Nutrition & Food Science
International Journal
ISSN 2474-767X

Juniper Publishers
key to the Researchers

Research Article
Volume 11 Issue 3 - January 2022
DOI: 10.19080/NFSIJ.2022.11.555812

Nutri Food Sci Int J

Impacts of Training to Member of Society on Production of Freshwater Prawn and Carps Polyculture using Feed in Rural Areas of Kashiganj in Mymensingh

M Ahsan B Habib[1]*, Maisha F Orpa[1], Khoshnur Y Ratna[1] and MA Satter[2]

[1]*Department of Aquaculture, Bangladesh Agricultural University, Bangladesh*

[2]*Department of Aquacultyre, Bangamata Sheikh Fajilatunnesa Mujib Science & Technology University, Bangladesh*

Submission: October 02, 2021; **Published:** January 28, 2022

***Corresponding author:** M Ahsan B Habib, Department of Aquaculture, Bangladesh Agricultural University, Bangladesh

Abstract

A society of 58 farmers in Kashiganj of Phulpur upazila in Mymensingh district cultured carps and giant freshwater prawn in 59 ponds where 45 people produced carp fishes in 50 ponds, and five farmers with other eight members cultured carps-prawn-poultry polyculture in nine ponds for about nine months. The members of the society received training and technical assistance for polyculture. The fry @ 20000/ acre of prawn and carps such as catla, rohu, mrigal, silver carp, mirror carp and silver barb were released in March 2016. The fry of prawn was released with carps in nine ponds in one village – Biska (L05) only. The water quality parameters and pond bottom soil properties were within the productive ranges. Formulated feed (30% protein) used to feed prawn two times daily, and supplementary feed (15% protein) was used to feed carps two times daily and feeds were adjusted fortnightly. Farmers started to harvest prawn (100-150g) and carps (0.80-2.10kg) and silver barb (150-200g) from middle of October up to the end of November. The crude protein of prawn was higher than mirror carp followed by rohu, catla, silver carp and silver barb. The estimated yearly production of carps, prawn of 59 ponds (approximately 35 acres) and poultry birds was about 30 ton which was about six times higher than the past from 59 ponds. Physico-chemical and biological properties of water, and feed had significantly combined effects and percentage contribution (MR2) on the growth and production of prawn (MR2 = 50.84%), and different species of fishes such as catla (MR2 = 80.28%), rohu (MR2 = 69.22%), mrigal (MR2 = 58.52%), silver carp (MR2 = 72.93%), mirror carp (MR2 = 61.62%) and silver barb (MR2 = 55.80%). These factors had almost positively linear correlation with prawn and different species of fishes. The increased production was due to use of fertilizer, feed and proper care taken by owners and the members of the society. Five farmers produced 1000 poultry birds in two lots from five farms which established by the side of ponds. Pond owners shared the benefits with the society at the ratio of 50:50 and kept for the welfare of the society.

Keywords: Training, Society; Water properties; Prawn; Carps; Combined effects; Correlation

Introduction

Fish production through aquaculture practice is a blooming industry in Bangladesh [1,2]. Most of the people are now trying hard to culture and to produce good amount of fish from their own land. They have been even converting rice fields into culture ponds to get more benefits than rice production since around early 90's [1,3,4]. Now because of this practice, fish production through aquaculture is increased in many folds and people are getting fish many times more than natural habitats. Due to mainly over exploitation and insufficient recruitment of fingerlings, natural production of open water fisheries such as rivers, reservoirs, ox-bow lakes (haor, baor), natural depressions (beel) are gradually decreasing [5,6] as a result scarcity of fishes became dominant. It was assumed that aquaculture practice is only the way to produce fish to minimize the increasing demand of fish for people of the country [6,7]. Government of Bangladesh is trying hard to grow fish following several ways and to alleviate poverty of poor fishers and producers through polyculture [5,8]. Some NGOs already had started working to facilitate the activities of fish farmers for better production of integrated production of carps, prawn, shrimp, poultry in the country and getting very good output in rural areas through active participation of members of the society [2,8-10].

The society members are working to produce carps, prawn, poultry and rice though fish cum shrimp farming, fish cum prawn farming, fish cum prawn cum poultry farming, paddy

cum fish culture etc. in the country. Day by day the cooperation of NGOs have been increasing through training in many folds in different fields of culture such as pond preparation, fertilization, fry rearing, and prawn, shrimp and fish culture, and technical assistance to record of environmental parameters, harvesting and marketing etc. An NGO, Agro-Based Industries and Technical Development Project-Phase II (ATDP-II), Dhaka has been working hard to develop fisheries sector in the country. Therefore, ATDP II selected Kashiganj under Phulpur upazila of Mymensingh district to train the members of society named as Gaint Freshwater Shrimp and Fish Farmer Cooperative Society Ltd., Kashiganj, Mymensingh. To facilitate the activities of the society, technical support and other scientific ideas were given by the Consultant through close supervision and training. Therefore, the present work was undertaken to study and to report on enhancement of production and yield of shrimp and carp fishes using fertilizer and feed in ponds in the area of Kashiganj of Mymensingh district through community participation.

