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RESEARCH ARTICLE

Growth performance of exotic carps in poultry waste recycled ponds

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Abstract

An attempt has been made to assess the Growth performance of exotic carps in the poultry waste recycled ponds in cold water conditions. 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 mid hills of Champawat district of Uttarakhand state. Though the growth of the individual fish was higher with less density but due to the better survival, SGR and pond condition the net fish production was higher with medium density of 3 fish/m^3. Better protein content in the fish flesh was recorded with less density and high integration. Grass carp was found with highest FCR of 3.1 followed by Silver carp (3.4) and Common carp (3.8) in the semi-temperate water of mid hills. The seasonal growth pattern was observed similar for the all tested three species with rapid growth during September-October and April-May and a stagnant growth during the winter months. The percent composition of the different species in the total production, shown the maximum contribution of grass carp (39-41%) followed by silver carp (36-37%) and common carp (23-24%) without significant difference in non- integrated and integrated ponds.

Introduction

The approach aims at gaining growth of exotic carps from small-holdings by recycling poultry waste within the farm itself. Integrated fish farming is generally considered particularly relevant to benefit the rural poor. In Asia, fish farming has been a part time activity of peasant farmers, who developed it as an efficient means of utilizing farm resources to the maximum capacity. In polyculture system several fish species are reared together in same pond that feed on different natural organisms to utilize the fish production potential of a pond. Success in composite fish culture depends largely on sustained production of fish food organisms. Commercial pond culture basically aims at achieving maximum possible rate of fish production and profit through optimum utilization of the natural food. Carps are the main output of freshwater pond aquaculture production system, which is photosynthesis dependant, most suited for poor resource farmers (Sinha,1990). India is a carp country (Dhawan,2005). Introduction of three Asiatic carps namely grass carp, silver carp and common carp in India as the component of composite fish culture has resulted in enhancing the productivity of rural aquaculture (Sinha,1973). Composite fish culture is a proven technology aimed for obtaining higher yield and return from unit area (Chand et al., 2003). The selection of stocking densities of different species along with conducive culture environment play vital roles for better growth rates of fishes ultimately leading to higher production.

In the upland waters the Indian major carps do not grow well, due to the low thermal regime. Therefore, Chinese carps may be taken as the candidate species for polyculture trials. The Chinese carp found suitable for the Mid-Himalayan region. It involved the three major Chinese carps namely grass carp, silver carp and common carp. Integrated livestock fish farming system is a proven environmentally sustainable and economically viable technology that encompasses rational utilization of available resources. Fish is the cheapest animal products when grown on wastes (Edwards, 1980). The cost of production is minimal as waste replaces the need for expensive supplementary feed. The basic principles involved in this system are the utilization of the synergetic effect of the interrelated farm activities and the conservation including the full utilization of farm wastes (Pillay, 1990). Many authors have emphasized the importance of fish livestock integration in recycling of waste products, income generation and diversification of products (Woyanarovich, 1979; Yadav, N.K., 1987; Little and Muir, 1987; Sharma and Das, 1988; Radhey Shyam, 1995; Kaunhog, 1996; Sharma *et al.,* 1998). Fang *et al.* (1994) observed the effect of animal manure protein (Chicken, duck, pig, cow) on fish yield and reported that the conversion efficiency of manure protein into fish protein was about 40% on a dry weight basis in the fish pond. Poultry fish integration is one of the excellent ways of recycling of all the organic waste efficiently in fish pond as a source of nutrients. 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 chicks stocked with pond. Integrated fish farming by recycling of poultry manure in fish pond have been reported by Sharma *et al.,* 1998; Cruz and Shehadeh 1980; Woynarovich, 1980; Sharma *et al.,* 1985; Sharma and Olaha, 1986; Sharma and Das, 1988; Gavina, 1994 and Borah *et al.,* 1998 in India and abroad. Ashwathanarayana (1979) has compared the effectiveness of poultry manure, sheep and goat manure and pig dung on carp production and found poultry and sheep manure as equally effective. Woyanarovich (1979) obtained a yield of 15-18 t/ha/year from the water treated with poultry and pig manure. Kapur (1984a) reported the 20% increase in fish yield with poultry-piggery waste combination in a ratio of 1:1 as compared to poultry waste alone.

The present study is an attempt to assess the Growth performance of exotic carps by recycling the poultry waste in the integrated ponds in the mid hills. The present study was conducted with the major objective of determining the production performance of Polyculture of exotic carps with appropriate stocking density and integration of poultry birds.

