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LARGE SCALE FISH PRODUCTION THOUGH CARP POLYCULTURE SYSTEM IN A FISH FARM IN BANGLADESH

Abstract. The aim of the study is to obtain maximum fish production per unit area within semi-intensive culture system. The duration of rearing Rui (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Common carp (*Cyprinus carpio*), Grass carp (*Ctenopharyngodon idella*) and Silver carp (*Hypophthalmichthys molitrix)* in 5 ponds (0.15 ha to 0.18 ha in size and water depth 2-2.5 m) was 8 months (March-October). All the aquatic vegetation was removed, all unwanted fish were destroyed with phostoxin. In 7 days after liming (200 kg/ha) the following fertilizers were introduced: organic (coudung at the rate of 1500 kg/ha) and chemical (urea – 50 kg/ha, TSP – 25 kg/ha). The water temperature was 28.4 ± 0.18 to 29.2 ± 0.88, pH value ranged from 6.96 ± 0.34 to 7.43 ± 0.52 and dissolved oxygen was 6.72 ± 0.22 to 7.74 ± 0.55 mg/l. In addition, fingerlings got fish flour, rice bran, wheat bran, mastered oil cake (once a day according to 4–6 % of the body weight). Sampling of fish was every 15 days. The highest average level of survival of fish was 89.2% (Rui – 91.0%), the lowest – 82.9% (carp – 78.0%). The average maximum weight was fixed in silver carp – 814.2 ± 11.8 and grass carp – 781,1 ± 11,8; the average minimum was in Rui (501.6 ± 10.8). The total volume of fish production (25 877.78 kg/ha) was higher than the average fish culture procedures followed in the rural areas of Bangladesh. Rui (1254.11 kg/ha, pond area 0.18 ha) and Mrigal (1222.22 kg/ha, pond area 0.15 ha) dominated by this parameter despite the highest values of stocking density. The obtained results confirm the efficiency of the proposed method of fish production in polyculture.

Key words: pond, polyculture, carp, growth rate, production volume.

Introduction

Bangladesh is a densely populated country of 147 570 km2 with a population of 130 million people. It is fortunate in having an extensive water resource in the form of ponds, natural depressions (haors and heels), lakes, canals, rivers and estuaries covering an area of 4.56 million ha [1].

Bangladesh is one of the world leading inland fisheries producer with a production of 1 646 819 tonnes during 2003–2004, with marine catch total of 455 601 tonnes and a total production from aquaculture of 914 752 tonnes during 2003–2004. Bangladesh's total fish production for the year totaled above 2.1 million tonnes [1]. Food and Agriculture Organization of the United Nations (FAO) [2] ranked Bangladesh as sixth largest aquaculture producing country with its estimated production of 856 956 tonnes in 2003 [2]. Aquaculture accounted for about 43.5% of the total fish production during 2003–2004, with inland open water fisheries contributed 34.8% [1].

Polyculture, the rearing of two or more species in each culture unit, enjoys wide popularity throughout much of the world [3]. Polyculture comprises different compatible species of fish of different trophic and spatial niches are raised together in the same pond to utilize all sorts of natural food available in the pond.

In Bangladesh, aquaculture production systems are mainly extensive and extended extensive, with some semi-intensive and in very few cases intensive systems. Although the culture fishery contributes over 55% of inland fish production, it covers only about 1l% of the total inland water resources. As most of the farmers are poor and living in rural area, it is not possible for them to follow the intensive technology of fish production which requires higher inputs supply. An appropriate intermediate technology for the farmers of Bangladesh, thus should be the semi-intensive culture technique which requires moderate inputs and production management based mainly on proper stocking rate and ratio and adequate manuring on a regular basis with or without supplementary feeding.

Indigenous freshwater carps (22%) and exotic carps (10%) from both the farming and capture sectors are the primary contributors to total production [4]; other freshwater fish include catfish, snakeheads and small indigenous species. However, carp polyculture in ponds is more productive, capital intensive and is a more profitable activity when compared to the other culture systems.

Materials and Methods

The experiment was carried out in five different ponds at Ratan Matsya Khamar, Netrakona, Bangladesh. Management of fish polycuture in ponds includes successive stages from pond preparation to final harvesting of fish.

