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Integrated Fish cum Pig Farming System for Enhancing Farm Income in Assam

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ABSTRACT

An experiment was conducted with the objective of developing a suitable strategy of low cost integrated fish cum pig farming system. The research study was carried out at the fish farm of College of Fisheries, Raha, Assam to evaluate the productivity of fish cum pig integration. Among the treatment tanks, maximum fish yield was reported in treatment $TP_2$with the recorded value of 3034.76 kg in pond size of 0.50 ha compared to treatment TP_1 (2795.59 kg) and TP_3 (2939.30 kg). Among fish species, highest growth rate was recorded for grass carp (*Ctenopharyngodon idella*) with a total harvested weight of 1142.40 kg followed by silver carp (*Hypopthalmichthys molitrix*) which attained 694.40kg of harvested weight among all the treatment ponds. The live weight among the pigs were reported to be highest in the Hamshire × Doom Pig (H-D) cross with a total meat production of 2047 kg. Integrating fishes with pig resulted in significant higher annual cash flow thus increasing yield, income and diversified food production.

Key Words: Agro-climatic, Fish, Integrated farming, Pigsty, Tribal

INTRODUCTION

Pig–fish farming is one of the most widely practiced integrated fish farming system in many countries (Bhat *et al,* 2006). Utilization of swine dung for augmenting fish production has developed into an industry in China, many South-East Asian countries and East European countries. Pig dung as an organic manure for fish pond has certain advantages over cattle, horse, sheep, buffalo and goat dung. This is because pigs have a limited ability to consume roughages and as such, the pig dung does not contain higher amount of cellulose, hemicellulose and lignin etc. which might resist the process of decomposition and blanket the soil at the bottom of the pond. Further fresh pig dung has about 70 per cent digestible food for fish. Therefore, supplemental fish feed or pond fertilizer is not required in the system. The expenditure on fish culture is drastically reduced as the pig excreta substitute to fish feed and pond fertilizer which accounts for 60 per cent of the input cost in fish culture (Pillay,1980). Hence the research work was carried out with the pre objective of developing a suitable strategy of low cost aquaculture by applying pig manure in fish ponds. The economics of integrated farming of pig and fish for effective utilization of available resources under agro-climatic condition of Assam was worked out.

MATERIALS AND METHODS

The research work was carried out in the year 2019 at the fish farm of College of Fisheries, Assam Agricultural University, Raha within 92°30/ E longitude and 26°15/ N latitude in Nagaon District, Assam. The farm was earlier known as Raha Fish Seed Production and Distribution Centre. As the Jonghal Balahu Garh Fish Farm, the biggest state owned fish farm situated at Raha started producing fish seeds on commercial scale, the Farm was converted to fish production farm in 1972. Bigger size fish ponds of size ≥ 0.5ha were selected for conducting the experiment. The pond soil was clay loam with a soil textural class of 43% sand, 28% silt and 29% clay.

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The pigs selected for the study was Hampshire and local Doom variety. About 25 to 27 numbers of pigs were stocked in the three experimental ponds of size 0.50, 0.52 and 0.54 ha, respectively. Pig stay was constructed on the sunny area of the sufficiently wide pond dyke. The average height of the sty was 1.5- 1.7 m. The floor was made sloppy towards a cemented pit so that the washings of the pigsty directly fall on pond water.

Pond management

Lime was applied @ 500 kg/ha/yr. The first installment was 1/3rd of the total yearly requirement, applied evenly over the bottom soil. The rest was applied at equal monthly installments. Before the start of the experiment, the pond bottom was exposed to the sun at least for 10 days. The bottom was excavated so that minimum water depth is not less than 1.5 m and not more than 3.0m in the monsoon months. The excavated soil was used to repair the dykes.

Amount of feed supplied to the pigs and their cost:

Pigs were fed with locally available feed ingredients comprising of kitchen wastes, broken maize, wild *Colocassia* leaves, rice bran and fish meal along with vitamin and mineral mixture. The feeding rate of the pigs were 3.5kg feed/pig/day and the cost of pig feed was estimated to Rs. 30-35/kg.

Stocking of fishes

The pond was stocked with fishes after water was properly limed and manured with pig dung. The stocking rates vary from 9000-10,000 fingerlings (15cm) per hectare and a species ratio of 40% surface feeders (Catla and Silver Carp), 20% column feeders (Rohu), 30% bottom feeders (Mrigal and Common carp) and 10% macro vegetation feeders (Grass carp) is preferred for high fish yields. To control the weed fishes which compete for food, space and dissolved oxygen with the target fishes, feather backs (*Notopterus notopterus)* can be stocked @100 no/ ha. The fishes derive their nutrition solely from the natural food available in the fish pond. Due to the regular application of pig waste there was an increase of natural food for the stocked fishes. The pig manures serve as a natural source of organic fertilizer for the proliferation of phytoplanktons and zooplanktons which are the natural food for the fishes. The fishes were also fed on the remaining uneaten feed of the pigs where the cost of the feed was minimized to a large extent.