Material 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). Fish seed was stocked in recommended ratio 40:30:30 (silver carp: grass carp: common carp) in all ponds. Pond C1, C2, T1, T2 and R1, R2 were stocked with stocking density 2.5/m^3 (250 fry/100m^3). Pond C3, C4, T3, T4, R3 and R4 were stocked with stocking density 3.0/m^3 (300 fry/100m^3). Pond C5, C6, T5, T6, R5 and R6 were stocked with stocking density 4.0/m^3 (400 fry/100m^3). The control ponds (C1-C6) were without integration, while T1-T6 were integrated with10 chicks/100m^2 and R1-R6 were integrated with20 chicks /100m^2. 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 rate of fish was measured in terms of gain in length and weight. Sampling was done at monthly intervals by netting out 10 fishes of each species from each pond and length and weight of each species measured separately. Survival rate, gain in live weight, specific growth rate (SGR), feed conversion ratio (FCR), Length-weight relationship and condition factor were calculated at the end of experiment.

Result and Discussion

The on field trial was conducted on selected 18 farmer's ponds with stocking density of 2.5, 3 and 4 fish/m^3 and species combination of 40:30:30 for silver carp, grass carp and common carp. The land holding in the hill area is smaller (700-900m^2) as compared to the national average (1370 m^2). Farmers are doing fish culture in small sized ponds (50-150m^2). Ponds having uniform size (100m^2) were selected for the present study.

The growth rate and average final weight of different species in different experimental ponds (non-integrated, integrated with 10 chicks and integrated with 20 chicks) are presented in Table 1-2. At the time of stocking, the average weight of fish were 5.0-5.4 g, 6.0-6.4g and 12.0-12.6 g for silver carp, grass carp and common carp, respectively (Table 1). The average final weight at harvest time was recorded as 318.7g, 325g and 347.3g in non-integrated, integrated with 10 chicks and integrated with 20 chicks for the silver carp. Hence, the average final weight of the silver carp was recorded higher in integrated ponds with 20 chicks (Table 1). The net weight gained by individual silver carp was recorded higher with 2.5 fish/m^{3}density (325g) in non-integrated pond which was 2.5% higher than the weight in density 3 fish/m^3 (316.8g) and 8.1% higher (298.6g) from the density 4 fish/m^3, which might be due to the overstocking of the fish (Table 1).The same trend was found in integration with 10 and 20 chicks having 2.2% and 3.5 % higher weight from the density 3 and 7.3% and 11.4 % from the density 4 fish/m^3,respectively. In case of non-integrated pond, the total production of silver carp (22.7 kg/100m^3) was found higher with the density of 3 fish/ m^3, having 14.6% difference from the density 2.5 fish/m^3.Total production with density 4 fish/m^3 was also 5.5% higher from the density of 2.5 fish/m^3. In non-integrated pond (10 chicks), 6.4% difference from the density 2.5 fish/m^3 was also recorded having the highest production with density 3 fish/m^3 (21.6 kg).The survival of this species was recorded as 60, 62 and 58 % with 2.5 fish/m^3 density, 60, 56 and 70 % with 3 fish/m^3 density and 44, 41 and 48 % with 4 fish/m^3 density (Table 1). Better SGR (2.56-3.12) was recorded with less density and with high integrated rate (Table 6). Though the growth of the individual fish was higher with less density but due to the better survival, SGR and pond condition the net fish production was higher with medium density of 3 fish/m^3. Better protein content in the fish flesh was recorded with less density and high integration (Table 8). Less density reflected the better nutrition, while high integration provides the enough natural food to the growing fish. The nutritive value of the silver carp observed as 17.1-17.64% crude protein, 2.24-2.40% crude fat and 73.98-74.14% moisture content (Table 8). The data revealed that the optimum density for the growth, survival and production is 3 fish/m^3 .

