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RESEARCH ARTICLE

Poultry cum Fish culture as an effective tool for environmentally sustainable and economically viable technology for the mid hills

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Abstract

An attempt has been made to evolve an economically viable and environmentally sustainable technology of poultry-Fish integration in mid hills. Experiment was conducted for different three fish stocking densities (2.5, 3.0, 4.0 fish/m^3) and two integration level of the poultry birds (10 and 20 chicks/100m^2) in double replication in Champawat district of Uttarakhand state. The average data for net production of fish reflected the maximum production of fish with stocking density of 3 fish/m^3 and integration of 20 chicks /100 m^2 pond area. The net return over the operational cost was calculated as 134.8%, 340.8% and 395.7 % in non-integrated pond and integrated pond with 10 chicks and 20 chicks, respectively. All parameters of physico- chemical properties of the water in above model of integrated ponds were found in permissible limits, indicates the feasibility of the conducted experiment with better economic returns and ecological efficiency in coldwater conditions

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Introduction

The aquaculture production potential of the coldwater sector has not been exploited to its fullest extent. As far as coldwater fisheries development is concerned except a few hill states like Kashmir valley and Himachal Pradesh, other mountain regions of India are still poorly developed or under exploited. Introduction of composite fish farming using Chinese carps for mid-altitudes is a major success in increasing the fish production from the hilly regions. Integrated fish farming for the hills could also an important inexpensive aquaculture practice for the rural population residing in the mountain areas of the country. Many authors have emphasized the importance of fish livestock integration in recycling of waste products, income generation and diversification of products (Sharma and Das, 1988; Radhey Shyam, 1995; Kaunhog, 1996; Sharma *et al.*, 1998 and Alam et al, 2009, Gangwar et al, 2013).

The land holding in the hill area is smaller (700-900m^2) as compared to the national average (1370 m^2). In the traditional fish culture, fish seed, Feed and fertilizer are the critical inputs and play important role in fish production. In most cases either due to unavailability or non-affordable cost of feed and fertilizer limits the fish production and income. This problem of feed and fertilizer can be mitigated by poultry droppings through integrated farming system. The integration of aquaculture with livestock offers greater efficiency in resource utilization reduces risk by diversifying crops and provides additional food, income and employment. Thus, the three major side effects of population growth which are hunger, poverty and unemployment are solved through integrated fish farming. Integrated fish farming is generally considered particularly relevant to benefit the rural poor. Nutrients from the chicken subsystem are recycled in the pond and this allows for intensification of production and income while reducing the impact, the disposal of the wastes would have had on the environment (Cota-Pierce, 2002). Direct use of livestock production wastes is one of the most widespread and conventionally recognized type of integrated fish farming and the practice increases the efficiency of both chicken farming and fish culture through the

profitable utilization of animal and feed waste products (Little and Edwards, 2003; Nnaji et al, 2009). The cost of formulated fish feed is usually about 70% of production costs (Adebowale and Olubamiwa, 2008) 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. According to Francis et al. (2004) integrated chicken-fish farming leads to better utilization of land and water resources, effective recycling of wastes, improved agricultural waste resource utilization efficiency, reduction in operational expenses usually incurred through the use of feeds and fertilizers in fish ponds and more income for small holder farmers which translates to higher living standards. This is due to the fact that about 72-79% of Nitrogen (N), 61-87% of Phosphorus (P) and 82-92% of Potassium (K) in feed given to animals are recovered in their excreta.

Nutrients requirement of fish pond which depends mainly on the nutrients status of pond soil and fish density there in, can be fulfilled by supplying needed quantity of excreta by regulating the number of poultry birds stocked with fish pond. Application of organic manure in the pond directly affects the water quality and regulates the pond productivity. Pond fertilization plays an important role in meeting nutrient deficiency as well as stimulating plankton production and functioning through autotrophic heterotrophic pathways (Bhakta et al.2004; Sahu et al 2007; Hussein 2009 and Ponce Palafox 2010). According to Banerjea (1967), the nutrient status of water and soil play the most important role in governing the production of planktonic organisms.

