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INTEGRATED POULTRY-FISH FARMING—A WAY TO INCREASE PRODUCTIVITY AND BENEFITS

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Studies to assess the viability and economic benefits of integrating poultry (layers) farming with fish culture were conducted using four shallow ponds. Chicken houses were constructed over each of these ponds using locally available materials such as bamboos and straw. Flooring was constructed using bamboo splits spaced at 2 cm intervals, in order to allow chicken excreta to fall directly into the ponds.

*The ponds were stocked with carp–*Hypophthalmichthys molitrix, Catla catla, Labeo rohita, Cirrhinus mrigala *and* Ctenopharyngodon idella *and tilapia-*Oreochromis niloticus, *at a density of 7,500 fingerlings/ha. The fish were not given supplementary feed, nor were the ponds fertilized with anything other than the chicken excreta falling into the ponds. After ten months rearing, fish production from the two treatments totaled 4,279.18 and 5,112.49 kg/ha.*

One day old Isa Brown chicks were raised for 15 days in a brood house, following which they were shifted to the houses on the ponds. The chickens started laying eggs at 20 weeks, and at the end of ten months the average proportion of chickens laying eggs was estimated at 70.12%. The mortality rate during this period was 2%. Analysis of experimental results at the end of the ten-month period showed a net economic benefit of Tk. 222,475.25/ha (US$5,704.49) (204,499.6 from fish culture and 17,975.65 from chickens).

The problems and constraints involved in large-scale adoption of these technologies is discussed.

INTRODUCTION

The integration of aquaculture with poultry results in a more efficient use of resources than is possible with aquaculture farming alone. Other benefits of diversification include a reduction in the risk of total crop failure, additional sources of food and extra income for poor farmers. The costs associated with fish culture operations are reduced by about 70% (Gupta 1987) when integrated with chickens, because fish farming recycles chicken wastes and spilled chicken feed as

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food and fertilizer for the fish. Consequently there is no need to provide supplemental feed or fertilizer.

Integrated fish-livestock farming has long been in practiced in sub-tropical climates—particularly China and Taiwan—but not in tropical countries (Sharma and Olah 1986). This study was undertaken to: (i) evaluate the economic benefits or integrating fish with livestock farming; (ii) determine species' ratios and combinations that would result in optimum productions; and (iii) assess the viability of integrating egg-layer poultry with fish culture in a tropical country.

MATERIALS AND METHODS

The experiment was conducted in four ponds 800 m^2, each with a water depth of 1 m, at the Fisheries Research Institute, Mymensingh, Bangladesh from June 1990 to April 1991. Chicken houses 15 m^2 were constructed over ponds using locally available materials such as bamboos and straw. Flooring was constructed using bamboo splits spaced at 2 cm intervals, in order to allow chicken excreta to fall directly into the ponds. Prior to the start of experiment the ponds were drained to eradicate predatory and weed fish, and lime was subsequently applied at the rate of 250 kg/ha. Three days later the ponds were filled with ground water. Each of the two experimental treatments was used in two of the four ponds.

One day old Isa Brown chicks were raised in a brood house for fifteen days, after which they were transferred to housing over the ponds at a density of 625 chicks/ha. The birds were fed ad libitum from 0 to 8 weeks on a starter ration. From 9 to 16 weeks they were fed a grower diet and from the 17th week on, a layer diet at a rate of 120 g/bird/d. The composition of the diets is shown in Table 1, a, b, c.

All the ponds were stocked with fingerlings of *Hypophthalmichthys molitrix, Catla catla, Labeo rohita, Cirrhinus mrigala, Ctenopharyngodon idella* and *Oreochromis niloticus* at a stocking density of 7,500 fingerlings/ha. Two species combinations and ratios were used as detailed in Table 2, with each treatment conducted in two ponds. The average size of fingerlings at stocking ranged from 8 to 15 cm. With the exception of the excreta of chickens falling into the ponds, no supplementary feed was given to fish, nor were the ponds fertilized with external inputs. Egg laying started after the age of 4 months (Figure 1), and daily records were kept of the quantity, quality and cost of feed provided to the birds, as well as of the egg production. The ponds were netted at monthly intervals, in order to observe growth and well-being of the fish. At the end of 10 months the fish were harvested, first by seine netting and later by draining the ponds.