Similarly, the net weight gained by Grass carp was recorded higher (454.2g) in 2.5 fish/m^3density in non-integrated pond which was 1.2 % higher than the weight in density 3 fish/m^3 (448.6g) and 5.8 % from the density 4 fish/m^3 (428.0g),which might be due to the overstocking of the fish. The same trend was found in integration with 10 and 20 chicks having 2.7% and 9.6% higher weight from the density 3 fish/m^3 (456.0g) and 4.9 % and 13.3 % from the density 4 fish/m^3(524.1g) (Table 1)). In case of non-integrated pond, the total production of Grass carp was found higher with the density of 3 fish/m^3 (25.5kg); having 17.0 % difference from the density 2.5 fish/m^3 .Total production with density 4 fish/m^3 (24.6kg) was also 12.8 % higher from the density of 2.5 fish/m^3 (21.8kg) (Table 5.14). In integrated pond(10 chicks), 20.8 % difference from the density 2.5 fish/100m^3 was also recorded having the highest production with density 3 fish/m^3 (24.9kg).Total production was also 19.9 % higher with density 4 fish/m^3(24.7kg) from the density 2.5 fish/m^3(20.6kg) .The survival of this species was recorded as 64,64 and 56 % with 2.5 fish/m^3 density, 64, 62 and 75 % with 3 fish/m^3 density and 48,48 and 55 % with 4 fish/m^3 density (Table 1). Better SGR was recorded in 2.5 fish density and in 20 chick's integration. Though, the growth of the individual fish was higher with less density but due to the better survival, SGR and pond condition the net fish production was higher with medium density of 3 fish/m^3. Better protein content in the fish flesh of grass carp was observed in integrated pond (Table 8). The data revealed that the optimum density for the growth, survival and production is 3fish/m^3.

Having the same trend of growth, survival and production, the net weight gained by individual common carp was recorded maximum (230g) in 2.5 fish/m^3density in non-integrated pond which was 8.9 % higher than the weight in density 3 fish/ m^3 and 14 % from the density 4 fish/m^3 (Table 1). The same trend was found in integration with 10 and 20 chicks having 5.2 % and 8.7 % higher weight from the density 3 fish/m^3(235.8g, 256.4g)) and 12.7 % and 15.7 % from the density 4 fish/m^3(Table 1). In case of non-integrated pond, the total production of Common carp was found maximum with the density of 3 fish/m^3 (13.7kg), having 10% difference from the density 2.5 fish/m^3. Total production with density 4 fish/m^3 (12.96kg) was also 4.3 % higher from the density of 2.5 fish/m^3. But, in integrated pond (10 chicks), the maximum production of this species was found in 4 fish/m^3 (16.2kg) with 23.7 % difference from the density 2.5 fish/m^3 (Table 1).Total production was also 7.6 % higher with density 3 fish/m^3(14.1kg) from the density 2.5 fish/m^3. Similar trend was observed in integration with 20 chicks having highest production of common carp in ponds of 3 fish/m^3 (17.5kg) with a difference of 31.6% from the density of 2.5 fish/m^3 (Table 1).The survival of this species was recorded as 72, 74 and 74 % with 2.5 fish/m^3 density, 72, 70 and 81 % with 3 fish/m^3 density and 55, 65 and 68 % with 4 fish/m^3 density (Table 1). Better SGR (1.74-2.56) was recorded with less density and with high integrated rate. The overall SGR showed by fishes pooled in experimental pond are almost similar as reported earlier by Kumar (2004). Though the growth of the individual fish was higher with less density but due to the better survival, SGR and pond condition the net fish production was higher with medium density of 3 fish/m^3 in non-integrated ponds and with 4 fish/m^3 in integrated ponds. Integrated ponds also reflected the better protein content (17.5-18.24%) in the fish flesh. As common carp is the bottom dwelling omnivorous fish, the growth and survival was recorded better in highly integrated ponds having the organic bottom deposits. The data revealed that the optimum density for the growth, survival and production of this fish is 3-4 fish/m^3. The growth data in the different non-integrated and integrated ponds and for different species showed non significant variation on the ANOVA analysis at 0.01 & 0.05 level (Table 3-5).

The average data for net production of fish reflected the maximum production of fish with stocking density of 3 fish/m^3 The net productions from the different integrated and non-integrated ponds reflected the maximum production with integration of 20 chicks /m^3 pond area (Table 2).

In a separate experiment of FCR, Grass carp was found with highest FCR of 3.1 followed by Silver carp (3.4) and Common carp(3.8) (Table 5.27).The similar results were also obtained by Pandey & Malik (2008).

On the analysis of proximate composition of feed 24% crude protein, 6 % crude fat and 12.8 % crude fiber was observed in the experimental diet. Overall high protein content (17.99±0.12%) in all carps in integrated fish ponds was reported by Pandey & Malik (2008).

