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Integrated Fish-cum-Duck farming system: A Tool for Increasing Farmer's Income

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ABSTRACT

The study was carried out to analyze incomegeneration by adopting integrated fish-cum-duckfarming at farmers' field for three consecutive years, 2016-17, 2017-18 and 2018-19.. The trials were conducted in 4 villages of Kamrup District of Assam namely Manikpur, Rajkhowapara, Kukurmara, and Bichennella. The economics of the integrated farming system as well as farmer's practice has been worked out and it has been found that gross profit to the tune of Rs. 5.69 lakh/ha and Rs. 2.39 lakh/ha were recorded from integrated fish cum duck farming and traditional fish farming practice with a net profit of Rs. 3.1 lakh/ha and Rs. 1.54 lakh/ha respectively. This gave an average benefit-cost ratio of 2.19 in integrated fish-cum-duckfarming and 1.83 in traditional fish culture practice. The study has revealed that the adoption of integrated fish cum duck farming provides additional net income of Rs. 1.56 lakhs/ha of water area over the traditional fish farming system. Additionally, the consumption of fish, duck meat and duck eggs add to food quality and livelihood security of the resource-poor family. The study has concluded that the integrated fish cum duck farming system could tackle the issues of sustainability, livelihood security and income generation effectively.

Key Words: Benefit-cost ratio, consumption, livelihood security, net profit, sustainability.

INTRODUCTION

Integrated fish farming combines livestock production with fish farming where animal manure is shed directly into a fish pond as fertilizer and supports the growth of photosynthetic organisms. The farming systems are relatively confined units with little exchange of water. This integrated fish farming system produces high yields with low input, with the fish receiving limited, if any, supplementary feed. In contrast, the livestock on the integrated farms, which includes duck, chickens and pigs, is reared intensively, and antimicrobial agents are used as growth promoters and for prophylactic and therapeutic treatment. Within integrated fish farming systems, antimicrobials, their residues, and anti-microbial resistant bacteria may enter the fish ponds through animal manure and/or excess feeding and are potential sources of antimicrobial-resistant bacteria. In an integrated fish culture, animal wastes and undigested and spilt food particles are directly consumed by the fish and some portion of waste acts as nutrients and organic substrates for many microorganisms which in turn consumed directly by fish or by invertebrate fish food organisms (Misra *et al*, 2016). Ducks are habituated to consume juvenile frogs, tadpoles and dragonfly etc. and there by make a safe environment for fish. Duck droppings provide essential nutrients go directly into the pond droppings as good sources of carbon, nitrogen and phosphorus, which in turn stimulate growth of natural food organism. In general, the farmers are using local indigenous variety of ducks for fish cum-duck integration. Duck dropping contains 0.9 per cent nitrogen and 0.4 per cent phosphorous. Duck dropping act as good organic manure which helps in production of

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different variety of phytoplankton & zooplankton in pond. About 250 - 300 ducks are enough to fertilize a hectare of water spread. The fish-cum-duck integration system provides meat, eggs in addition to fish. It generates production of additional food and income to the farmer. Approximately 40-50 kg of organic waste is converted into one kg of fish.

Under this system the nutrients from the poultry are recycled in the pond and this allows for escalation of production and income while reducing the affluent along with the dumping of the wastes would have had on the environment (Singh et al, 2014; Misra *et al*, 2016). Direct use of livestock wastes is one of the most widespread and conventionally accepted forms of integrated fish farming and the practice increases the efficiency of both duck farming and fish culture through the profitable utilization of animal and feed waste products. The cost of formulated fish feed is usually about 70per cent of production costs and the use of animal manure considerably reduces operational costs and makes it possible for low income fish farmers to profitably engage in the enterprise. Banerjee *et al* (2014) reported that the use of cow dung and duck manure for practicing aquaculture is a viable option for natural biodiversity. Bhuiyal *et al* (2014) documented that the integrated farming system improve the efficiency of marginal and small farms that appeared to be the most efficient performers in the integration and arrangement of farming enterprises. Hence, the present study was aimed to assess the utility of integrated fish and poultry farming for self-employment and nutritional security.