Table 1a. Composition of the starter rations given to Isa Brown layer birds from 0 to 8 weeks of age.

Ingredients[a]	Percent (%)	ME [b] Kcal/kg	Crude protein (%)	Ether Extract (%)	Crude fibre (%)	Ash (%)
Crushed wheat	48.0	1,560.0	5.65	2.08	2.33	0.56
Rice bran	18.0	514.80	2.61	3.67	2.08	2.94
Fish meal	15.5	410.75	8.97	1.77	0.53	2.80
Sesame oil cake	16.0	416.00	4.92	1.66	3.29	2.14
Oyster shell	2.0	-	-	-	-	-
Common salt	0.5	-	-	-	-	-
Total	100	2,901.55	22.15	9.18	8.23	8.44

[a] Vitamin mineral premix added @ 250 g/100 kg prepared feed.
[b] Metabolizable energy.

Table 1b. Composition of the grower rations given to Isa Brown Layer birds from 9 to 16 weeks of age.

Ingredients[a]	Percent (%)	ME [b] Kcal/kg	Crude protein (%)	Ether Extract (%)	Crude fibre (%)	Ash (%)
Crushed wheat	45.00	1,462.5	5.301	1.95	2.19	0.52
Rice bran	24.00	686.4	3.48	4.89	2.78	3.92
Fish meal	14.00	371.0	8.09	1.60	0.44	2.53
Sesame oil cake	13.00	338.0	4.00	1.35	2.62	1.74
Oyster shell	3.50	-	-	-	-	-
Common salt	0.50	-	-	-	-	-
Total	100.00	2,857.90	20.87	9.79	8.03	8.71

[a] Vitamin mineral premix added @ 250 g/100 kg prepared feed.
[b] Metabolizable energy.

RESULTS

Stocking details, the weights of different species at stocking and harvesting, and their contribution to total production and survival rates are shown in Table 3. At the end of ten months, gross production totaled 4,279 kg/ha/year from ponds stocked with carp only, while the production from ponds stocked with *O. niloticus* was 5,112 kg/ha. *O. niloticus*, when

Table 1c. Composition of the layer rations given to Isa Brown Layer birds from 17 weeks to end of the egging.

Ingredients[a]	Percent (%)	ME[b] Kcal/kg	Crude protein (%)	Ether Extract (%)	Crude fibre (%)	Ash (%)
Crushed wheat	44.0	1,430	5.18	1.90	2.14	0.51
Rice bran	28.0	800.8	4.06	5.71	3.24	4.58
Fish meal	10.0	265	5.78	1.14	0.34	1.81
Sesame oil cake	12.0	3.12	3.68	1.24	2.42	1.61
Oyster shell	5.5	-	-	-	-	-
Common salt	0.5	-	-	-	-	-
Total	100.0	2,807.80	18.7	10.00	8.14	8.51

[a] Vitamin mineral premix added @ 250 g/100 kg prepared feed.
[b] Metabolizable energy.

Table 2. Details of species combinations and the percentage of each species in different treatments.

Species	Treatment - I %	Treatment - II %
H. molitrix	30	10
C. catla	10	10
L. rohita	25	25
C. mrigala	25	25
C. idella	10	10
O. niloticus	-	20

stocked at 20% of total density, contributed 41 to fish production. *C. idella*, with a stocking density of 10%, contributed 12% of gross production when *O. nilotica* was present, and 19% of gross production when *O. nilotica* was absent (Table 3). Similarly, *H. molitrix* was stocked at 10 and 30% of density and contributed between 16 and 37% of the gross production.