Materials and Methods

A society of 58 members of five villages of Kashiganj under upazila of Phulpur of Mymensingh district was taken all the measures to produce fish and prawn using polyculture technique through aquaculture practice in 59 ponds with the technical help and training of Agro-Based Industries and Technology Development Project II (ATDP-II), Dhaka. The ATDP-II first formed the society in the area of Kashiganj named as Gaint Shrimp and Fish Farmer Cooperative Society Ltd., Kashiganj, Mymensingh. The members of the society received training and technical assistances for polyculture of golda chingri (gaint freshwater prawn) and carp fishes (plankton feeder fishes) from ATDP-II. Five farmers practiced fish cum prawn cum poultry polyculture in their land. The ponds of the area were first surveyed and village-wise arranged for the sake of work.

In dry season (December-January), the ponds were first limed @ 0.50 kg/dec and then embankment was repaired. The entrance of fish through inlet and escape of fish through outlets were controlled by nylon net with small mesh supported by bamboo made fence locally known as 'Bana'. Excess water was drained through outlet when necessary arose. The average water depth of pond was ranged from 1.0 to 1.50 m. The ponds were fertilized with urea and triple super phosphate (TSP) @ 1.0 kg/dec each to facilitate the production of live food organisms. Then after seven days, a total of 20000 fry/acre of 1.5-2 g PL40 of gaint freshwater prawn (*Macrobrachium rosenbergii*, Palaemonidae) and fry of 10-15 g of six species of carps such as catla (*Catla catla*, Cyprinidae), rohu (*Labeo rohita*, Cyprinidae), mrigal (*Cirrhina mrigala*, Cyprinidae), silver carp (*Hypophthalmichthys molitrix*, Cyprinidae), mirror (common) carp (*Cyprinus carpio*, Cyprinidae) and rajputi (*Puntius gonionatus*, Cyprinidae) (fry 3-4 g) at the ratio of 3:2:4:2:2:4:2 per acre were released in ponds of one village (Biska, L05) where poultry birds were farmed nearby ponds. Poultry manure was used as biofertilizer and feed for them. Same number of fry of carps were released in ponds of other four villages at the ratio of 3:4:3:3:4:2 per acre. The urea and TSP were used fortnightly up to September. Supplementary feed (15% protein) prepared with mixture of mustard oil cake (10% protein) and rice bran (5% protein), and formulated feed (30% protein) used to feed carp fishes, and prawn cum carps cum poultry birds polyculture system were used to feed twice daily at the rate of 1.50% body weight of cultured species. Feed was adjusted every fortnight after weighing 10% culture spcies of the stock. The harvesting of carps and prawn was started periodically from middle of September up to the end of November of the same year. Growth of plankton as natural food organisms of ponds was monitored.

Hand on training

The ponds of the farmers were first surveyed and the areas for improvement were identified. The members of the society, young men of the area involved in polyculture and skilled labourers were trained for different aspects of pond culture and management. Training was given how to prepare ponds for culture after drying, to release fry in ponds after carrying from nursery, use of decomposed cow dung, and poultry waste (litter). They were also trained how to measure water depth, water temperature, water transparency (secchi disc reading), water colour, pH, dissolved oxygen, to collect mud (bottom soil) of ponds and to prepare mud samples for analysis, to observe plankton growth, to grow plankton in ponds as live food for fishes, fry weighing, to minimize oxygen deficiency using lime and cut pieces of banana trees etc. in pond. They were trained to manage all the works of society including handling of money for common purpose like purchase of prawn fry from nursery far away from the society area and feed ingredients from local market. Training was given how to identify inbreeded fry produced from the same stock, market assessment, and how to send caught fishes quickly to the market for getting good market value. They were also trained to maintain the healthy atmosphere of ponds to culture carp fishes and prawn. A list of optimum ranges of some important physico-chemical environmental factors of water with tolerable levels were presented (Table 1) so that the farmers (owners) and society members could understand the quality of water.