The seasonal growth pattern was observed similar for the all tested three species with rapid growth during September-October and April-May and a stagnant growth during the winter months . This growth pattern may be correlated with the optimum water quality and availability of enough natural food in the form of plankton during high growth period. The period of the month of November to January is the hibernation period for the growth of these species due to the low water temperature. The silver carp shown uniform growth pattern, while common carp reflected the non uniform seasonal growth. The length of the silver carp and grass carp was uniformly increased in accordance to the body weight, but it was not shown by the common carp. The percent composition of the different species in the total production, shown the maximum contribution of grass carp (39-41%) followed by silver carp (36-37%) and common carp (23-24%) without significant difference in non-integrated and integrated ponds (Fig. 2-4).

High production trend in the experimental ponds found to be similar with the earlier reports on integrated fish farming in India and abroad (Sharma *et al.*, 1979, Cruz and Shehadeh 1980, Woynarovich 1980, Sharma and Das 1988). Such high rate of fish yield was due the application of the animal excreta, recycled in the pond, which served two most important purposes for enhancing fish yield (as direct feed and pond fertilizer) and also acted as substratum for multiplication of microbial community that provide essential nutrition for fish and fish food organisms (Newell 1980, Schroedar 1980).

Apart from this, it was observed that high percentage of survival can be achieved with healthy fish, predator free pond, favorable ecological conditions etc. Lakshmanan *et al.* (1971) and Chaudhury *et al.* (1978) stressed the importance of these factors in governing the survival. The survival was found better in low stocking density in comparison of higher stocking density.

Jena et al. (2001) and Alikunhi et al. (1971) reported the superior growth of silver carp over the other exotic and indigenous carps in polyculture system. But, in hilly climate the growth of silver carp was not in higher side probably due to the low production of phytoplankton.

Singh (2002) reported the survival of carp species in the range 67-72% in an integrated fish production practice. In integrated pond, Singh *et al.* (1972) obtained survival rate of fishes in the range of 80.0-98.9% of fishes with best survival of surface feeder fishes. The survival rates in the experimental pond of present study are comparable to the above values. Data of present study on survival reflected that the survival was less for the surface feeder fish followed by column feeder and highest for bottom feeder. The similar findings were also reported by Aravindakshan et al. (1999), Azim *et al*. (2001) and Jena *et al*. (2001).

Comparatively higher fish production @ 0.34-0.68 kg/m2 /yr (3400 to 6800 kg/ha/yr) has been harvested from the earthen ponds of Uttarakhand state located in middle Himalayan region (800-2000 msl) under transfer of technology programme of DCFR,Bhimtal. The production observed in the present study was in higher side as reported by the previous workers.

These findings reflected the feasibility of the aquaculture of exotic carps in the poultry waste recycled ponds in cold water conditions.

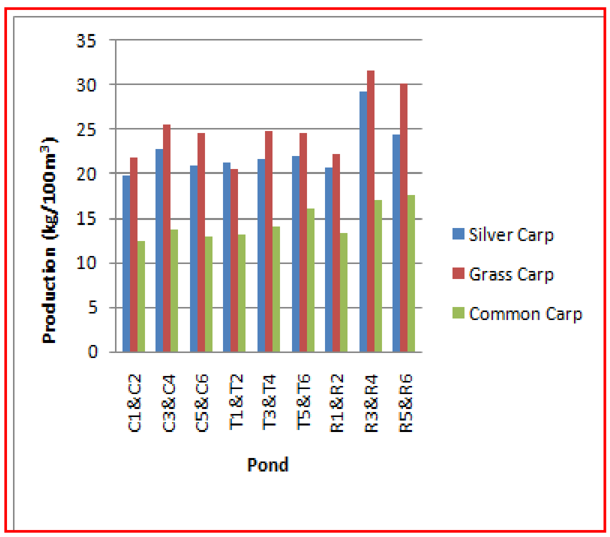


Fig.1: Production of different carp fish in non-integrated and integrated ponds

Fig.2: Species composition of net fish production in non- integrated ponds.

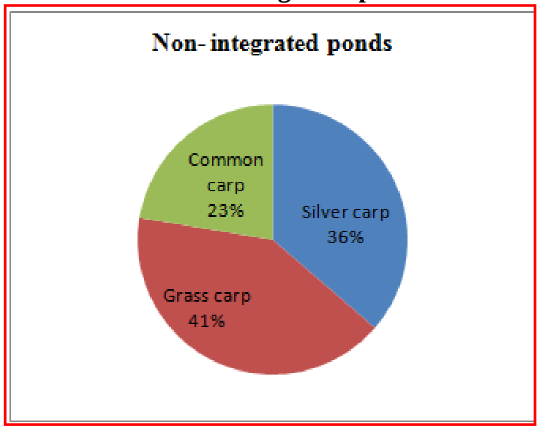


Fig.4: Species composition in net fish production in integrated ponds (20 Chicks)

