments (Table 2). The lowest and highest production of fishes were varied 163.02 (T_3) and 449.54 (T_4), 83.98 (T_2) and 363.09 (T_4), 654.55 (T_4) and 889.2 (T_2), 187.72 (T_1) and 471.77 (T_3), 313.69 (T_3) and 815.10 (T_4) and 61.75 (T_1) and 405.08 (T_2), (kg/ha) respectively. The highest production (kg/ha) was observed in treatment, T_4 (469.26) followed by T_2, T_3 and T_1 respectively. Diana *et al*. (1994) demonstrated that organic fertilizers result in higher primary production and consequently larger carps and catfish yields, apparently due to increased production of both autotrophic and heterotrophic organisms.

References

Akand, A. M. 1986. Effects of inorganic fertilizers on water quality and fish production in carp ponds. Bangladesh J. Fish.12(1-9): 78-86.

Boyd, C. E. 1982. Water quality management for pond fish culture. Elsevier Sci. Publishers B. V., 1000 AH. Amsterdam-Oxford-New York, 318p.

Degani, G., Doscretz, C., Levanon, D., Marchaim, U. and Pearch, Z. 1982. Feeding Sarotherodon aureus with fermented cow manure. Bamidegh 34(4):119-129.

Diana, J. S., Lin, C. K. and Jaiyen, K. 1994. Supplemental feeding of tilapia in fertilized ponds. Journal of the World Aquaculture Society. 25: 497-506.

DOF. 1996. Fish Fortnight compendium 1996. Directirate of fisheries, Bangladesh, 11: 34-81.

Ghosh, C., Frijns, J. and Lettinga, G. 1999. Performance of silver carp (*Hypophthalmichthys molitrix*) dominated integrated post treatment system for purification of municipal waste water in a temperate climate. Bioresources Technol. 69: 255-262.

Gomez, K. A. and Gomez, A. A. 1984. Statistical procedure for agricultural research. John Wiley and Sons, Inc. New York.

Hossain, M. Y. 2000. Effects of iso-phosphorus organic and inorganic fertilizer on water quality parameters and biological production. M. S. Thesis, Department of Fisheries Management, BAU, Mymensingh. 74p.

Hossain, M.A., Toyub, M.A., Islam M.N. and Hasan, M.R. 1997. Effect of species combination on the growth of major and Chinese carps in demonstration pond under Feni district. Bngladesh. J. Agril. Sci. 21(2): 257-266.