Physico-chemical properties of water

Physico-chemical properties of water were analyzed following the standard methods [11]. For convenience, samples were collected from five locations of each of five villages. These properties of water were analyzed by using different chemicals and equipments at the spot and in the laboratory. The properties of water such as water temperature, water depth, water transparency, water colour, turbidity, pH, dissolved O_2, alkalinity, Nitrate-N, and ortho-P were analyzed. Water colour of ponds was recorded by eye estimation. Temperature (°C) and dissolved O_2 (mg/L) of water were determined by Digital Oxygen meter (HANNA instruments model: HI-9142) and digital meter (HEQEP CP 6014 G2). Depth

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of water (m) by graduated pole and transparency of water (cm) by secchi disc were measured. Turbidity (mg/L) was measured by turbidity meter. pH of water was measured by a digital pH meter (HANNA instruments, Model: HI 8314). Alkalinity of water (mg/L) was estimated using alkalinity meter after chemical treatment. Nitrate-N (mg/L) was determined after filtration of 100 ml water through glass microfilter paper using Nitrogen-5 powder pillow and then direct reading from Spectrophotometer DR 2010. Similarly Phosphate-P (mg/L) was determined from filtered water using reagent pillow Phosver-3 and then direct reading from Spectrophotometer DR 2010.

Table 1: Average physico-chemical properties of bottom soil samples of five villages.

Parameters	L01	L02	L03	L04	L05
Texture	Sandy clay	Sandy clay	Sandy clay	Sandy clay	Sandy clay
pH	7.4	7.4	6.7	7.4	7.5
Organic carbon (%)	0.58	0.47	0.67	0.4	0.58
Total N (%)	0.27	0.3	0.26	0.35	0.28
Ortho-PO_4 (ppm)	10	11	12	11	10

Estimation of chlorophyll a of phytoplankton (Clesceri et al. 1989)

Fifty ml of phytoplankton sample was filtered with an electric filtration unit using microfilter paper (Sartorius filter paper of 0.45 µm mesh size and 47 mm). These filtered samples together with filter paper were taken into test tubes, ground with glass rod and finally mixed with 10 ml of 100% redistilled acetone. Each of the test tubes was wrapped with aluminium foil to inhibit penetration of light. The wrapped test tubes were kept into a refrigerator over night. Then the refrigerated samples were homogenized for 2 minutes followed by centrifugation at 4000 rpm for 10 minutes. After centrifugation, the supernatant was separated and taken for chlorophyll a estimation. Optical densities of the samples were recorded at 664, 647 and 630 nm by using UV spectrophotometer (Spectronic 1001 plus). A blank with 100% acetone was run simultaneously. Chlorophyll a content was calculated by the following formula:

$$\text{Chlorophyll a (mg/L)} = 11.85\ (OD\ 664) - 1.54\ (OD\ 647) - 0.08\ (OD\ 630)$$

Collection and identification of plankton

Plankton (phytoplankton and zooplankton) were collected using three consecutive plankton nets of different mesh sizes (10, 30 and 70 µm) arranged in downward direction. The end of each net was tied with plastic tube so that the filtrate finally collected in tube. The downward direction meant that the net of mesh size 70 µm was placed in side the net of mesh size 30 µm and then these two nets were placed in side the net of mesh size 10 µm. Three nets were arranged in such a way that water passed through all the nets and final filtrates were collected in the tubes attached at the end of each net. About 10 L of water was filtered from each sampling station. The sample collected from three tubes was preserved in 6% buffered formalin (mixture of 6 ml conc. formalin; 4.0 g NaH_2PO_4 {Sodium biphosphate, monobasic} H_2O; 6.50 Na_2PO_4 {Sodium monophosphate, dibasic} and volume was made 100 ml with distilled water) in 100 ml vial and carried to the laboratory for identification. From vial, 1.0 ml sample was taken by pipette and put in the groove of Sedgwick Rafter counting chamber (SR cell) of one ml capacity and organisms were counted as outlined by [12] under microscope. Plankton was identified to the levels of genera where possible in accordance with the procedures given by [13-21]. Phytoplankton was identified as harmful phytoplankton (blue-green algae) and beneficial phytoplankton (green and yellow green algae).

Chemical analysis of bottom soil of ponds

Bottom soil (mud) of ponds from five locations of each village were collected. Bottom mud samples were air dried in the room. Texture of bottom soil was determined after treatment of dry soil with 5% calgon solution using hydrometer. pH of sample (soil: distilled/deionized water suspension = 1:10) was measured by a digital pH meter (HANNA instruments, Model: HI 8314). Organic carbon was calculated following wet oxidation method. Total N was analyzed by Microkjeldahl method. Ortho-P was determined after extraction of sample with 0.5 M $NaHCO_3$ and then direct reading using UV Spectrophotometer.