MATERIALS AND METHODS

The study was carried out during the years 2016 to 2018. The experiment was carried out in Manikpur, Rajkhowapara (Bezera), Kukurmara, and Bichennella (Rangia)villages of Kamrup District, Assam geographically located between $25^0$46' and $26^0$49' north latitudes and between $90^0$48' and $91^0$50'' east longitudes. Fingerlings of Catla (*Catla catla*), Rohu (*Labeo rohita*), Mrigala (*Cirrhinus mrigala*), Grass Carp (*Ctenopharyngodon idella*), Common carp (*Cyprinus carpio*) and Silver carp (*Hypophthalmichthys molitrix*) were stocked in a ratio 2:2.5:1.5:1.5:1:1.5 respectively @ 6000 carried over fish seed/ha(Mahapatra *et al*, 2006). Total cost of production includes cost of labour for pond preparation and management, liming, netting etc. and material cost like Ducklings, fish yearlings, duck feed, lime etc. in the local price. The gross production includes fish production, egg production, and duck meat production. The egg laying capacity of Chara Chambelli duck calculated as 160- 180 nos. per year and eggs laying age of ducks after 5 month old.

Preparation of fish pond

The management practices in scientific fish farming can be categorized as pre-stocking, stocking and post-stocking management. The major steps followed in pre-stocking management were aquatic weed clearance by manual effort, eradication of predatory and weed fish by repeated netting, NPK added into fish pond through organic manure and liming with quick lime @ 2000 kg/ha/yr for regulating pH of pond water. One third quantity of total amount of lime was applied as initial dose and rest was applied in seven split doses after checking pH of the pond water. In stocking management, transportation of fingerling is one of the most important steps. In the present investigation, transportation of fingerlings was done in the early morning hours. Acclimatization of the fingerlings was also done by putting the Oxygen packed polythene bags in pond water for 15 min followed by addition of excess water in the same bag and releasing the fishes slowly in the pond for reducing the stress related to temperature fluctuation. Sampling for checking the health and growth were also done once in two months.

Preparation of duck house

Duck house was constructed over the pond water with a dimension 5 m length, 4 m width and 2.5 m height by using locally available bamboo. The floor of each house was made of slated bamboo and

the space between slats was just enough to facilitate the wasted food and duck dropping to fall directly into the pond water. A bamboo mashed bridge like structure was installed or connecting the dyke of the fish pond and duck house. Prior to shifting, proper disinfection procedure of duck house and equipment was also ensured. In each duck house 20 days old ducklings of Chara Chemballi were integrated @ 40 nos./house.

Feeding of duck

Starter feed was provided to the ducklings during the age of 2-20 week @ 40 g/bird/ day in semi closure system whereas a layer mash was provided to the duck above 20 week @ 60 g/bird/ day.

RESULTS AND DISCUSSION

The present study revealed thatintegrated fish cum duck farming system has many advantages over traditional fishfarming practice.Different fish species *viz.* Silver carp, Catla, Mrigala, Grass Carp, Common carp and Rohu harvested from Manikpur, Rajkhowapara(Bezera), Kukurmara, and Bichennella (Rangia)villages of Kamrup District showed that growth of silver carp and catla was better than other fish species in integrated fish cum duck farming system. The average weight was taken from ten (10) numbers of fishes for result analysis.