Survival rates for all species were fairly high, and ranged from 72.5 to 99% in both treatments. Survival rates better than 95% were observed with *L. rohita* (99%), *C. mrigal, C. catla, C. mrigala* and *H. molitrix*. These high survival rates were probably due to using advanced fingerlings for stocking. It is evident from Table 3 that the presence of *O. nilotica* reduced the production of *C. catla, L. rohita, C. mrigala*, and *C. idella* in treatment 2, and that the reduced density of *H. molitrix* in treatment 2 promoted its growth.

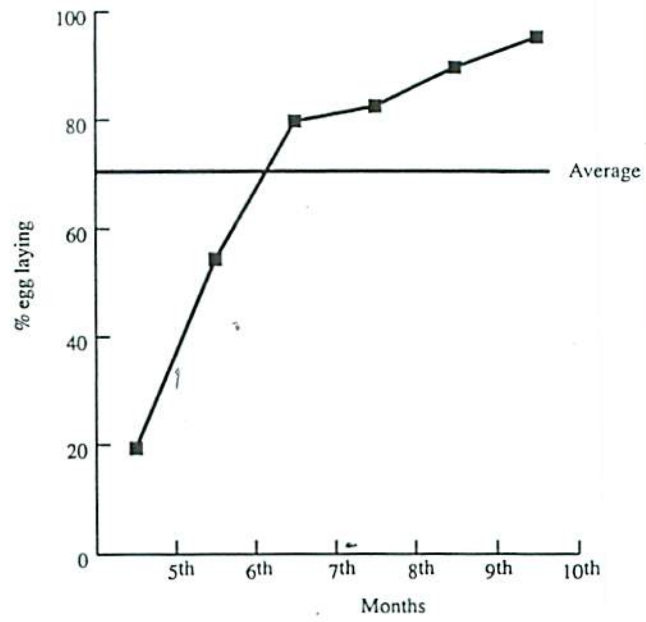

Figure 1. Average percentage egg laying in months.

Table 3. Details of stocking and gross production per hectare.

Treat-ment	Species	Initial average weight (g)	Final average weight (g)	Survival (%)	Production (kg/ha)	Percentage of total production (%)	Total produc-tion (kg/ha)
	H. molitrix	32.5	785	94.4	1,614	37.7	
	C. catla	17.8	610	75.0	339	7.9	
I	*L. rohita*	18.4	460	95.7	722	16.9	4,279
	C. mrigala	28.0	490	90.3	804	18.8	
	C. idella	8.0	1,425	72.5	798	18.7	
	H. molitrix	32.5	1,150	95.8	822	16.1	
	C. catla	17.8	314	96.7	227	4.5	
II	*L. rohita*	18.4	335	99.0	621	12.2	5,112
	C. mrigala	28.0	390	96.7	705	13.8	
	C. idella	8.0	1,065	83.3	637	12.5	
	O. niloticus	14.75	-	-	2,098	41.1	

Chicken rearing

Fifty Isa Brown chickens were raised on each of the ponds for a period of 10 months, with a mortality rate of 2%. Chickens started laying eggs during the fifth month, at rates varying from 19.39 to 95.24% at different times (Figure 1), but peaking during the tenth month. A total of 5,879 eggs were obtained from a 800 m^2 experimental pond over the ten-month period.

Costs and Returns

Table 4 details the capital and operating costs as well as the returns from an experimental integrated poultry-fish-farm operation using a 800 m^2 pond for a period of ten months. Capital costs for the pond lease, chicken houses, feeders and water amounted to Tk. 2,183[1]. Variable costs, such as the cost of chicks, feed, labour, vaccine, lime and fingerlings, amounted to Tk. 14,403. While the costs required for the full ten months of operation are provided, farmers are not required to invest the full amount at one time. Instead, beginning in the fifth month, income from the sale of eggs can be used to offset on-going operating costs. Total production from the 800 m^2 pond over a ten-month period included: 5,879 eggs, 49 chickens and 409 kg of fish.