Analysis of supplemental feed

The used supplemental feed containing 15% protein prepared from mustard oil cake and rice bran as sources of total protein. A feed mill prepared diet contained 30% protein for shrimp was bought from market. Feed was analyzed for proximate composition [22] such as moisture, total protein, total lipids, ash, nitrogen free extract (NFE) and crude fibre in the laboratory of Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Collection and identification of fishes

Fishes other than the cultured species entered in ponds with fry of cultured species when purchased and with rainwater from outside were collected from the fishers during harvest

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of carps. Fishers caught fishes by sein net and cast net during sampling. Fishes were identified at the spot as far as possible and unidentified fishes were preserved in buffered formalin. These preserved fishes were carried to the laboratory of Department of Aquaculture, BAU, Mymensingh for identification. These fishes were identified upto species level using their morphometric characters with help of keys given by [23-26].

Statistical analyses

The growth and production of fishes depended on many factors which were worked as independent factors. These independent factors (xi) were physico-chemical factors of water, live foods (Plankton), feed had combined (multiple) effects on dependent factors (yi) such as the growth and production of prawn and different fishes. The effects may vary from one fish to another. The independent and dependent factors are as follows:

Independent factors were: Water temperature (x1), water transparency (x2), water depth (x3), TSS (x4), TDS (x5), pH (x6), dissolved O2 (x7), alkalinity (x8), nitrate-N (x9), ortho-P (x10), chlorophyll a (x11), beneficial algae (x12), zooplankton (x13), benthos (x14) and feed (x15);

Where, dependent factors (Prawn and fishes) were: Prawn (y1), catla (y2), rohu (y3), mrigal (y4), silver carp (y5), mirror carp (y6) and sorpunti (y7).

The equation of multiple correlation, yi = a0 ± a1x1 ± a2x2 ± a3x3 ± a4x4……..a14x14

The equation of linear correlation, yi = a0 ± aixi

Cost-benefit analysis

It was done following simple calculation at the end of the experiment. Cost of feed, fry and fertilizers, and sell value of carp fishes, shrimp and poultry birds were taken into account for calculation of cost-benefit analysis.

Results and Discussion

Overall presentation of the area and available ingredients

There were 59 ponds covered an area of 35 acres in five villages in the selected area of Kashiganj under Mymensingh district (Table 2). Among these ponds, 15 (9.50 acres) located in Shuvoliapara village, 12 (7.50 acres) located in Ghojoharpur, 12 (7 acres) in Sonura, 11 (6 acres) in Ghituari and 9 (5 acres) in Biska. The average size of pond varied from 25 to 150 dec. This size represents almost all the ponds in rural areas in the country which has the similarity with the findings of [2,27]. There were about 14 ingredients available in the local market of the area where fishers and growers used these ingredients to prepare feed for prawn, carp and poultry (Table 3). These ingredients were fish meal, fish scrap meal, rice bran, rice polish, wheat bran, maize bran, wheat flour, mustard oil cake, soyabean cake meal, lintel cake meal, groundnut cake meal, shark liver oil and molasses which are almost similar with the findings of [5-7]. Among these ingredients, fish meal, fish scrap meal, mustard oil cake, soyabean cake meal, lintel cake meal and groundnut cake meal contained high total protein, total lipids and ash (minerals). Rice bran, rice polish, wheat bran, maize meal, wheat flour, chopra cake meal and molasses contained high carbohydrate (nitrogen free extract, NFE). Shark liver oil contained very high total lipids (86-90%). These ingredients contained reasonable amount of different composition which has the similarity with the findings of [10,28]. Mostly the feeds used were prepared from these ingredients. After analysis of proximate composition in the laboratory, it was found that the artificial feed for prawn and carps contained 30.15% protein where the supplemental feed contained 14.60% protein for carps (Table 4) which were suitable recommended levels [8,10,28].

Table 2: Distribution of ponds of five villages in the area.

Number of pond & area	Village					
	Shuvoliapara (L01)	Ghojoharpur (L02)	Sonura (L03)	Ghituari (L04)	Biska (L05)	Total
No. of pond	15	12	12	11	9	59
Area (dec)	30-150	30-140	30-140	30-130	25-150	
No. of culture pond	4	3	3	3	3	16
Area (dec)	33-90	30-66	30-66	30-70	25-80	
No. of stocking pond	11	97	9	8	7	43
Area (dec)	30-150	33-140	33-140	30-130	40-150	
Total area (acre)	9.5	7.5	7	6	5	35

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Table 3: Proximate composition (%) and price of available ingredients in local market.