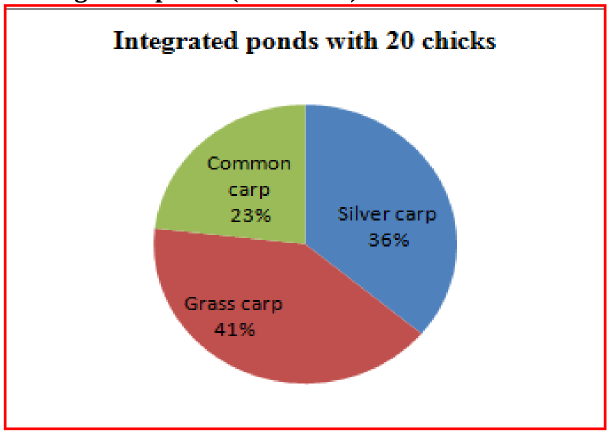
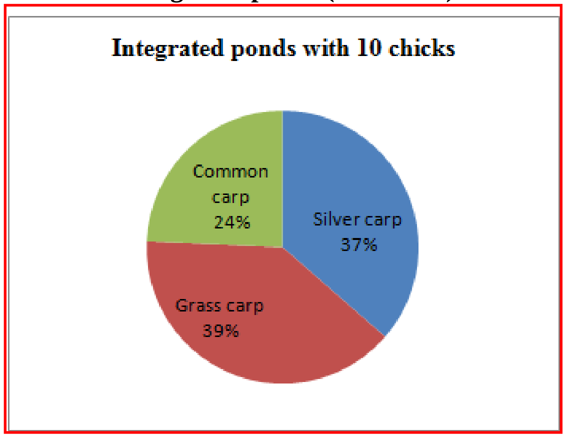


Fig.3: Species composition of net fish production in integrated ponds (10 Chicks)



Ponds/ Tanks	Fish species	Avg. initial wt. (g.)	Avg. final wt.(g.)	Avg. net wt gain(g)	Survival (%)	Production (Kg/100m^3)	Net production (Kg/100m^3)
C1&C2	Silver carp	5.0	330	325	60	19.8	54.02
	Grass carp	6.2	460.4	454.2	64	21.8	
	Common carp	12	242	230	72	12.42	
C3&C4	Silver carp	5.2	322	316.8	60	22.7	61.9
	Grass carp	6.4	455	448.6	64	25.5	
	Common carp	12.5	222	209.5	72	13.7	
C5&C6	Silver carp	5.4	304	298.6	44	20.9	58.46
	Grass carp	6.0	434	428	48	24.6	
	Common carp	12.4	210	197.6	55	12.96	
T1&T2	Silver carp	5.1	335	329.9	62	21.3	55.0
	Grass carp	6.0	462	456	64	20.6	
	Common carp	12.2	248	235.8	74	13.1	
T3&T4	Silver carp	5.3	328	322.7	56	21.6	60.6
	Grass carp	6.2	450	443.8	62	24.9	
	Common carp	12.4	236	223.6	70	14.1	
T5&T6	Silver carp	5.5	312	306.5	41	22.1	63.0

	Grass carp	6.4	440	433.6	48	24.7	
	Common carp	12.0	218	206	65	16.2	
R1&R2	Silver carp	5.2	365.2	360	58	20.8	56.3
	Grass carp	6.1	530.2	524.1	56	22.2	
	Common carp	12.0	268.4	256.4	70	13.3	
R3&R4	Silver carp	5.1	352.3	347.2	70	29.2	78.05
	Grass carp	6.4	480.4	474	75	31.75	
	Common carp	12.2	246.2	234	81	17.1	
R5&R6	Silver carp	5.4	324.4	319	48	24.5	72.0
	Grass carp	6.2	460.5	454.3	55	30.1	
	Common carp	12.6	228.8	216.2	68	17.5	

Table 1: Species wise growth performance of fish in integrated and non-integrated ponds having different fish density.