Amount of pig waste recycled in the pond and its NPK concentration

The pig waste comprises of 1.36 -2% nitrogen (N), 0.4% phosphorus (P) 0.4% potash (K) and the total amount of pig waste recycled in the experimental ponds ranged between 35.50 -38.75 kg of dung/dropping. The cost benefit detail of Integrated fish cum pig farming has been mentioned in Table 3.

Measurement of Dissolved Oxygen

Dissolved oxygen concentration of the three treatment pondswas analyzed using standards methods (APHA, 2017). Water samples were analyzed for dissolved oxygen two times daily at 6.00 am and 4.00 am respectively.

RESULTS AND DISCUSSION

Growth study

The total fish production (Table 1) was reported to be highest in treatment $TP_2$with the recorded value of 3034.76 kg in pond size of 0.50 ha. The total harvested weight of grass carp (*Ctenopharyngodon idella*) was highest in the treatment pond of size 0.50 ha with a value of 1142.40 kg followed by silver carp (*Hypopthalmichthys molitrix*) which attained a total harvested weight of 694.40kg among all the treatment ponds. Among the carp species, the survival rate of common carp (*Cyrinus carpio*) was 73.98 per cent which represents the treatment pond TP_1 of size 0.52 ha. The survival rate of common carp was highest among all the treatment ponds irrespective of the stocking density.

Table 1: Details of stocking, survival (%) and fish production in treated ponds.

Species	Species Ratio	Initial Av. Wt. (kg)	Treated ponds (TP_1: 0.52ha, TP_2: 0.50ha, TP_3: 0.54ha)								
			TP_1 (Pond 1)			TP_2 (Pond 2)			TP_3 (Pond 3)		
			Final Av. Wt. (kg)	Survival (%)	Total Wt. Harvested (kg.)	Final Av. Wt. (kg)	Survival (%)	Total Wt. Harvested (kg.)	Final Av. Wt. (kg)	Survival (%)	Total Wt. Harvested (kg.)
Catla	20	0.05	0.81	71.15	509.50	0.85	69.29	500.65	0.90	65.47	540.90
Rohu	20	0.03	0.48	65.95	279.84	0.45	68.59	262.65	0.46	60.13	253.92
Mrigal	20	0.03	0.40	62.00	219.20	0.38	66.94	216.22	0.36	63.94	211.32
Silver Carp	15	0.02	1.45	63.05	606.10	1.60	68.03	694.40	1.52	64.88	678.98
Grass carp	15	0.04	2.10	69.08	961.80	2.80	63.95	1142.40	2.10	70.97	1026.90
Common Carp	10	0.03	0.65	73.98	212.55	0.74	68.00	213.86	0.71	68.19	222.23
Chital	0.15	0.30	1.10	85.71	6.60	1.22	66.67	4.88	1.01	71.43	5.05
Total fish production (kg):					2795.59			3034.76			2939.30

The total fish production of the recent study is in agreement with the earlier studies of the Indian plain zones where fish production in integrated fish farming systems was recorded to be 5.0 -7.5 mt/ha/yr (Samra *et al,* 2003). So far as fish growth was concerned, grass carp exhibited maximum production in fish cum pig integration followed by silver carp and catla (*Catla catla*) which contradicts the earlier findings of Bhat *et al* (2011). This may be due to the different agro-climatic conditions in where the experiment was performed and in which temperature and dissolved oxygen play a crucial role in fish growth.

Water quality management is very much important in carp culture. Due to high manure load, the dissolve oxygen content of water may fall below the critical level particularly at dawn during the summer season when the water temperature is high and the depth of water is low. As mentioned in Fig. 1. The dissolved oxygen (DO) fluctuates during the morning and evening hours with a peak value achieving at 4.00 pm irrespective of all the culture ponds. The least value of 2.83 ppm of DO was observed in Pond 2 *i.e.,* treatment TP_2 followed by increasing trend of 8.63 ppm in the same treatment pond. The results of the present study suggest that the DO level undergoes severe diurnal fluctuations which corroborate with the findings of Bhatt *et al* (2006).