Pond preparation. A pond with suitable environmental features would give higher fish production per unit area than that of a pond having adverse environmental conditions. All the aquatic vegetation (floating, submerged or emergent) was removed from the pond. The pond bottom was made even to allow effective netting and harvesting of fish. The broken pond dyke repaired. All the predatory and unwanted fishes were eradicated from the pond by using phostoxin (2 tablets/decimal). Liming of the pond was carried out at the rate of 200 kg/ha in order to neutralize the soil acidity, settles excess dissolved organic matter and make the pond free from any parasites. After 7 days of liming, ponds were manured with coudung at the rate of 1500 kg/ha. The chemical fertilizers such as urea and TSP were applied at the rate of 50 and 25 kg/ha correspondingly all over the ponds.

Species selection. Selection of compatible fast growing species was of vital importance in maximizing fish production. This was also considered that the species grows fast with accumulation of natural food. A combination of six species, viz. Rui (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Common carp (*Cyprinus carpio*), Grass carp (*Ctenopharyngodon idella*) and Silver carp (*Hypophthalmichthys molitrix).* Of these, Rui was column feeder; Catla was surface feeder; Common carp and Mrigal was bottom feeder; Grass carp was surface/column feeder and Silver carp was surface feeder.

Stocking density. Fishes were stocked in three tanks (Pond 1 – T1, Pond 2 – T2, Pond 3 – T3, Pond 4 – T4, Pond 5 – T5) by completely randomized design (CRD) (Table 1).

Table 1

Stocking densities of different fishes in five different ponds

Fish Species	Stoking densities of different fish species in five different treatments				
	T1	T2	T3	T4	T5
Rui	500	400	400	400	500
Catla	300	200	200	200	300
Mrigal	250	250	400	300	300
Common Carp	200	200	300	300	200
Grass Carp	200	150	200	200	200
Silver Carp	300	200	200	200	300
Total	1750	1400	1700	1600	1800
Pond area, ha	0.18	0.16	0.15	0.16	0.18

Supplementary feeding. After stocking of fingerlings, supplementary food (fish meal, rice bran, wheat bran, mastered oil cake and wheat flour) was applied once a day according to the 4–6% of the body weight (Table 2).

Table 2

Composition of supplementary feed with theirdry weight and percentage

Feed Ingredients	Dry weight, g	%
Wheat Bran	150	15
Rice bran	250	25
Mastered oil cake	300	30
Fish Meal	200	20
Wheat flour	100	10

Sampling of fish. Sampling of fish was done in every fifteen days to check the health condition, growth rate and mortality of the fishes. Periodic sampling of fish was done at least in a month.

Water quality parameters. Physical and chemical parameters such as water temperature (˚C), dissolved oxygen (mg/l), and pH were measured by thermometer, DO meter (DO8401) and pH meter (PH 004) respectively.

Harvesting. Final harvesting of fish was done after 6 month of stocking in tanks when the carrying capacity of tank was saturated.

Statistical analysis. Simple arithmetical tools like average, range, percentage etc. were used to tabulate the results. For analysis of treatment effects of fish production and separation of treatment means by Duncans Multiple Range Test (DMRT) were performed as per methods outlined in [5].

Results

Physical and chemical parameters: The optimum fish production depends on the physical and chemical qualities of water. The water quality parameters that were recorded during the study period are provided in Table 3.

Table 3

Average physico chemical parameters in five different ponds

Treatments	No of Estimation	Physical and chemical parameters		
		Temperature, °C	pH	Dissolved Oxygen, mg/l
T1	32	28.4 ± 0.18	6.96 ± 0.34	6.92 ± 0.52
T2	32	29.2 ± 0.88	7.25 ± 0.38	7.35 ± 0.31
T3	32	28.8 ± 0.85	7.33 ± 0.41	7.74 ± 0.55
T4	32	28.6 ± 0.65	7.35 ± 0.31	6.85 ± 0.72
T5	32	28.7 ± 0.25	7.43 ± 0.52	6.72 ± 0.22

The values of water quality parameters were within the acceptable ranges that regulate this semi-intensive culture system strongly. The water temperature was almost the same ranged from 28.4 ± 0.18 to 29.2 ± 0.88, pH value ranged from 6.96 ± 0.34 to 7.43 ± 0.52 and Dissolved Oxygen was 6.72 ± 0.22 to 7.74 ± 0.55 mg/l.

