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A comparative analysis of integrated fish-pig and fish-duck farming in lower Brahmaputra valley zone of Assam

Mihir Sarm, J Brahma, Prasanta Boro, M Sonowal, D Bharali, Anil Deka and HK Bhattacharyya

Abstract

Purpose: The aim of the study was to analyse, two important fish-based integration systems i.e. Fish-Pig and Fish-Duck in lower Brahmaputra valley zone, Assam.

Materials and Methods: The experiment was carried out in three sets of ponds in duplicate- (i) Control (T_0), where the fishes were fed with commercial feed, (ii) Treatment (T_1), integrated fish duck farming pond and (iii) Treatment (T_2), integrated pig fish farming pond. The prepared ponds were stocked with yearlings (average length: 15cm; average weight: 242 gms) of Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*) & Grass carp (*Ctenopharyngodon idella*) at a stocking density of 10,000 fingerlings/ha in T_0& T_1 and 5,000 fingerlings/ha in T_2.In all the treatments stocking combination was maintained at Catla:Rohu: Mrigal:Grass carp 30:25:20:25. Fishes in the T_0 (Control group) were provided with commercial fish feed (CP:24%, 4 mm size pellet) @4% of the body weight while fishes in T_1 and T_2 were provided with commercial feed @50% of the control group and pig & duck excreta respectively. After 6 months, final weights of the fishes were recorded and total productions of each group were noted. Water quality parameters of the ponds like pH, dissolved oxygen, free carbon dioxide, alkalinity, hardness etc. were estimated using standard methods (APHA, 2019). TDS and Electrical Conductivity were estimated on monthly intervals using Systronics digital conductivity meter 306.

Results: The results reveal that pond fertilization from the pig excreta and duck droppings encourages the growth of tiny plants like algae and other phytoplankton and tiny animals (zooplankton), providing food for the fishes. Initial average weight of individual carry over fish i.e., Grass-carp, Catla, Rohu and Mrigala were 242, 230,160 and 170 g, respectively. Final average weight of Grass carp in T_0, T_1 and T_2 pond were 1800±13.270, 1950± 12.850 and 2050± 13.520, respectively. Final average weight of Catla in T_0 T_1 and T_2 pond were 910± 9.450, 960±10.260 and 980± 12.20 g, respectively. Final average weight of Rohu in T_0 T_1 and T_2 pond were 850± 7.980, 900± 11.230 and 910± 11.160 g respectively. Final average weight of Mrigala in T_0 T_1 and T_2 pond were 600± 6.040, 720±8.500 and 730± 10.560 g, respectively. So, significant differences were found in the productivity of the four varieties of fish between T_0 and T_1 and between T_0 and T_2.But only numerical difference was noticed between T_1 and T_2. Amongst the fish varieties tested, Grass carp exhibited highest growth followed by Catla, Rohu and Mrigala as mentioned in table (1) i.e., Growth of Grass carp in T_0, T_1 and T_2 pond were 743.80, 805.78 and 847.10 %, respectively. This may be attributed to the feeding potential and genetic characteristics of the fishes. However, the fish productivity is greater in the fish-pig system than the fish- duck system. Growth of Catla in T_0, T_1 and T_2 pond were 395.65, 417.39 and 426.08 %, respectively. Growth of Rohu in T_0, T_1 and T_2 pond were 531.25, 562.50 and 568.75 % respectively. Growth of Mrigala in T_0 T_1 and T_2 pond were 348.83, 418.60 and 424.41 % respectively. The study revealed that the pig excreta act as excellent manure for the fish followed by Duck manure.

Conclusion: Among the three treatments integrated fish pig farming found to be the most profitable integrated farming system followed by the fish duck farming.

Keywords: Integrated farming, pig, fish and duck

1. Introduction

Integrated animal-fish farming could be an appropriate means for increasing returns from a limited land area and reducing risk by diversifying crops (Jhingran, 1986; Williams, 1997; Korikantimath and Manjunath, 2008) [6, 18, 7]. Integrated fish farming is based on the concept that 'there is no waste' and waste is only a misplaced resource which can become a valuable material for another product. The principle of integrated fish farming involves farming of fish along with livestock or/and agricultural crops. This type of farming offers great efficiency in resource utilization, as waste or by-product from one system is effectively recycled.