Ingredients	Moisture	Total protein	Total lipid	Ash	NFE*	Approximate price (Tk)
Fish meal	12-Oct	58-62	13-15	15-17	2-3	40-45
Fish scrap meal	12-Nov	40-50	16-Dec	16-18	4-5	20-30
Rice bran	7-9	13-Dec	5-7	12-Oct	55-62	3-4
Rice polish	7-8	14-16	15-Nov	9-11	48-55	5-6
Wheat bran	8-10	14-Dec	5-7	7-9	52-58	4-5
Maize meal	7-9	17-20	6-8	8-10	45-48	7-8
Wheat flour	7-9	14-16	4-6	6-9	47-50	22-25
Mustard oil cake meal	9-10	34-36	5-7	13-Oct	29-33	6-8
Soyabean cake meal	8-10	45-46	4-6	12-Oct	24-28	5-7
Lintel cake meal	8-10	44-46	5-6	13-Nov	25-29	6-7
Groundnut cake meal	12-Oct	27-30	8-10	14-Oct	31-33	5-6
Chopra cake meal	14-20	13-16	7-10	6-8	40-45	3-4
Shark liver oil	0.7-0.8	2-3	86-90	4-6	-	30-35
Molasses	30-37	1-2	0.4-0.8	1-2	55-60	2-3

Source: *NFE = Nitrogen Free Extract.

Table 4: Proximate composition of giant freshwater prawn and carp fish feeds used for feeding in the area of Kashiganj of Mymensingh district.

Proximate composition (%)	Feed of prawn	Feed of fish
Moisture	12.57	9.6
Total protein	30.15	14.6
Total lipids	7.55	8.16
Ash	11.2	15.23
Nitrogen free extract (NFE)*	30.7	33.7
Crude fibre	7.93	10.29

Source: *Nitrogen Free Extract = 100 – (Moisture + crude protein + crude lipid + ash + crude fibre).

Water and bottom soil properties, and plankton of ponds

Water samples of ponds from four locations of each village were collected to record physico-chemical environmental parameters of water (Table 5). All the water qualities, phytoplankton & zooplankton production ranges and fish production has the similarities with the findings of [29,30]. Temperature was ranged from 27.40 to 30.90 °C during the period. Turbidity was ranged from 10 to 58 mg/L. The pH of water was found within the alkaline range which was favourable for plankton growth and fish culture. Dissolved oxygen, Nitrate-N and ortho-P of water of ponds were within the suitable ranges of good quality pond water. It was found that chlorophyll a content of phytoplankton of both beneficial and harmful algae was ranged from 47.60 to 57.10µg/L which was recorded as poor amount in ponds might be due to grazing by carps and prawn. Most of the ponds of carps contained more beneficial algae than harmful ones, but prawn and carps cultured ponds in village Biska (L05) contained lesser amount beneficial algae than harmful ones (Table 5 & 6). Shrimp and carps grazed more on beneficial algae which ultimately reduced beneficial algae in ponds of L05 though released and naturally available fishes fed on algae in all the ponds. Only culture ponds were greenish in colour more than stocking ponds. Zooplankton was also found in lesser number in ponds with carps and carps than ponds with only carps which indicate that prawn and carps fed more on zooplankton than ponds with only carps. It was observed that the smell of decomposed feed was coming out from some ponds otherwise the ponds were almost free from any hazards. Beneficial phytoplankton grew during the period of culture which were *Chlorella, Cyclotella, Cymbella, Euglena, Pediastrum, Ankistrodesmus, Ceratium, Volvox, Melosira, Navicula, Nitzschia, Peridinium, Pinnularia, Synedra,* and *Surirella*, and harmful algae (blue-green algae) were *Microcystis, Anabaena, Chroococcus, Nostoc* and *Oscillatoria* [30,31].

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Table 5: Average physico-chemical environmental parameters, chlorophyll a of phytoplankton and phytoplankton abundance (harmful algae and beneficial algae) of ponds in five villages.

Physical Parameters	Villages				
	L01	L02	L03	L04	L05
Water temperature (°C)	29.10 ± 1.5	29.30 ± 1.2	28.80 ± 1.4	28.50 ± 1.2	29.70 ± 1.2
Water depth (m)	1.50 ± 1.1	1.50 ± 1.0	1.60 ± 1.0	1.50 ± 1.2	1.60 ± 1.2
Water transparency (cm)	16.15 ± 0.5	17.20 ± 0.5	18.40 ± 0.5	17.20 ± 0.6	17.80 ± 0.5
Water colour	Av. greenish turbid	Av. greenish turbid	Av. greenish turbid	Greenish turbid	Greenish turbid
TSS (mg/L)	250 ± 25	270 ± 19	260 ± 16	477 ± 20	495 ± 22
TDS (mg/L)	110 ± 10	115 ± 12	105 ± 11	112 ± 10	118 ± 11
pH	7.15 ± 0.11	7.25 ± 0.15	7.20 ± 0.13	6.95 ± 0.1	6.85 ± 0.1
Dissolved O_2 (mg/L)	4.50 ± 0.4	4.80 ± 0.4	4.40 ± 0.3	4.70 ± 0.6	3.50 ± 0.6
Alkalinity (mg/L)	150 ± 12	165 ± 13	170 ± 15	160 ± 12	167 ± 13
Nitrate-N (mg/L)	14.10 ± 0.6	14.30 ± 0.7	16.20 ± 0.7	25.40 ± 1.5	27.60 ± 1.6
Ortho-P (mg/L)	34.60 ± 1.3	35.50 ± 1.5	39.60 ± 1.2	53.50 ± 1.2	55.30 ± 1.3
Chlorophyll a (µg/L) of phytoplankton	53.40 ± 1.6	52.50 ± 1.4	55.20 ± 1.2	55.60 ± 1.5	49.40 ± 1.8
Beneficial algae (green & yellow-green), No./L	2460 ± 36	2590 ± 40	2370 ± 35	2250 ± 29	870 ± 12
Zooplankton, No./L	260 ± 12	250 ± 10	230 ± 11	210 ± 12	150 ± 8
Benthos (No./m^2)	1270 ± 17	1380 ± 20	1490 ± 19	1215 ± 17	395 ± 19