The present study is an attempt to evolve an economically viable and environmentally sustainable technology of poultry-Fish integration in mid hills.

Materials and methods

Study area and experiment design

The experiment was carried out for a period of 12 months in different locations of District Champawat in Uttarakhand state (80° 10' E longitude, 29° 60' N Latitude and an altitude of 1750 msal) at farmers fields. The experiment was designed for three different fish stocking densities (2.5, 3.0, 4.0 fish/m^3) and two level of poultry integration (10 and 20 nos./100m^2) in double replication. Fish seed was stocked in recommended ratio 40:30:30 (silver carp: grass carp: common carp) in all ponds. The poultry cages were fabricated with locally available bamboo or wooden splits and constructed on the dyke of the fish ponds with the proper facility of the waste drainage directly into the pond water.

Sampling and analysis

The growth of fishes in terms of weight was observed and monitored monthly. Cost and returns of production from the experimental ponds were calculated per 100m^2 area in 12 months duration. Samples of the whole day wastes were collected from the each cage during the rearing period on monthly basis. Average of the weight of all samples was calculated to estimate the average quantity of waste voided by birds in a month. The total quantity of waste recycled in the pond was computed by average quantity and numbers of rearing months. On the basis of proximate nutrients composition, the quantity of each nutrient from recycled wastes was calculated. At the end of the experiment, samples of the poultry droppings of 7 days were collected from each integrated unit and analyzed for proximate composition to know the manorial value of the poultry waste.

Results and Discussions

The average data for net production of fish reflected the maximum production of fish with stocking density of 3.0 fish/m^3 and integration of 20 chicks /m^3 pond area. The total production was found higher with the density of 3 fish/m^3 (78.05kg); having 27.86 % difference from the density 2.5 fish/m^3 (56.3 Kg) and 7.75 % higher than the density with 4 fish/m^3 (72 kg) in the integrated ponds with 20 chicks. The maximum production was found in the integrated ponds than in non-integrated ponds. It was 58.08 Kg in non- integrated ponds while it was 59.52 Kg and 68.7 Kg in ponds integrated with 10 and 20 chicks respectively.

The initial weight of the 2 weeks old chicks was recorded as 40 g. The average weight gain by the individual bird in 12 months was recorded as 2.2 kg. Hence, a net production of the poultry birds was achieved as 22 kg from the integration of 10 birds and 44 kg from the integration of 20 chicks. The feed intake of the individual birds during the entire rearing period of 12 months was 30 kg in integration of 10 birds and 60 kg in integration of 20 birds. The FCR of the poultry feed was calculated as 1.36. The poultry waste included the droppings, urine and spilled feed. On the proximate composition of the waste, 1.8% nitrogen, 1.2% phosphorus and 75% moisture was found (Table2). Hence a net quantity of 34.5kg.waste was added in the pond of 10 bird's integration and 69 kg waste

was added in the pond having 20 chicks. 0.620 kg. Nitrogen and 0.414 kg phosphorus was made available in the pond having 10 chicks through the continuous recycling of poultry waste. Similarly, 1.240 kg nitrogen and 0.828 kg phosphorus was made available in the pond having 20 chicks. Birds started egg laying after attaining the age of 22 weeks. The average production of eggs was 200 per bird up to the disposal. On average 40% bird provided the eggs. Thus the average number of eggs from integrated with 10 and 20 poultry birds were found 800 and 1600 eggs respectively. (Table 1).

The total operational cost was recorded as Rs. 3710/-, Rs. 3550/-, Rs. 4790/- for the non-integrated pond and integrated pond with 10 chicks and 20 chicks. Sharma *et al.* (1998) reported that the variable costs alone accounts for more than 85 per cent of the total cost while fixed cost constitutes nearly 15 per cent of the total cost because almost all the farmers either use their own ponds or ponds taken on lease. Among the different variable costs items, the highest average expenditure incurred on fish feed which accounted for 64.7% for the non integrated pond while it is on the zero supplementary feeding cost in integrated pond with 10 chicks and 20 chicks. Pillay (1990) found that in semi-intensive and intensive aquaculture feed accounts for about 40-60 per cent of the production cost.