Integrated farming system is one of the best methods for maximizing animal and plant protein production through optimum use of land, water and waste resources at sustainable level. In this system, nothing is wasted and ecological balance is maintained. Recycling of organic wastes for fish culture serves the dual purpose of cleaning the environment and providing economic benefits (Shyam *et al*., 2012) [16]. The integration of livestock with fisheries aquaculture has received considerable attention lately with emphasis on the incorporation of animal manures as fertilizer and nutrient for promotion of natural feed in fish ponds (Delmendo, 1980; Wohlfarth, 1979) [3, 19]. The rationale behind integrating fish with livestock is the large amount of nutrients (N-P-K) present in the animal feed being recovered in the manure, with possible proportions of 72–79% nitrogen, 61–87% phosphorus, and 82–92% potassium. These act as fertilisers in fish ponds to produce plankton which comprise high-protein natural food for certain species of fish. Recent experiments have demonstrated that considerable fish production can be obtained when animal manures are properly applied to fish polyculture systems (Shoko, 2011) [15]. Supplementary addition of chicken droppings under conditions of intensive fish culture increased fish yield by 21% and decreased the feed conversion rate by 0.4 units (Rappaport, 1978).The recycling of animal dung/wastes in aquaculture ponds is important for natural fish production, which supports sustainable aquaculture and also reduces expenditure on supplementary feeds and fertilizers.

Aim and Objective

The aim of the study was to analyse, two important fish-based integration systems i.e. Fish-Pig and Fish-Duck in lower Brahmaputra valley zone, Assam.

Materials and methods

The study was carried out for a period of 6 months from April, 2020 to September, 2020 at Integrated Farming System unit, Livestock Research Station, Assam Agricultural University, Mandira in Lower Brahmaputra Valley Zone of Assam. Three sets of uniform ponds (890 m^2) were selected in duplicate and marked as T_0, T_1 and T_2. Pre-stocking management of the ponds was carried out as per the Package of Practices of Fisheries & Aquaculture in Assam (2017). The prepared ponds were stocked with yearlings (average length: 15cm; average weight: 242 gms) of Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*) & Grass carp (*Ctenopharyngodon idella*) at a stocking density of 10,000 fingerlings/ha in T_0& T_1 and 5,000 fingerlings/ha in T_2.In all the treatments stocking combination was maintained at Catla:Rohu: Mrigal:Grass carp 30:25:20:25. Fishes in the T_0 (Control group) were provided with commercial fish feed (CP:24%, 4 mm size pellet) @4% of the body weight while fishes in T_1 and T_2 were provided with commercial feed @50% of the control group and pig & duck excreta respectively. After 6 months, final weights of the fishes were recorded and total productions of each group were noted. Water quality parameters of the ponds like pH, dissolved oxygen, free carbon dioxide, alkalinity, hardness etc. were estimated using standard methods (APHA, 2019).TDS and Electrical Conductivity were estimated on monthly intervals using Systronics digital conductivity meter 306. Plankton samples were collected in duplicate by filtering 100-200 liters of river water using 28 mm mesh nylobolt plankton net as described by Santhanam *et al.* (1987) [14]. The collected plankton samples were preserved in 3-4 % formalin in separate plankton tubes. Plankton were identified at genera level using the identifying keys of Edmondson (1959) [20], Needham & Needham (1966) [8] and ICAR monograph series on algae (Ramanathan, 1964; Philipose, 1967) [14, 10]. The data so collected were tabulated and analyzed by using SPSS version 17.0 as per standard statistical methods (Snedecor and Cochran, 1994) and expressed in mean±SE. Duncan Multiple Range test of SPSS was performed for mean statistically significant difference.

Results

The average growth performances of fish in the systems are presented in Table 1. It is observed that in each of the systems, the fingerlings/ carry over exhibited considerable weight gain. The results reveal that pond fertilization from the pig excreta and duck droppings encourages the growth of tiny plants like algae and other phytoplankton and tiny animals (zooplankton), providing food for the fishes. Initial average weight of individual carry over fish i.e., Grass-carp, Catla, Rohu and Mrigala were 242, 230,160 and 170 g, respectively. Final average weight of Grass carp in T_0, T_1 and T_2 pond were 1800±13.270, 1950± 12.850 and 2050± 13.520, respectively. Final average weight of Catla in T_0 T_1 and T_2 pond were 910± 9.450, 960±10.260 and 980± 12.20 g, respectively. Final average weight of Rohu in T_0 T_1 and T_2 pond were 850± 7.980, 900± 11.230 and 910± 11.160 g respectively. Final average weight of Mrigala in T_0 T_1 and T_2 pond were 600± 6.040, 720±8.500 and 730± 10.560 g, respectively. So, significant differences were found in the productivity of the four varieties of fish between T_0 and T_1 and between T_0 and T_2 as mentioned in the table (1). But only numerical difference was noticed between T_1 and T_2. Amongst the fish varieties tested, Grass carp exhibited highest growth followed by Catla, Rohu and Mrigala as mentioned in table (1) i.e., Growth of Grass carp in $T_{0,}$ T_1 and T_2 pond were 743.80, 805.78 and 847.10 %, respectively. This may be attributed to the feeding potential and genetic characteristics of the fishes. However, the fish productivity is greater in the fish-pig system than the fish- duck system. Growth of Catla in T_0, T_1 and T_2 pond were 395.65, 417.39 and 426.08 %, respectively. Growth of Rohu in $T_{0,}$ T_1 and T_2 pond were 531.25, 562.50 and 568.75 % respectively. Growth of Mrigala in T_0 T_1 and T_2 pond were 348.83, 418.60 and 424.41 % respectively. The study revealed that the pig excreta act as excellent manure for the fish followed by Duck manure.