Table 6: Optimum and toxic levels*, and ranges of different physico-chemical properties* of water of ponds for aquaculture (*Pillay, 1992).

Name of properties	Optimum levels*	Properties of water*		Toxic levels*
Turbidity by suspended & dissolved particles	< 20 000 mg/L	TDS	310-470	> 20 000 mg/L (Destroy fish eggs, limits light penetration & photosynthesis)
		TSS	550-740	> 175 000 mg/L mortality occurs
Turbidity by phytoplankton	No range	No range		Not harmful if not by blue-green algae
pH	6.50-9.0 (Desirable growth of fish)	6.85-7.25 4.0 Acid death point 11.0 Alkaline death point		6.0-6.50 Poor growth
Dissolved Oxygen	> 5.0 mg/L (Good growth)	4.40-6.90 3-4 mg/L carp, eel & tilapia can survive		Above 5.0 mg/L good for shrimp
	1.0 mg/L (For warm water carp)			
Nitrate-N	< 100 mg/L	14.10-27.60		Fish survive
Ortho-PO_4	45-100 mg/L	34.60-55.30		Not toxic
Chlorophyll a of phytoplankton	No limitation	32.50-49.40		Normal for fish
Phytoplankton	Beneficial phytoplankton	350-590		Good live food for fish
	Harmful phytoplankton	170-395		> 2500 No./L, untolerable & toxic

Among zooplankton, rotifer was dominant where some important genera such as *Asplanchna, Brachionus, Ceriodaphnia, Hexarthra, Keratella, Trichocerca, Filinia* and *Polyarthra* were abundant [32]. Beyond plankton production, benthic fauna such as annelids and larvae of insects were grown which contributed as good food organisms for bottom feeders [33-35].Chironomid larvae was found dominant among the insect larvae in the fish ponds which contributed a lot as live food for bottom feeders [35,36]. Among the phytoplankton, the harmful algae were found dominant but available in poor amount in all the ponds. These are harmful for fish but poor growth of these blue-greens didn't create any problem for the growth of prawn and carps [30, 31,37].Pond bottom soil was analyzed for texture, pH, total N and Phosphate-P during culture (Table 1). Soil texture was found sandy clay which

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was suitable for fish culture [33]. It was found that pH ranged from 6.7 to 7.5 which indicate that the water was almost alkaline in nature and favourable for fish culture. Organic carbon (0.40 to 0.67%), total N (0.25 to 0.35%) and available P (Phosphate-P) (10 to 12 ppm) were almost within the suitable ranges for good quality water of pond for fish culture. Habib et al. [33] and Habib al et al. [38] recorded properties of pond bottom soil which were within the optimum ranges of culture ponds has the similarity with the present findings.

Production of prawn, carps and poultry birds

The fry of giant freshwater prawn (Golda) and different species of carps were bought from suppliers and released in ponds in all the five villages in first week of March. The fry of all the carps and prawn were grown rapidly for first six months and then found little bit slow from September. Weight of fishes and prwan were taken first on July 19 and then Nov. 24, 2001 (Table 7). A total of 22 fish species were caught and identified during the study (Table 8). Increments of weight was satisfactory but not so promising because all the species of fishes were not growing similarly. It might be due to competition for feeding among cultured species, suitability of feed and other related factors [5,9,39]. These cultured species were first harvested in early September and then ended at the end of November. Fishes were weighted 0.80-2.50 kg except silver barb (rajpunti) (150-200 g) and prawn (100-150 g). With prawn and carps in the village Biska, poultry was grown and reared nearby ponds. Five owners and some members of the society produced about 1000 poultry birds in two lots which were reared by the side of five ponds. The poultry manure was used as biofertilizer and raw feed for prawn and carps which seemed to enhance the growth of these cultured species. The gross production of carps, prawn and poultry birds were about 30 ton from 35 acres of ponds which was about six times more than the past. Where fertilizers, feed and manure were not used and proper management was not taken, and no vigilance and activity of society people in the past [40]. The estimated benefits was about Tk. 500000 (US$ 6024 approx., @ Tk. 83 = 1.00 US$) only. Beyond cultured species, there were about 22 species of both indigenous and exotic fishes were found and caught during harvest time (Table 9). These fishes were grown naturally and the fries of these fishes were entered with fries of cultured species in ponds.