Fish Survival: During the period of investigation the survival of the fish was fairly high in all the ponds. The survival rate was estimated after the total count of the fishes at the end of the culture period. Highest survival rate was recorded in Pond 1. The survival rate of the fishes that stocked in different ponds is presented in Table 4.

Table 4

Survival rate of fishes in five different ponds

Treatments	Species Name	Stocking No.	Harvested No.	Survival, %
T1	Rui	500	455	91.0
	Catla	300	260	86.6
	Mrigal	250	220	88.0
	Common Carp	200	175	86.0
	Grass Carp	200	181	90.5
	Silver Carp	300	270	90.0
	Total	1750	1561	89.2
T2	Rui	400	341	85.2
	Catla	200	165	82.5
	Mrigal	250	213	85.2
	Common Carp	200	156	78.0
	Grass Carp	150	123	82.0
	Silver Carp	200	165	82.5
	Total	1400	1163	83.0
T3	Rui	400	320	80.0
	Catla	200	157	78.5
	Mrigal	400	359	89.7
	Common Carp	300	245	81.6
	Grass Carp	200	166	83.0
	Silver Carp	200	163	81.5
	Total	1700	1410	82.9
T4	Rui	400	343	85.7
	Catla	200	173	86.5
	Mrigal	300	241	80.3
	Common Carp	300	270	90.0
	Grass Carp	200	175	87.5
	Silver Carp	200	171	85.5
	Total	1600	1373	85.8
T5	Rui	500	440	88.0
	Catla	300	269	89.6
	Mrigal	300	257	85.6
	Common Carp	200	169	84.5
	Grass Carp	200	173	86.5
	Silver Carp	300	251	83.6
	Total	1800	1559	86.6

Fish growth and production: Observations were made on fish growth performances in terms of monthly weight gain and daily weight gain. The average cumulative weight gain of fishes for five ponds is presented in Table 5. Gross production of individual species of fish was calculated from the average final weight gain multiplied by the actual number of fish harvested. Estimation for the gross fish production in different ponds is shown in Table 6.