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Physico-chemical parameters of pond water found to be congenial for good growth of plankton as well as fishes. Freshwater bodies productivity can be determined from pH of water. Our findings also coincide with the congenial limit of prescribed range. Likewise, other parameters *viz*. dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, total dissolved solids and electrical conductivity are also found to be ideal for fish culture practice (Table 2).

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The plankton diversity in each treatment tanks were observed every 60th days. The plankton density (Table 3) was observed to be significantly higher in T_2 (102±2.58-132±1.47 Units/L) than T_0 and T_1 which might be due to the effect of pig dung which contains higher levels of nitrogen and phosphorus. The phytoplankton composition comprises of mainly by *Closterium, Chlorella, Chlamydomonous. Oedogonium, Spirogyra, Staurastrum, Ulothrix, Volvox, Diatoma, Fragilaria, Melosira, Navicula, Nitzchia, Pinnularia, Spirulina* and *Chroococus* while zooplankton density contained *Moina, Daphnia, Cyclops, Branchionous, Bosmina* and *Copepoda*. These finding was total agreement with the findings of Tripathi and Sharma (2005) [17].

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Discussion

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Table 1: Fish annual stocking rate, initial and final weight (g/unit) & productivity (kg)

Fish variety	**Grass-Carp**			**Catla**			**Rohu**			**Mrigala**		
Pond	T_0	T_1	T_2	T_0	T_1	T_2	T_0	T_1	T_2	T_0	T_1	T_2
Stocking density (units) carried over Fish	225	225	112	270	270	135	225	225	112	180	180	91
Stocking density (units) after 5% mortality	213	213	106	256	256	128	213	213	106	171	171	86
Initial Av. Wt (g/unit) considering 5% mortality												
Final Av. weight (g/unit)												
Total Initial wt (kg)												
Productivity (Kg)												

*Means bearing similar superscripts in a row do not differ significantly.(Pond 1 (T_0) = Fish only, Pond 2 (T_1) = Fish-Duck Integration and Pond 3 T_2=Fish-Pig Integration)

Table 2: Mean value of physiochemical characteristics of the three ponds before and after treatment

Sl. No.	**Parameters**	**Pre-treated pond**			**Treated pond**		
		T_0	T_1	T_2	T_0	T_1	T_2
1.	pH	8.84±0.50	8.11±0.38	8.62±0.25	7.3±0.06	7.2±0.06	7.1±0.07
2.	DO (mg/L)	6.28±0.05	6.78±0.12	7.01±0.08	6.55±0.18	6.35±0.01	6.87±0.22
3.	TDS (mg/L)	0.53±0.01	0.41±0.01	0.8±0.2	30.72±2.50	29.44±2.54	35.15±2.72
4.	FCO_2 (mg/L)	2.05±0.06	3.15±0.11	2.88±0.19	3.39±0.22	3.45±0.02	3.22±0.09
5.	Hardness(mg/L)	76.07±0.49	81.08±0.12	79.08±0.02	89.09±0.19	87.08±0.23	85.08±0.01
6.	Total Alkalinity (mg/L)	89±0.33	102±0.32	97±0.01	101±0.12	92±0.17	96±0.07
7.	Conductivity (µS/cm)	112±1.05	108±1.00	108±1.15	113±0.72	102±0.82	105±2.12
8.	Temperature (^{0}C)	28.5±2.0	29.27±2.7	29.9±2.6	29.58±0.44	29.94±0.43	30.46±0.58

Table 3: Plankton Density

Treatment	**60 Days**		**120 Days**		**180 Days**	
	No. per litre	**Total Plankton**	**No. per litre**	**Total Plankton**	**No. per litre**	**Total Plankton**
T_0	35±1.25	29,000	31±0.29	37,200	39±0.08	55,000
T_1	88±0.79	1,02,050	81±0.86	96,600	76±1.02	1,15,000
T_2	102±2.58	2,05,110	123±2.98	1,84,000	132±1.47	2,23,000

Conclusions

From the findings of the present study, it may be concluded that integrated fish-pig farming is profitable for getting higher growth of fish, net income and optimum utilization of the given resources.

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