Table 7: Average growth and production of giant freshwater prawn and different fish species cultured in ponds (arranged according to culture of preference) and poultry.

Sl. No	Common name (species)	Initial wt. (mg/ fish) March	Av. wt. (g) on July	Av. wt. on November	Total estimated production (kg)
1	Giant freshwater prawn (*Macrobrachium rogenbergii*)	4-Mar	50-70	100-150 g	200
2	Catla (*Catla catla*)	7-May	100-120	0.30-2.0 kg	7000
3	Rohu (*Labeo rohita*)	6-Apr	80-90	0.50-1.9 kg	5000
4	Mrigal (*Cirrhina mrigala*)	6-Apr	60-70	0.50-1.5 kg	3500
5	Silver carp (*Hypophthalmichthyes molitrix*)	7-May	110-120	0.80-2.1 kg	6000
6	Mirror carp (*Cyprinus carpio*)	5-Apr	130-150	0.90-2.20 kg	5000
7	Silver barb (*Puntius gonionatus*)	4-Mar	50-60	100-170 g	2500
8	Poultry birds (2 lots, No. 1000, 90% survivality)	80-100 g	-	1.0-1.20 kg	1000
Total production of shrimp and fishes, and poultry birds					30 ton
Total estimated income (Taka) 5,00,000 (US$ 6024 approx., @ Tk. 83 = 1.00 US$)					

Table 8: Local and scientific name of fishes available in ponds other than cultured species.

Sl. No.	Local name	English name	Scientific name
1	Punti (Tit punti)	Ticto barb	*Puntius ticto*
2	Mola	Mola carplet	*Amblypharyngodon mola*
3	Chela	-	*Chela phulo*
4	Khalisha	Perch	*Colisa fasciatus*
5	Meni, Veda	Perch	*Nandus*
6	Koi	Climbing perch	*Anabas testudineus*
7	Tara baim	Spiny eel	*Macrognathus aculeatus*
8	Magur	Walking catfish	*Clarias batrachus*

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DOI: 10.19080/NFSIJ.2022.11.555812

9	Shing	Stinging catfish	*Heteropneustes fossilis*
10	Tilapia	Nile tilapia	*Tilapia niloticus*
11	Bual	Freshwater shark	*Wallago attu*
12	Cheng, Gachua	Snakehead	*Channa gachua*
13	Lati	Snakehead	*Channa punctatus*
14	Shol	Snakehead murrel	*Channa striata*
15	Katla	Catla, major carp	*Catla catla*
16	Rui	Rohu, major carp	*Labeo rohita*
17	Mrigal	Mrigal, major carp	*Cirrhina mrigala*
18	Mirror carp	Common carp	*Cyprinus carpio*
19	Grass carp	Grass carp	*Ctenopharyngodon idella*
20	Silver carp	Silver carp	*Hypophthalmichthys molitrix*
21	Thai pangus	Thai pangus	*Pangasius hypophthalmus*
22	Thai sarpunti	Silver barb	*Barbodes gonionatus*

Table 9: Proximate composition (%, on dry weight basis) of cultured species.

Sl. No	Common name (species)	Moisture	Crude protein	Crude lipids	Ash
1	Prawn (*Macrobrachium rogenbergii*)	9.4	65.7	18.5	6.3
2	Catla (*Catla catla*)	9.7	59.8	13.6	16.8
3	Rohu (*Labeo rohita*)	9.6	61.3	13.8	15.2
4	Mrigal (*Cirrhina mrigala*)	9.5	58.25	15.7	16.5
5	Silver carp (*Hypophthalmichthyes molitrix*)	10.3	59.75	13.4	16.5
6	Mirror carp (*Cyprinus carpio*)	9.7	61.65	13.5	15.1
7	Silver barb (*Puntius gonionatus*)	10.1	59.55	13.7	16.6

Combined effects of water properties, plankton and feed on prawn and fishes

Table 10: Multiple correlation analyses of dependent factors (Prawn and fishes) with independent factors (Physio-chemical factors, biological factors and feed.