Table 5

Average cumulative growth performances in months in five different treatments

Species	Treat-ments	Stocking Size in March, g	Average cumulative growth performances, g						
			April	May	June	July	August	September	October
Rui	T1	18.4 ± 1.1	48.4 ± 2.9	114.0 ± 3.6	161.6 ± 3.3	223.8 ± 4.8	295.3 ± 7.3	380.8 ± 5.2	464.5 ± 7.9
	T2	20.1 ± 1.4	50.7 ± 3.9	111.0 ± 8.3	160.2 ± 7.6	225 ± 10.4	301.2 ± 10.9	384.6 ± 10.3	493.5 ± 13
	T3	20.7 ± 0.8	60.2 ± 7.0	113.0 ± 9.3	165.2 ± 8.5	230.5 ± 11	305 ± 11.6	384.6 ± 10.3	495.9 ± 12
	T4	25.0 ± 3.9	68.7 ± 9.3	121.3 ± 9.2	183.7 ± 11.6	245.3 ± 10.6	310 ± 10.3	389.1 ± 10.6	501.6 ± 10.8
	T5	24.1 ± 3.0	68.2 ± 8.8	120.3 ± 7.2	182.4 ± 9.5	242.3 ± 10.2	306.8 ± 8.8	388.1 ± 8.7	500.0 ± 9.7
Catla	T1	24.0 ± 3.0	88.8 ± 5.8	170.1 ± 3.3	249.7 ± 5.7	327.8 ± 6.7	413.8 ± 9.1	495.4 ± 6.4	576.8 ± 7.4
	T2	25.0 ± 2.0	90.3 ± 4.3	176.5 ± 6.7	256.4 ± 6.8	334.7 ± 6.9	419.1 ± 5.7	500.5 ± 8.12	578.5 ± 9.0
	T3	25.0 ± 2.0	88.5 ± 5.9	174.5 ± 8.5	254.7 ± 6.7	335.4 ± 7.4	421.0 ± 5.1	502.7 ± 10.9	582.4 ± 12.5
	T4	27.5 ± 3.9	91.4 ± 10.1	180.5 ±9.0	259.2 ± 7.3	337.1 ± 9.3	425.5 ± 7.1	503.4 ± 10.6	586.1 ± 11.4
	T5	28.8 ± 3.7	95.7 ± 9.1	187.4 ±8.5	264.2 ± 7.9	346.5 ± 11.5	430.5 ± 10.1	516.2 ± 9.5	601.4 ± 10.5
Mrigal	T1	19.1 ± 1.6	57.0 ± 5.6	128.1 ±5.3	206.8 ± 5.9	272.1 ± 5.4	360.7 ± 4.5	457.0 ± 6.8	515.4 ± 6.0
	T2	22.8 ± 1.6	75.2 ± 5.1	131.0 ±5.6	210.8 ± 7.6	278.1 ± 8.5	363.7 ± 10.3	455.5 ± 8.1	521.1 ± 9.9
	T3	21.8 ± 1.3	72.2 ± 5.5	130.7 ±5.8	212.2 ± 10.1	282.7 ± 11.0	366.0 ± 9.0	458.0 ± 8.2	524.0 ± 10.7
	T4	22.5 ± 1.9	74.5 ± 6.2	134.5 ± 9.3	215.2 ± 9.3	285.5 ± 11.3	371.7 ± 11.0	463.7 ± 8.6	526.8 ± 11.7
	T5	26.8 ± 3.2	81.0 ± 6.1	136.5 ± 9.2	219.5 ± 7.8	288.4 ± 9.7	384.7 ± 10.7	468.0 ± 8.0	537.5 ± 10.6
Common Carp	T1	22.4 ± 1.9	103.4 ± 6.1	182.0 ± 9.3	278.0 ± 13.0	345.8 ± 8.7	416.8 ± 8.7	514.8 ± 8.1	613.0 ± 12.7
	T2	21.8 ± 2.4	106.0 ± 8.6	183.0 ± 8.9	279.1 ± 11.1	347.2 ± 8.4	417.8 ± 8.6	516.2 ± 7.6	618.7 ± 14.7
	T3	23.0 ± 2.1	107.4 ± 7.9	182.2 ± 9.8	280.5 ± 10.0	345.7 ± 11.4	419.2 ± 10.6	515.2 ± 9.9	618.7 ± 10.5
	T4	23.2 ± 2.6	108.8 ± 8.8	182.8 ± 10.0	280.1 ± 9.2	351.4 ± 9.1	425.0 ± 10.4	517.4 ± 10.4	620.1 ± 10.1
	T5	24.1 ± 2.1	110.2 ± 8.9	184.0 ± 10.0	283.0 ± 10.0	362.1 ± 11.5	429.2 ± 11.4	521.7 ± 9.8	621.4 ± 10.8
Grass Carp	T1	24.7 ± 1.9	111.5 ± 6.8	265.4 ±12.7	342.7 ± 10.3	467.4 ± 8.1	571.0 ± 9.4	676.0 ± 12.1	781.1 ± 11.8
	T2	23.4 ± 2.0	114.5 ± 9.2	267.0 ± 11.3	344.2 ± 11.8	470.2 ± 8.5	572.1 ± 9.7	675.5 ± 11.6	774.4 ± 10.8
	T3	24.2 ± 1.3	112.1 ± 8.2	265.5 ± 9.5	342.8 ± 10.0	467.0 ± 8.7	571.5 ± 10.5	672.7 ± 9.8	775.8 ± 11.1
	T4	25.0 ± 2.1	114.0 ± 8.3	266.7 ± 9.2	345.2 ± 11.4	469.5 ± 9.05	576.4 ± 9.2	673.2 ± 8.7	775.1 ± 10.5
	T5	26.1 ± 2.4	115.0 ± 8.5	265.7 ± 11.4	344.1 ± 10.0	466.7 ± 8.2	574.8 ± 8.0	670.0 ± 7.9	773.0 ± 9.7
Silver Carp	T1	32.0 ± 2.7	132.5 ± 5.8	284.4 ± 7.1	375.0 ± 7.6	492.1 ± 10.0	604.8 ± 14.2	715.0 ± 12.2	810.0 ± 14.5
	T2	33.0 ± 2.3	138.4 ± 6.1	280.0 ± 8.2	379.2 ± 7.9	502.1 ± 15.8	613.4 ± 13.6	720.4 ± 13.8	814.2 ± 11.8
	T3	32.0 ± 1.9	139.7 ± 8.2	279.0 ± 8.8	382.8 ± 11.9	513.2 ± 11.7	616.4 ± 12.1	722.0 ± 10.7	812.8 ± 10.0
	T4	32.8 ± 2.1	141.1 ± 9.1	285.2 ± 9.7	386.8 ± 11.3	517.5 ± 9.3	620.5 ± 9.5	723.5 ± 10.3	814.2 ± 10.6
	T5	31.2 ± 1.8	136.8 ± 9.1	272.7 ± 9.2	375.7 ± 10.5	499.7 ± 10.5	607.8 ± 9.7	704.4 ± 9.6	795.0 ± 11.9