Growth performance

Silver carp and catla was recorded to grow faster with an average size of 1070g and 980g respectively in eight months of culture period. This might be attributed to duck droppings to the fishes as well as manuring of pond and consequently optimum production of phytoplankton and zooplankton which were basic food for silver carp and catla, respectively (Amir *et al*, 2013). The significant increase(*) in final weight of fingerlings were recorded as mentioned in Table 1.In reference to Catla, the maximum weight at the time of harvest was recorded 920±40g in integrated fish cum duck demonstration units against 530±20g in the traditional farming practice having the weight of 90±0.5g at the time of stocking.In case of Rohu the maximum weight was found 610±20g in integrated fish cum duck demonstration units in comparison to 450±30g in the pond of traditional practicing farmers. The initial weight of fingerlings of Rohu was 70±0.3g at the time of stocking. While In reference to Mrigala it was found 510±30g in integrated fish cum duck demonstration units in comparison to the farmers practice ponds which were recorded 430±15g. In case of exotic carp, significant growth was also observed. In Silver carp the maximum weight was 1015±25g in integrated fish cum duck demonstration units in comparison to 580±30g in the traditional practicing farmer's pond. With reference to Grass carp, it was recorded 815±35g in the same demonstration units in comparison to 750±23g recorded in practicing farmer's pond. Common carp recorded 810±40g in comparison to 520±50g recorded in the fishes obtained from traditional practicing farmers.

During the study period, congenial water temperature for fish growth was observed from March to October last in all the locations. Average fish yield recorded in integrated fish cum duck farming demonstration units was 38.3 q/ha, 37.3 q/ha and 40.2 q/ha during 2016, 2017 and 2018 respectively. This might be attributed to pre-stocking, stocking and post-stocking management practices. Gradual increase in fish productivity in integrated duck fish farming demonstration units over traditional fish farming practicemight be due to the residual effect of incorporation of inputs *viz.* lime, manure and feeding materials in the same pond over the years. Similar observations were also made by Manjappa *et al* (2017) and Kund *et al* (2010). An increment of fish harvest to the tune of 164 , 156 and 163 per cent was recorded by adopting composite fish farming in the year 2016, 2017 and 2018 respectively (Table 2).

Economic evaluation

The data on economic aspect recorded from all the integrated fish cum duck farming demonstration units is presented in Table 3. The cost of cultivation

Table 1. Growth performance of carried over fish seed after stocking at integrated duck fish farming system.

Sl. No.	Species	Initial weight during stocking (g)	Weight of fishes during harvest (g)	
			Integrated duck fish farming	Traditional fish farming
1	Catla	90	920 ± 40*	530 ±20
2	Rohu	70	610 ± 20	450 ± 30
3	Mrigala	55	510 ± 30	430 ± 15
4	Silver Carp	85	1015 ± 25	580 ± 30
5	Grass Carp	65	815 ± 35	750 ± 23
6	Common Carp	65	810 ± 40	520 ± 50

was observed as Rs. 40,200.00 for an average of 1300 m^2 pond including whole expenditure incurred during the experimentation in compared to the average outcome/return i.e. Rs. 82,000.00 from all the locations after selling of the system produce like fish, egg and duck which shows about 2.03 fold increment in farms income of the region. The main reason observed for increased income was due to the availability of direct duck dropping along with unused and undigested feed items which was directly used by the fish stock and in other way it acts as a fertilizer to increase the fish pond productivity (Misra *et al,* 2016).

Economic analysis of integrated fish cum duck farming demonstration and traditional farming practice was made to evaluate the sustainability of integrated fish cum duck farming. Average total cost of production over the period of 2016 to 2018 was Rs. 2.59 lakh/ha and Rs. 84,667.00 in integrated fish cum duck farming and traditional fish farming practice respectively (Table 4). Variation in the cost of production in different years was due to variation in cost of inputs. More cost of production in integrated fish cum duck farming as compared to the traditional fish farming practice is due to duck husbandry, balance feeding, manuring, liming and using chemicals in the former system. Mean yield of fishes obtained from these two systems were 38.6 q/ha and 23.95q/ha. Gross profit to the tune of Rs. 5.69 lakh/ha and Rs. 2.39 lakh/ha were recorded from integrated fish cum duck farming and traditional fish farming practice with a net profit of Rs. 3.1 lakh/ha and Rs. 1.54 lakh/ha respectively. This gave an average benefit-cost ratio of 2.19 in integrated fish cum duck farming and 1.83 in traditional fish culture practice.