Gross return was calculated according to the prevailing selling rates collected from surrounding fish markets viz., local market of Champawat district of Uttarakhand. The average rate for different fish species in local markets was Rs. 150/ kg. The total returns from the ponds were Rs. 8712/-, 15648/- and 23745/- in non-integrated pond and integrated pond with 10 chicks and 20 chicks, respectively. Net profits of fish production in the present experiment was found as Rs. 5002/-, 12098/-, and 18955/- from $100m^2$ pond area in non-integrated pond and integrated pond with 10 chicks and 20 chicks, respectively. The net return over the operational cost was calculated as 134.8%, 340.8% and 395.7 % in non-integrated pond and integrated pond with 10 chicks and 20 chicks, respectively. The cost-benefit structures of the experimental ponds are presented in Table 3-5 and fig. 1.

Borah *et al.,* 1998 studied the economic aspects of integrated Poultry-Pig-Fish farming and reported 40.5% decrease in the total variable cost with 306.7% higher net economic return in the integrated unit in comparison to non-integrated unit. Pandey& Malik (2008) calculated the net return of the integrated fish farming as Rs. 203755/- with 77.66 percent reduction in variable cost. Gangwar et al (2013) revealed that integrated poultry fish farming could be an economical viable avenue for the resource poor hill farmers for their livelihood security with an additional income of Rs 5000-6000 per annum.

The maximum benefit was recorded in improved fish management due to supplementation of feed from poultry droppings and feed wastage and involvement of no additional cost for feed. These findings reflected the feasibility of the aquaculture of exotic carps with an optimum fish stocking density of 3 fish/$m^3$and poultry integration of 20chicks/$100m^2$ fish pond area for the higher economic returns and sustainable production for the poor farmers in the mid hills.

Table1: Growth performance of Poultry birds and waste production in different stocking densities.

Parameters	**No. of chicks stocked**	
	10 nos.	20 nos.
Nos. of Chicks	10	20
Av. Initial wt. (gm)	40	40
Av. Final wt. (kg.) in 12 months	2.240	2.240
Av. Gain in wt. (kg)	2.2	2.2
Eggs production/year/bird	200	200
Total Eggs production	800	1600
Feed intake in 12 months/bird (kg)	3.0	3.0
Total feed intake (kg)	30.0	60.0
Total *Waste released (kg)	34.5	69.0

Total N recycled in pond (kg)	0.620	1.240
Total P recycled in pond (kg)	0.414	0.828

* Including droppings + urine + spilled feed

Table 2: Proximate composition of nutrients in poultry droppings (%).

Parameters	Quantity (%)
Nitrogen	1.8
Phosphorus	1.2
Moisture	75

Table 3 : Total input cost of without integrated ponds (unit area100m^2).

Components	Items	Unit	Experimental		
			kg. / No.	Rate (Rs.)	Cost (Rs.)
A. Fish	Pond preparation	-	-	LS*	300
	Lime	Kg.	20	8	160
	Carry over Seed	No.	300	1/seed	300
	Harvesting	-	-	LS	300
	Fish feed	Kg.	150	16	2400
B. Livestock	Poultry house	-	-	LS	
	Chicks	-	-	-	-
	Poultry feed	-	-	-	-
	Medicine	-	-	LS	50
	Miscellaneous	-	-	LS	200
	Total (Rs.)			3710/-	
	Income from fish sale	kg	58.08	Rs 150/kg	8712/-
	Income from egg sale	Nos.	-	Rs 3.0/egg	-
	Income from poultry meat	Kg	-	Rs 100/kg	-
	Net Income(Rs.)- 8712-3710				5002/-

*Lump sum

Table 4 : Total input cost of integrated ponds (10 chicks) (unit area 100m^2)..