Table 6

Gross production of fishes in five different treatments

Species Name	Treatments	Fish stocking No.	No. of Survival	Initial weight, g	Final weight, g	Gross Production, kg	Area of pond, ha	Gross production, kg/ha/crop
Rui	T1	500	455	18.4	464.5	211.35	0.18	1174.15
	T2	400	341	20.1	493.5	168.28	0.16	1051.77
	T3	400	320	20.7	495.9	158.69	0.15	1057.92
	T4	400	343	25.0	501.6	172.05	0.16	1075.31
	T5	500	440	24.1	500.0	220.00	0.18	1222.22
Catla	T1	300	260	24.0	576.8	149.97	0.18	833.16
	T2	200	165	25.0	578.5	95.45	0.16	596.58
	T3	200	157	25.0	582.1	91.39	0.15	609.26
	T4	200	173	27.5	586.1	101.40	0.16	633.72
	T5	300	269	28.8	601.4	161.78	0.18	898.76
Mrigal	T1	250	220	19.1	515.4	113.39	0.18	629.93
	T2	250	213	22.8	521.1	110.99	0.16	693.71
	T3	400	359	21.8	524.0	188.12	0.15	1254.11
	T4	300	241	22.5	526.8	126.96	0.16	793.49
	T5	300	257	26.8	537.5	138.14	0.18	767.43

Continued table 6

Gross production of fishes in five different treatments

Species Name	Treatments	Fish stocking No.	No. of Survival	Initial weight, g	Final weight, g	Gross Production, kg	Area of pond, ha	Gross production, kg/ha/crop
Common Carp	T1	200	175	22.4	613.0	107.28	0.18	595.97
	T2	200	156	21.8	618.7	96.52	0.16	603.23
	T3	300	245	23.0	618.7	151.58	0.15	1010.54
	T4	300	270	23.2	620.1	167.43	0.16	1046.42
	T5	200	169	24.1	621.4	105.02	0.18	583.43
Grass Carp	T1	200	181	24.7	781.1	141.38	0.18	785.44
	T2	150	123	23.4	774.4	95.25	0.16	595.32
	T3	200	166	24.2	775.8	128.78	0.15	858.55
	T4	200	175	25.0	775.1	135.64	0.16	847.77
	T5	200	173	26.1	773.0	133.73	0.18	742.94
Silver Carp	T1	300	270	32.0	810.0	218.70	0.18	1215.00
	T2	200	165	33.0	814.2	134.34	0.16	839.64
	T3	200	163	32.0	812.8	132.49	0.15	883.24
	T4	200	171	32.8	814.2	139.23	0.16	870.18
	T5	300	251	31.2	795.0	199.55	0.18	1108.58
							Total	25877.78

Due to availability of the supplementary food the fishes are increased in body weight enormously. All of six species attained an average maximum weight at the last month of the study period (Table 5) in five different ponds. Silver carp attained the maximum weight 810.0 ± 14.5, 814.2 ± 11.8, 812.8 ± 10.0, 814.2 ± 10.6 and 795.0 ± 11.9 g in five ponds respectively. Grass carp also followed by the silver carp that gained their weight 781.1 ± 11.8, 774.4 ± 10.8, 775.8 ± 11.1, 775.1 ± 10.5 and 773. 0 ± 9.7 g in Pond 1, Pond 2, Pond 3, Pond 4 and Pond 5 respectively. Rui gained their maximum weight (501.6 ± 10.8) in Pond 4. Catla, Mrigal and Common Carp gained their maximum weight 601.4 ± 10.5, 537.5 ± 10.6 and 621.4 ± 10.8 g respectively in the same pond (Pond 5). This also noted that in the Pond 5 silver carp comparatively gained minimum weight where Catla gained their maximum weight.