The result reflects that production of fishes and profitability was more in integrated fish cum duck farming over the traditional fish culture practice which is because of adoption of good management practices.

CONCLUSION

From the present study, it can be concluded that with intensification in stocking density of fish and duck resulted in increased fish production up to 38.3 q/ha/year with an annual income of 5.63 lakh/ha/year in 2016,37.3 q/ha/year with an annual income of 5.75 lakh/ha/year in 2017& 40.2 q/ha/year with an annual income of 6.27 lakh/ha/year in 2018, which is 64%, 56%, 63% higher than traditional fish farming practices in three consecutive years respectively.Under reduction of cost of supplementary feed and fertilizers for fish farming strengthening integration of fish cum duck farming which makes this system viable in state environment for employment generation and concerned aspects. As the fish cum duck farms are ageing the farmers become fully experienced and the profit margin would increase. If increased fish production is encouraged, the farmer's income will increase and his poverty level will be reduced

Table 2. Average yield (q/ha) of fishes in duck cum fish farming system and traditional fish farming system.

Year	Manikpur	Kukurmara	Rajkhowapara	Bichenella	Av. yield
Average yield (q/ha) of fishes in integrated fish cum duck farming					
2016-17	39.4	38.5	36.6	38.6	38.3 (164%*)
2017-18	39.2	36.45	35.2	38.45	37.3 (156%*)
2018-19	42.2	38.2	38.6	41.6	40.2 (163%*)
Average yield (q/ha) of fishes in traditional fish culture					
2016-17	23.25	22.45	22.5	25.2	23.35
2017-18	25.8	23.2	22.9	23.6	23.88
2018-19	25.5	24.6	23.8	24.6	24.63

*Fish yield Increase in integrated fish cum duck farming over traditional fish farming practice (%).

Table3. Economics of integrated fish cum duck farming.

Expenditure analysis for 0.133 ha(1 bigha)		
Sl. no	**Commodity/item**	**Cost involved (Rs.)**
1	Pond preparation	3000.00
2	Yearlings (n=800)	8000.00
3	Poultry housing	2000.00
4	Chara Chambelli ducklings (n=40)	3200.00
5	Duck feed	9000.00
6	Labour cost	10,000.00
7	Miscellaneous	5000.00
Total cost involved		40200.00
Outcome statement		
1	Fish (560 Kg)@ Rs 100.00 per kg	56000.00
2	Eggs (5760nos)@ 180 eggs/bird for 32 no.s female duck@ Rs. 5.00 per egg	28800.00
3	Duck 40nos @ Rs. 200.00 per duck	8000.00
Total outcome per demonstration (0.133 ha)		92800.00

while concomitantly there will be more protein available for the farmer's family, his associates and the community at large especially in the rural areas. Therefore, a method needed to produce more food from existing farming land in this context is integrated farming offers a possible solution.

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Table 4. Economics of Integrated fish cum duck farming and traditional fish culture practice.

Parameters	Integrated fish cum duck farming				Traditional fish farming practice			
	2016	2017	2018	Avg.	2016	2017	2018	Avg.
Total cost of production (Rs. Lakh/ha)	2.50	2.61	2.68	2.59	0.8	0.85	0.89	0.84
Mean yield of fishes(q/ha)	38.3	37.3	40.2	38.6	23.35	23.88	24.63	23.95
Income from eggs and Duck (Rs. Lakh/ha)	1.8	2.02	2.25	2.02	-	-	-	-
Gross profit(Rs. Lakh/ha).	5.63	5.75	6.27	5.88	2.33	2.38	2.46	2.39
Net returns (Rs. Lakh/ha)	3.13	3.14	3.59	3.28	1.53	1.53	1.57	1.54
Benefit Cost Ratio	2.25	2.20	2.33	2.26	1.92	1.81	1.77	1.83

Sale price of fish per kg @Rs. 100/-

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