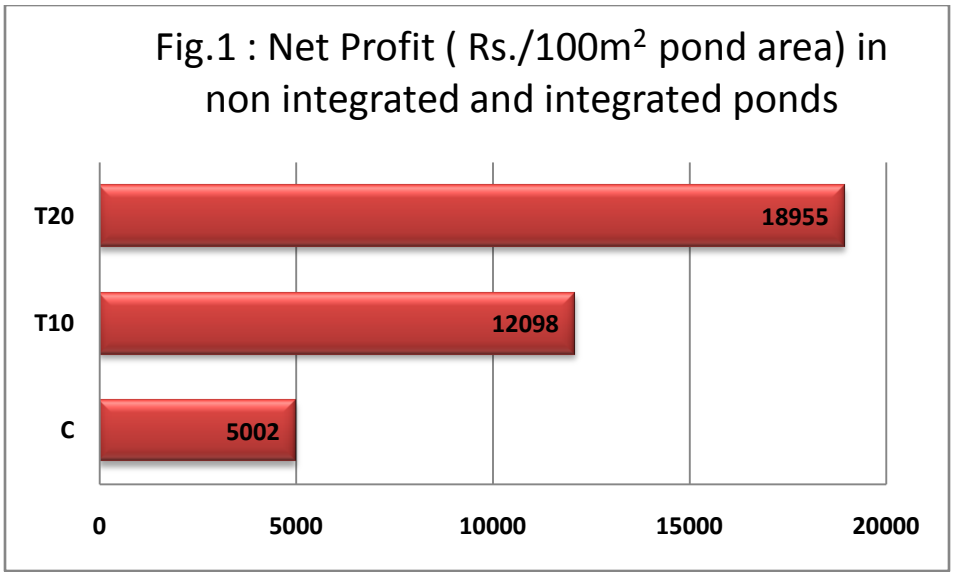
Components	Items	Unit	Experimental		
			kg. / No.	Rate (Rs.)	Cost (Rs.)
A. Fish	Pond preparation	-	-	LS*	300
	Lime	Kg.	20	8	160
	Carry over Seed	No.	300	1/seed	300
	Harvesting	-	-	LS	300
	Fish feed	Kg.	-	-	-
B. Livestock	Poultry house	-	-	LS	1000
	Chicks	No.	10	34	340
	Poultry feed	Kg	30	30	900
	Medicine	-	-	LS	50
	Miscellaneous	-	-	LS	200
	Total (Rs.)			3550/-	
	Income from fish sale	kg	59.52	Rs 150/kg	8928/-
	Income from egg sale	Nos.	800	Rs 4.0/egg	3200.00
	Income from poultry meat	Kg	22	Rs 160/kg	3520/-
	Net Income(Rs.)- 15648-3550				12098/-

*Lump sum

Table 5: Total input cost of integrated pond (20 chicks) (unit area 100m^2).

Component	Items	Unit	Experimental		
			kg. / No.	Rate (Rs.)	Cost (Rs.)
A. Fish	Pond preparation	-	-	LS*	300
	Lime	Kg.	20	8	160
	Carry over Seed	No.	300	1/seed	300
	Harvesting	-	-	LS	300
	Fish feed	Kg.	-	-	-
B. Livestock	Poultry house	-	-	LS	1000
	Chicks	No.	20	34	680
	Poultry feed	Kg	60	30	1800
	Medicine	-	-	LS	50
	Miscellaneous	-	-	LS	200
	Total (Rs.)			4790/-	
	Income from fish sale	kg	68.7	Rs 150/kg	10305/-
	Income from egg sale	Nos.	1600	Rs 4.0/egg	6400/-
	Income from poultry meat	Kg	44	Rs 160/kg	7040/-
	Net Income(Rs.)- 23745-4790				18955/-

*Lump sum



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