Discussion

The average growth of Rui (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Common carp (*Cyprinus carpio*), Grass carp (*Ctenopharyngodon idella*) and Silver carp (*Hypophthalmichthys molitrix*) were observed in all five ponds. The average cumulative growth increment of fishes showed that fishes gained their weight significantly with the months. In this semi-intensive pond culture system, due to availability of natural food the fishes were fed actively and gained their weight very quickly. Davis et al. [6] observed that slow growth of fishes due to less feeding activity during fish growth study. Observations made on the five ponds clearly indicate that silver carp exhibited better growth than other species. But the growth rate of grass carp also followed by the silver carp and the growth rate of common carp is closer to the grass carp. This indicates that the growth rate of the exotic carps is higher than any other fish species. Jhingran [7] reported about the superiority of growth performances by silver carp. In the water quality parameter, the recorded water temperature (28.4 ± 0.18 to 29.2 ± 0.88) was favorable for active growth and feeding of fishes because water temperature affects the feeding pattern and growth of fish. The range of pH and dissolved oxygen was also in normal condition that affected the growth of the fishes positively. From the investigation, it is found that the production of fish is high and rather satisfactory. DoF [8] reported that Carp production from trial and experimental ponds was 2000 kg/ha/yr.

Conclusion

Polyculture is an effective way to maximize benefit from available natural food in a pond. The possibilities of increasing fish production per unit area, through polyculture, are considerable. Growth rate of these carps in semi intensive culture system was higher than we observed. The productivity, growth and survivability of the fishes in the pond environment were notable. The present study disclosed that the production of the ponds was higher than the average fish culture procedures followed in the rural areas of Bangladesh. This indicates that the feed and fertilizers used were adjusted according to the body weight.

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КРУПНОМАСШТАБНОЕ ПРОИЗВОДСТВО КАРПОВЫХ В ПОЛИКУЛЬТУРЕ В РЫБНОМ ХОЗЯЙСТВЕ РЕСПУБЛИКИ БАНГЛАДЕШ

Цель исследования – получение максимального количества рыбы на единицу площади в рамках полуинтенсивной системы культуры. Продолжительность выращивания в 5 прудах (площадь – 0,15–0,18 га, глубина – 2,0–2,5 м): роху (*Labeo rohita*), катли (*Catla catla*), индийского карпа (*Cirrhinus mrigala*), карпа (*Cyprinus carpio*), белого амура (*Ctenopharyngodon idella*) и белого толстолобика (*Hypophthalmichthys molitrix*) – 8 месяцев (март – октябрь). Из прудов была удалена вся водная растительность, фостоксином уничтожены все нежелательные рыбы. Через 7 дней после известкования (200 кг/га) вносились удобрения: органические (навоз – 1500 кг/га) и химические (мочевина – 50 кг/га, тройной суперфосфат – 25 кг/га). Температура воды составляла 28,4 ± 0,18 – 29,2 ± 0,88 °С; pH – 6,96 ± 0,34 – 7,43 ± 0,52; содержание растворенного в воде кислорода – 6,72 ± 0,22–7,74 ± 0,55 мг/л. Дополнительно молодь получала рыбную муку, рисовые отруби, пшеничные отруби, льняной жмых (один раз в день по 4–6 % от массы тела). Отбор проб проводился каждые 15 дней. Самый высокий средний уровень выживаемости рыб – 89,2 % (у роху – 91,0 %), самый низкий – 82,9 % (у карпа – 78,0 %). Средний максимальный вес отмечен у толстолобика – 814,2 ± 11,8 и белого амура – 781,1 ± 11,8 г; средний минимальный – у роху – 501,6 ± 10,8 г. Общий объем производства рыбы (25 877,78 кг/га) был выше, чем в среднем по рыбоводным хозяйствам Бангладеш. Доминировали по этому показателю роху (1254,11 кг/га, площадь пруда 0,18 га) и индийский карп (1222,22 кг/га, площадь пруда 0,15 га), несмотря на самые высокие значения плотности посадки. Полученные данные подтверждают результативность предлагаемого способа производства рыбы в поликультуре.

Ключевые слова: пруд, поликультура, карповые, темпы роста, объем производства.

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