Table 2. Weight, survival and production of fishes

Treatments	Fishes stocked	Growth parameters of fishes						
		Initial weight (g)	Final weight(g)	Weight gain (g)	SGR% per day	Survival rate (%)	Production (Kg/ha/120 days)	
T_1	Saur punti	4.94 ± 0.63^{a}	50.37 ± 33.51^{c}	45.43 ± 32.92^{c}	0.77 ± 0.25^{b}	68.01 ± 2.80^{a}	97.6 ± 0.4^{c}	262.20^{d}
	Silver carp	3.62 ± 2.17^{a}	25.38 ± 13.76^{c}	21.75 ± 12.37^{c}	0.72 ± 0.24^{b}	72.24 ± 1.55^{a}	108.6 ± 0.2^{c}	
	Mrigal	5.99 ± 1.59^{a}	169.76 ± 19.09^{b}	163.77 ± 20.37^{b}	1.21 ± 0.13^{a}	74.70 ± 4.44^{a}	699.0 ± 0.4^{b}	
	Catla	5.43 ± 1.37^{a}	46.46 ± 11.48^{d}	41.03 ± 12.56^{d}	0.77 ± 0.17^{c}	45.46 ± 3.23^{a}	187.7 ± 0.2^{d}	
	Rui	4.07 ± 0.88^{a}	81.47 ± 18.82^{b}	77.40 ± 17.96^{c}	1.08 ± 0.02^{ab}	44.89 ± 3.47^{a}	318.6 ± 0.2^{c}	
	Grass carp	7.93 ± 0.98^{a}	20.53 ± 5.64^{d}	12.60 ± 4.7^{d}	0.33 ± 0.06^{b}	50.00 ± 2.00^{a}	61.7 ± 0.1^{d}	
T_2	Saur punti	5.87 ± 2.71^{a}	110.82 ± 21.85^{b}	104.95 ± 24.16^{b}	1.08 ± 0.24^{a}	63.40 ± 1.57^{c}	410.0 ± 0.3^{b}	437.57^{b}
	Silver carp	4.36 ± 1.19^{a}	22.16 ± 1.04^{c}	17.80 ± 2.22^{d}	0.59 ± 0.11^{c}	64.85 ± 4.08^{c}	83.9 ± 0.2^{d}	
	Mrigal	5.43 ± 0.28^{a}	236.07 ± 54.38^{a}	230.63 ± 54.15^{a}	1.35 ± 0.06^{a}	66.81 ± 5.29^{b}	889.2 ± 0.7^{a}	
	Catla	6.21 ± 1.09^{a}	110.33 ± 25.74^{b}	104.12 ± 24.64^{b}	1.03 ± 0.02^{b}	41.84 ± 2.25^{b}	417.4 ± 0.3^{b}	
	Rui	4.64 ± 0.30^{a}	112.36 ± 52.34^{a}	107.71 ± 52.64^{b}	1.12 ± 0.18^{ab}	42.64 ± 2.71^{b}	419.9 ± 0.7^{b}	
	Grass carp	8.50 ± 0.00^{a}	145.66 ± 75.34^{a}	137.16 ± 75.34^{a}	0.99 ± 0.18^{a}	47.94 ± 3.66^{a}	405.0 ± 0.8^{a}	
T_3	Saur punti	7.33 ± 0.95^{a}	39.82 ± 13.15^{d}	32.49 ± 13.72^{d}	0.60 ± 0.15^{c}	66.67 ± 2.30^{ab}	163.0 ± 0.2^{d}	376.22^{c}
	Silver carp	4.35 ± 0.94^{a}	79.66 ± 11.01^{b}	75.31 ± 10.51^{b}	1.05 ± 0.06^{a}	68.00 ± 4.00^{b}	333.4 ± 0.2^{b}	
	Mrigal	5.39 ± 2.43^{a}	157.38 ± 45.87^{d}	151.98 ± 46.24^{d}	1.23 ± 0.18^{a}	76.48 ± 2.28^{a}	671.8 ± 0.7^{c}	
	Catla	4.83 ± 1.58^{a}	121.00 ± 65.57^{a}	116.17 ± 65.16^{a}	1.14 ± 0.24^{a}	43.24 ± 2.70^{b}	471.7 ± 1.0^{a}	
	Rui	5.41 ± 1.21^{a}	78.49 ± 13.25^{b}	73.07 ± 12.16^{d}	0.97 ± 0.04^{b}	46.21 ± 2.98^{a}	313.6 ± 0.1^{d}	
	Grass carp	7.72 ± 1.35^{a}	105.73 ± 1.55^{c}	98.01 ± 0.42^{c}	0.95 ± 0.06^{a}	49.33 ± 3.22^{a}	303.8 ± 0.1^{a}	
T_4	Saur punti	5.39 ± 0.86^{a}	114.88 ± 95.47^{a}	109.48 ± 96.14^{a}	1.03 ± 0.33^{a}	64.39 ± 2.11^{bc}	449.5 ± 1.5^{a}	469.26^{a}
	Silver carp	4.42 ± 1.65^{a}	92.15 ± 6.19^{a}	87.73 ± 5.62^{a}	1.11 ± 0.11^{a}	65.72 ± 2.86^{c}	363.0 ± 0.1^{c}	
	Mrigal	5.75 ± 1.36^{a}	165.11 ± 79.36^{c}	159.36 ± 80.46^{c}	1.19 ± 0.24^{a}	74.24 ± 6.94^{a}	654.5 ± 1.2^{d}	
	Catla	6.37 ± 0.66^{a}	70.28 ± 42.24^{c}	63.91 ± 41.60^{c}	0.82 ± 0.17^{c}	39.11 ± 2.21^{c}	247.0 ± 0.5^{c}	
	Rui	5.73 ± 1.83^{a}	238.56 ± 20.22^{c}	232.83 ± 80.00^{a}	1.27 ± 0.42^{a}	39.43 ± 1.54^{c}	815.1 ± 2.9^{a}	
	Grass carp	8.50 ± 0.00^{a}	116.83 ± 17.29^{b}	108.33 ± 17.29^{b}	0.94 ± 0.05^{a}	$44.13\pm1.13^{\mathbf{b}}$	286.5 ± 0.2^{c}	
Level of significance		NS	*	*	*	*	*	*