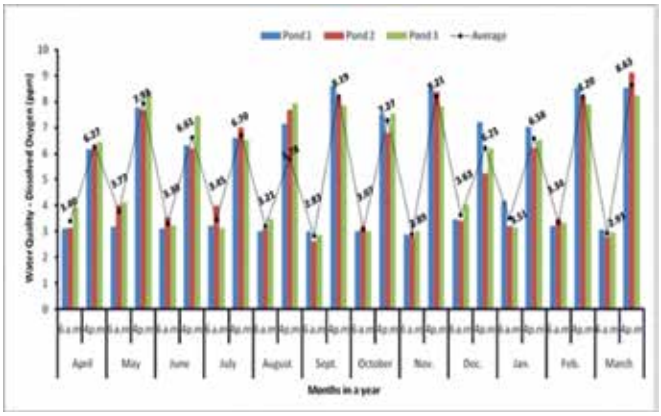

Fig. 1:Diurnal fluctuation ofDissolved Oxygen concentration in treatment ponds (Pond 1: 0.52ha; Pond 2: 0.50 ha; Pond 3: 0.54ha)

The growth of the piglets was mentioned in the Table 2 states that the maximum production was observed in the H-D cross variety of piglets as compared to the local Doom (D) variety. The live weight among the pigs were reported to be highest

Table 2:Details of pig production in different treatment ponds (PS1: 0.52Ha; PS2: 0.50ha; PS3: 0.54ha)

No. of Pigs /ha	Batch No.	Variety	Initial Av.Wt (Kg.)	No. of Piglets			Survival (%)			Total Meat Production (Live wt. in Kg.)			Cum. Av. Final Wt. gained (live wt. in Kg.)
				PS1 (0.52ha)	PS2 (0.50ha)	PS3 (0.54ha)	PS1	PS2	PS3	PS1	PS2	PS3	
50	1	H-D	9.55	26	25	27	92	92	96	1967	2047	2033	83
	2	D	8.91	26	25	27	100	100	93	1500	1467	1222	55

H-D: Hamshire × Doom Pig Variety;

D: Doom Pig Variety.

in the Hamshire × Doom Pig (H-D) cross with a total meat production of 2047kg (PS2) integrated with fish farming in the treatment pond of size 0.50 ha. The variety of pigs is one of the most important aspects of pig husbandry. The local regional pig varieties such as the Doom variety are small in size and growth is slower as compared with the exotic cross varieties reported by Panda *et al* (2018) which substantiates the pig production of the recent study.

Cost –benefit analysis

Table 3 presents the cost-benefit structures of the integrated fish cum pig farming experiment conducted with a stocking density of 50 pigs ha^{-1} yr^{-1}. Total fish production in the three treated ponds was 8769.65 kg including 16.53 kg chital fish. As a whole, fish contributed 41.79% of the gross farm income. The individual weight of the harvested fish was best in treatment pond TP2 ranging between 0.38 kg (mrigal) and 2.80 kg (grass carp). The percentage return on cost variable expense was computed to be 68.40% in the present study.

PROFIT

Receipt –Total operational cost

= Rs. (21,10,244.00 – 6,66,932.27)

= Rs. 14,43,311.73

Percentage return on cost variable expense: 68.40%

CONCLUSION

Within the broad concept of sustainable agriculture, "Integrated Farming Systems" hold special position as in this system nothing is wasted, the byproduct of one system becomes the input for other. Integrated farming is an integrated approach to farming as compared to existing monoculture approaches. The findings from this study indicate that the live weight among the pigs were reported to be highest in the Hamshire × Doom Pig (H-D) cross with a total meat production of 2047kg integrated with fish farming in the treatment pond of size 0.50 ha followed by highest fish growth exhibited by grass carp (*Ctenopharyngodon idella*) in fish cum pig integration. As fish farming was done by integrating with pig, the animal waste were recycled into the ponds which enhanced the natural productivity of fish pond. Consequently, the integration of fishes and pigs increases yield, provides additional income and food that generates employment avenues for small-scale farmers. Thus, small-scale farmers should integrate fishes with livestock as a practical solution to meet the increasing demand for both pig and fish in north east India which will stabilize their income and diversify food production.

Table 3: Cost–benefit details (variable cost, gross output and net farm income) of the integrated fish cum pig farming system.

A. COST FUNCTIONS			
1. Non –recurring expenditure			
	Item	**Total Expenditure (Rs.)**	**Depreciation cost (Rs.)**
i)	Renovation of the three treated ponds, repairing of the embankments, procuring dragnets, pump sets and construction of pig sty etc. Life Expectancy=10 yr	6,34,075.00	63,407.50
2. Recurring expenditures			
(a)	Cost of fish culture		2,25,000.00
(b)	Cost of pig farming		3,78,524.77
3. Total operational Cost			
i)	Depreciation cost of non-recurring expense		**63,407.50**
ii)	Recurring expenditure		
	(a) Cost of fish culture		**2,25,000.00**
	(b) Cost of pig farming		**3,78,524.77**
	Total		**6,66,932.27**
B. RETURN FUNCTIONS			
i)	Farm gate price of 8769.65 kg carps @ Rs. 100/-		**8,76,965.00**
ii)	Sale of 16.53 kg chital @ Rs. 300/-		**4959.00**
iii)	Farm gate price of 10,236 kg pig meat (live weight) @ Rs. 120/-		**12,28,320.00**
	Total:		**21,10,244.00**

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