Estimating the market price for fish and egg at Tk. 40 per kg and Tk. 2.40 per egg, a net profit of Tk. 17,798 would have been earned.

DISCUSSION

Integrated poultry-fish farming is practiced in many countries of the world, and especially in Asia. It is not only an efficient way of recycling farm wastes but also produces high economic returns. Hopkins and Cruz (1982) studied integrated animal-fish farming systems in the Philippines and concluded that livestock manure was a very important source of nutrients for fish cultivated in ponds. In India, the integration of poultry birds with fish culture resulted in fish productions of 4,500 to 5,000 kg/ha (Anonymous 1985). There are a number of traditional aquaculture systems in tropical Asia, such as the Indian major carp polyculture system, but until recently this system was not an example of integrated farming because farm wastes were not used as fertilizer or feed inputs (Tripathi and Ranadhir, 1982). Chicken manure is a complete fertilizer with the characteristics of both organic as well as inorganic fertilizer (Banerjee *et. al.* 1979), and fish culture in this type of an integrated system uses free manure as a pond fertilizer.

Raising chickens over ponds has a number of benefits for Bangladesh. These advantages include the following: (i) the chicken houses constructed on ponds do not have to compete for land needed for other purposes in a region where growing populations are reducing the amount of land available for farming; (ii) hygienic conditions are better in chicken houses constructed over ponds, as the feces fall directly into the ponds; and iii) chicken excreta provide food and fertilizer for the fish culture.

[1] 1 US$ = Tk. 39.00.

Table 4. Costs and returns[a] of 50 layer chickens raised for 10 months in a 15 m^2 house over a pond 800 m^2.

	Quantity	Rate (Tk)	Cost/yr (Tk)
Capital costs			
Chicken shed (Tk.) (life expectancy - 3 years)	4,000	15 m^2	1,333
Pond lease			800
Feeders and water			50
Total capital cost (A)			2,183
Variable costs			
Cost of day old chicks	50	20.00/chick	1,000
Feed	1,433 kg	8.16/kg	11,693
Labour	-	-	1,000
Vaccine	-	-	50
Lime (for pond preparation)	20 kg	3.00/kg	60
Fingerlings	600	1.00 each	600
Total variable costs B			14,403
Bank interest (16%) on A and B			2,211
Total costs (C) = (A+B+interest)			18,797
Income			
Egg production	5,879	2.40/egg	14,110
Culled birds	49	125.00/bird	6,125
Fish	409 kg	40.00/kg	16,360
Total income (D)			36,595
Net profit (D-C) =			17,798
Net profit/ha			222,475

[a] US$ = Tk. 39.00, 1992.

The present study shows that an integrated polyculture system of major carp and *O. niloticus* results in higher production levels than does the culture of major carp alone. *O. niloticus*, which occupies several niches, is an exceptionally versatile feeder. Hickley and Baily (1987) described it as taking phytoplankton in the water column, periphyton and fine particulate organic matter from plant and other surfaces, and benthic organic detritus. The low growth rates of different species of carp in the second treatment may have been caused by competition for food with *O. niloticus*. The people of Bangladesh, however, prefer the larger carp, which fetch a higher price in the market. Thus, despite the higher production levels possible when *O. niloticus* are integrated with carp, economic returns are better from the culture of carp alone. As a result, carp polyculture is more popular in Bangladesh, where fish production in polyculture averages 4 to 5 t/ha/year, using supplementary feeding and fertilization of ponds.

Our results indicated that the total cost of production in polyculture of carp was Tk. 58,000/ha for ten months, with a net benefit of Tk. 93,805/ha. In fact, net benefits of integrated farming could be as high as Tk. 222,475/ha. These results demonstrate the economic viability of integrating poultry and fish farming.

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