Figure indicates mean values ± standard deviation and * = significant at ($P<0.05$). Same super scripts in the same species are not significantly different ($P>0.05$).

Kausar, R. and Khan, A. G. 1992. Growth performance of carps fed on biogas waste effluent, fertilizer and different supplementary feeds. In: Dr. A. R. shakoori Pakistan, Panjab University, Lahor, Pakistan. 265-270.

Kohinoor, A. H. M. 2000. Development of culture technology of three indigenous fish mola (Amblypharyngodon mola), Punti (Puntius sophore) and Chela (Chela cachius) with notes on some aspects of their biology. Ph. D. dissertation, Department of Fisheries Management, BAU, Mymensingh. 363.

Kohinoor, A. H. M., Islam, M. L., Wahab, M. A. and Thilsted, S. H. 1998. Effect of mola (*Amblypharyngodon mola* Ham.*)* on the growth and production of carpa in polyculture. Bangladesh J. Fish Res. 2 (2): 119-126.

Masud, A. K. M. S., Chowdhury, H. A., Rahamutullah, S. M., Islam, M. A. and Islam, A. K. M. S. 1996. Comparative study on the zooplankton production of derelict, extensive and semi-intensive fish ponds. Bangladesh J. Aquacult. 18: 32-37.

Miah, M. S., Shahabuddin, M. and Shah, M. S. 1998. Effect of fertilizers on the growth of fishes under carp polyculture system. Bangladesh J. Fish. 21 (2): 89-92.

Mitra, B., Gupta, A. and Laha, U. K. 1987. Effects of some manure on the growth and production on major carps in villages ponds of districts Birbhum, West Bengal, Emlion. *Ecol.* 5: 381-385.

Raihan, A. 2001. To asses the effect of adding punti, *Puntias sophore* and mola, *Amblypharyngodon mola* in carp polyculture system. M. S. Dissertation, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. 76.

Ridha, T. M. 2006. Comparative study of growth performance of three strains of Nile tilapia, *Oreochromis niloticus*, L. at two stocking densities. Aquaculture Res. 37: 172-179.

Saha, S. B., Gupta, M. V. and Shahabuddin, M. 1989. Studies on the comparative efficiency of different fertilizers on the production of silver carp (*Hypophthalmichthys molitrix*) fry in nursery ponds. Bangladesh J. Fish. 12 (1): 11-20.

Swingle, H. S. 1961. Relationship of p^{H} of pond water to their suitability for fish culture. Proc. 9th Pacific Sci. Cong., 10: 72-75.

Tang, Y. A. 1970. Evaluation of balance between fishes and available fish foods in multispecies fish culture ponds in Taiwan. Tran. Am. Fish. Soc. 99: 708-718.

Tripathi, S. D. and Karma, B. 2001. Integrated agriculture-aquaculture: a primer; Animal Fish-systems (Integrated duck-fish farming). FAO Fisheries Technical Paper, 407.

Wahab, M. A., Azim, M. E., Mahmud, A. A., Kohinoor, A. H. M. and Haque, M. M. 2001. Optimizatiopn of stocking density of Thai silver barb (*Barbodes gonionotus)* in the duck weed fed four species polyculture system. Bangladesh J. Fish. *5 (1): 13-21.*