No	Common name (species)	R	R^2	MR^2	F-value
1	Prawn (*Macrobrachium rogenbergii*)	0.713*	0.5084	50.84	3.86
2	Catla (*Catla catla*)	0.896**	0.8028	80.28	6.55
3	Rohu (*Labeo rohita*)	0.832**	0.6922	69.22	5.32
4	Mrigal (*Cirrhina mrigala*)	0.765*	0.5852	58.52	3.66
5	Silver carp (*Hypophthalmichthyes molitrix*)	0.854**	0.7293	72.93	5.45
6	Mirror carp (*Cyprinus carpio*)	0.785**	0.6162	61.62	5.22
7	Silver barb (*Puntius gonionatus*)	0.747*	0.558	55.8	3.56

Source: $F_{0.05(DF = 14,15)} = 3.46$, $F_{0.01(DF = 14,15)} = 5.02$, MR^2 = Percentage comtribution of different independent factors on the growth and production of prawn and fishes.

Physico-chemical properties of water, plankton and feed had combined effect on the growth and production of freshwater prawn (*Macrobrachium rogenbergii*) and different species of fishes (Table 10). The combined (Multiple) effect was simply ($p < 0.05$) on the growth and production of prawn (R = 0.713), mrigal (R = 0.765) and silver barb (R = 0.747) where highly significant ($p < 0.01$) on the growth and production of catla (R = 0.896), rohu (R = 0.832), mrigal (R =- 0.765), silver carp (R = 0.854) and mirror carp (R = 0.854). Physico-chemical factors, plankton and feed (Independent factors) had contribution (percentage) on the growth and production of prawn, catla, rohu, mrigal, silver carp, mirror carp and silver barb (Table 10) which were 50.84, 80.28,

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69.22, 58.52, 72.93, 61.62 and 55.80%, respectively. The growth and production of prawn and fishes were linearly and almost positively correlated with these independent factors during the study (Table 11). Habib and Chowdhury [41] reported that water quality parameters and feed had combined (multiple) effect on the growth and production of different species of fishes which has similarity with the present findings. Habib et al. [41] found that bottom soil properties had combined (Multiple) effect on the growth of benthic fauna which is similar with the present results.

Table 11: Linear correlation (r) of growth and production of prwan and fishes with independant factors.

Independent factors (xi)	Independent factors, yi (Prawn and fishes)						
	Prawn	Catla	Rohu	Mrigal	Silver carp	Mirror carp	Silver barb
Water temp.	0.424*	0.545**	0.532**	0.465**	0.524**	0.510**	0.417*
Transparency	-0.426*	-0.343	-0.326	0.321	-0.325	0.366*	0.234
Water depth	0.413*	0.378*	0.455*	0.448*	0.354	0.322	0.212
Turbidity	-0.234	-0.247	-0.267	0.167	-0.279	0.175	0.128
TSS	0.287	0.256	0.177	0.372*	0.256	0.231	0.374*
TDS	0.221	0.314	0.305	0.342	0.323	0.243	0.396*
Dissolved Oxygen	0.423*	0.467*	0.486**	0.476**	0.498**	0.421*	0.422*
Alkalinity	0.435*	0.412*	0.432*	0.449*	0.422*	0.430*	0.411*
Nitrate-N	0.21	0.349	0.367	0.352	0.333	0.342	0.31
Ortho-P	0.232	0.342	0.326	0.335	0.342	0.313	0.322
Chlorophyll a	0.224	0.567**	0.358	0.321	0.545**	0.342	0.428*
Beneficial algae	0.242	0.586**	0.335		0.542**	0.356	0.439*
Zooplankton	0.453*	0.345	0.465**	0.412*	0.332	0.419*	0.415*
Benthos	0.458*	0.212	0.356*	0.420*	0.225	0.434*	0.432*
Feed	0.563**	0.324	0.375*	0.414*	0.335	0.428*	0.437*

Source: df 28, *p < 0.05= 0.361 **p < 0.01 = 0.463.

Conclusion

Production of carp fishes, prawn and poultry birds was about 30 tons which was six times more than the past from 59 ponds of 35 acres in the area due to use of fertilizer, feed, manure and proper care taken by owners, people of owners and members of the society. Five farmers produced about 1000 birds (90% survivality) in two lots from five farms which established by the side of the ponds. The physico-chemical factors of water, phytoplankton, chlorophyll a of phytoplankton, zooplankton, benthos and feed had positively and effectively combined effect and contribution (Percentage) on the growth of prawn and fishes. Pond owners shared the benefits of Tk. 500000 (US$ 6024 approx., @ Tk. 83 = 1.00 US$) with the society at the ratio of 50:50. The farmers and members of the society were satisfied due to this good bulk of production and income of the society. They were very happy for getting higher income and benefits than the past. The people of the area, members of the society and owners were encouraged to take more initiatives for culture and production of carps, prawn and poultry birds in coming years.

Acknowledgement

Bangladesh Agricultural University Research System (BAURES) (Project No. 2017/281/BAU) provided financial support. The researchers wish to extend his deep gratitude to BAURES for their valuable contribution for the study.

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