Ponds/ Tanks	Fish species	Avg. initial wt. (g.)	Avg. final wt.(g.)	Avg. net wt gain (g)	Survival (%)	Production (Kg/100m^3)	Net production (Kg/100m^3)
C	Silver carp	5.2	318.7	313.5	54.6	21.10	58.08
	Grass carp	6.2	449.8	443.6	58.7	23.96	
	Common carp	12.3	224.7	212.4	66.3	13.02	
T10	Silver carp	5.3	325	319.7	53.0	21.66	59.52
	Grass carp	6.2	450.7	444.5	58.0	23.40	
	Common carp	12.2	234	221.8	69.7	14.46	
T20	Silver carp	5.2	347.3	342.1	58.7	24.83	68.7
	Grass carp	6.2	490.4	484.2	62.0	28.00	
	Common carp	12.3	247.8	235.5	73.0	15.96	

Table 2: Species wise growth performance of fish in different integrated and non-integrated ponds.

Source of variation	S.S.	d.f.	M.S.	F-value
Treatment	27.9204	2	13.9602	0.26*
Error	1751.1502	33	53.0652	
Total	1779.0706	35		

Table 3: Analysis of variance (ANOVA) for Silver carp in non integrated and integrated (with 10 and 20 chicks) ponds of different fish density.

*non significant at 0.01 and 0.05 level.

Source of variation	S.S.	d.f.	M.S.	F-value
Treatment	28.0672	2	14.0336	0.26*
Error	1752.835	33	53.1162	
Total	1780.9022	35		

Table 4: Analysis of variance (ANOVA) for Grass carp in non integrated and integrated (with 10 and 20 chicks) ponds of different fish density.

*non significant at 0.01 and 0.05 level

Source of variation	S.S.	d.f.	M.S.	F-value
Treatment	18.8493	2	9.4247	0.71*
Error	422.411	32	13.2003	
Total	441.2604	34		

Table 5: Analysis of variance (ANOVA) for common carp in non integrated and integrated (with 10 and 20 chicks) ponds of different fish density.

*non significant at 0.01 and 0.05 level.

Ponds	SGR		
	Silver carp	Grass carp	Common carp
C1&C2	2.88	2.73	2.18
C3&C4	2.42	2.64	1.90
C5&C6	2.16	2.32	1.74
T1&T2	2.98	3.10	2.42
T3&T4	2.64	2.54	2.02
T5&T6	2.34	2.48	1.82
R1&R2	3.12	3.41	2.56
R3&R4	3.10	3.22	2.34
R5&R6	2.56	2.98	1.94

Table 6: Specific growth rate (SGR) in different fish species stocked in integrated and non-integrated fish ponds.

Ponds	Value of 'k'		
	Silver carp	Grass carp	Common carp
C1&C2	1.40	1.48	1.36
C3&C4	1.28	1.36	1.25
C5&C6	1.25	1.32	1.19
T1&T2	1.32	1.42	1.30
T3&T4	1.39	1.52	1.39
T5&T6	1.22	1.30	1.18
R1&R2	1.36	1.44	1.32
R3&R4	1.56	1.64	1.53
R5&R6	1.48	1.56	1.42

Table 7: Condition factor 'k' in different fishes stocked in experimental and control pond.

Table 8: Nutritive value (in %) of fish at the end of experiment in different fish species stocked in integrated and non integrated fish ponds.

Pond	Silver carp				Grass carp				Common carp			
	MO	CP	CF	AS	MO	CP	CF	AS	MO	CP	CF	AS
C1&C2	73.98	17.32	2.4	6.3	73.86	17.44	2.3	6.4	74.1	17.5	2.1	6.3
C3&C4	74.2	17.3	2.3	6.2	73.99	17.42	2.29	6.3	74.08	17.52	2.1	6.3
C5&C6	74.3	17.1	2.4	6.2	74.01	17.38	2.31	6.3	73.91	17.59	2.1	6.4
T1&T2	74.04	17.46	2.3	6.2	73.82	17.76	2.22	6.2	73.94	17.82	2.14	6.1
T3&T4	74.12	17.38	2.3	6.2	73.87	17.72	2.31	6.1	74.01	17.76	2.13	6.1
T5&T6	74.09	17.32	2.29	6.3	74.15	17.54	2.21	6.1	74.12	17.68	2.1	6.1
R1&R2	73.78	17.64	2.28	6.3	73.33	18.12	2.35	6.2	73.64	18.24	2.12	6.0
R3&R4	74.11	17.54	2.25	6.1	73.46	18.02	2.32	6.2	73.64	18.2	2.16	6.0
R5&R6	74.14	17.42	2.24	6.2	73.64	17.86	2.3	6.2	73.76	18.1	2.14	6.0

MO = Moisture, CP = Crude protein, CF = Crude fat, As = Ash content

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