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Status of polyculture pangasius hypophthalmus with Carps in Jhikargacha Upazila of Jessore District, Bangladesh

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Abstract
The present study was conducted in Jhikargacha sub-district of Jessore district with the view to evaluating status of polyculture of Pangasius hypophthalmus with carps from July to December 2012. The mean age and experience of the respondents was 41.28±12.19 and 9.48±3.12 years respectively. Culture pond size was 0.41±0.21 ha (0.343 to 0.478 at 95% CL). 67.50% culture ponds were leased ponds and mean yearly lease value was 535364.70±468224.20 BDT/ha. All the ponds were rectangular in shape and perennial in nature. During preparation of pond, all the ponds were dried by draining out the water. Liming was done at 229.30±118.70 kg/ha (pre-stocking) and 250 kg/ha (post-stocking). Application rate of various fertilizers during post stocking management were recorded as- 155.12±79.10 kg/ha (cow dung); 158.27±79.85 kg/ha (urea); and 79.90±42.93 kg/ha (TSP). Five species of fishes were found to be stocked at the rate of 7377 individuals/ha including 93.10% P. hypophthalmus seeds and 6.90% other carps. Supplementary feeding was done daily and the application rates were 444.23±236.41 kg/ha (rice bran), 228.29±116.96 kg/ha (mustard oil cake), and 912.91±468.05 kg/ha (commercial pangus feeds, pellet). Average fish production was found 6672.84 kg/ha. All the fishes grown in the study area were marketed to fish landing centers and markets of three districts- Chuadanga (47.50%), Dhaka (30%) and Jessore (22.50%). The average cost-benefit ratio was 1:1.15. High mortality, low growth of seeds, and high input price were the major problems.

Keywords: Polyculture, *Pangasius hypophthalmus*, Carps, Supplementary feeding, Jessore

1. Introduction
In spite of vast water resources, the people of Bangladesh are suffering from malnutrition. Yet there is a serious shortage of animal protein in our diet and the daily per capita consumption is very low. While in 1962-63 the per capita fish consumption was 33 g, the present per capita annual fish consumption is only about 18.94 kg, annual fish demand 20.44 kg. In our country about 60% of animal protein comes from fish and it contributes 4.43% in G.D.P (DoF, 2012) [10]. The principal causes for this low per capita consumption are the rapid growth of population compounded with a gradual decline in fish production resulting from the deterioration of fish habitat due unplanned construction of flood control dikes and roads, indiscriminate use of insecticides, improper withdrawal of water for irrigation purpose, overfishing and lack of proper management techniques and other unknown reasons (Azimuddin, 1998) [3]. Bangladesh has about 260 fresh water native fish species, 13 exotic fish species, and 24 species of freshwater prawn. In marine zone there are 475 fish species and 36 shrimp. These varieties of species playing an important role to develop in our socio-economic conditions and fulfill the nutritional demand. Among the exotic species the Thai Pangus (Pangasius hypophthalmus) is the one of the potential species due to its easy culture system and good production result. It has been proved that the weather of Bangladesh is suitable for pangus culture (Sarkar, 2000) [31]. It is known that native pangus (P. pangasius) cultured was started in pond condition in 1945 in Khulna region of Bangladesh. Lack of proper culture management it was not successes and not so popular to the local people. Although it has been taken to necessary steps for native pangus (P. pangasius) culture water condition in 1987 at Chandpur but it has not been successes (Sarkar, 2000) [31]. After the failure of native pangus culture government of Bangladesh firstly imported 0.18 g weighted 100 numbers fry of Thai pangus (P. hypophthalmus) from Thailand at 1990 and reared in our country. Then Bangladesh

Fisheries Research Institute (BFRI) produced Thai pangus fry through artificial breeding at 1993 (Sarkar, 2000) [31]. The fish farmers all over the country are now too much interested to culture Thai pangus due to availability of fry. High density, semi-intensive and intensive in ponds have established and are very popular in Bangladesh. Such culture can produce at a rate of as high as 25-30 tons /ha/year with protein rich diets (BFRI, 1999) [4]. Thus, it can be expected that there is a great scope for increasing fish production in inland water and it could be made a profitable industry like Japan, Cambodia, Philippines, Malaysia, USA and UK. But unfortunately, it was not yet cultured extensively to meet the protein requirement and to remove poverty. This is due to the non-availability of fry, proper management, selection of low cost artificial diets and socio-economic constraints. Bangladesh has water resources with 0.5 million ha of perennial and 2.3 million ha of seasonal inland waters, in addition to a costal line of 480 km. There are approximately 1.3 million fresh water ponds covering the total area of 1.5 million ha out of nearly 46% are under culture,30% cultivable and 25% are derelict (FRSS,1986) [13]. At present fish productions from these ponds are low being 700-800 kg/ha/year (Chisty, 1997) [7]. Pond fishery is an important component of Bangladesh fisheries. At the national level, 46% of the ponds are in culture condition (FRSS, 1986) [13]. Most farmers in rural areas have access to water bodies such as ponds, ditches, canals etc. Farmers can effectively utilize these water these water areas for fish culture either for their subsistence or as commercial enterprises.

While developing and transferring technologies, it is important to understand the farmers resources while should be better utilized for minimizing input costs and optimizing returns. Technologies often developed for increased fish production, have proved technically feasible and economically viable in on station research trails, but failed when taken to farmers for their adoption. The reason for the failure are that research support for developing technologies have not taken into consideration that fields and farmers condition that fit to farmers resources. The present study was conducted in Jhikargacha Upazila of Jessore district, 25 km from the Jessore Science and Technology University campus. In view of the above, the present study has been revealed to know the detail culture management of Pangus cost-benefit ratio, basic socio-economic conditions of the pangus farmers in Jhikargacha Upazila, Jessore, Bangladesh.

2. Materials and Methods

Study area and period

The present study was conducted in Jhikargacha sub-district of Jessore district for a period of six months from July 2012 to December 2012. Pangus farmers from the 10 unions of Jhikargacha sub-district were studied. The study area is located between $23^0$12'to $22^0$56' north latitude and $88^0$58' to $89^0$08' east longitude.

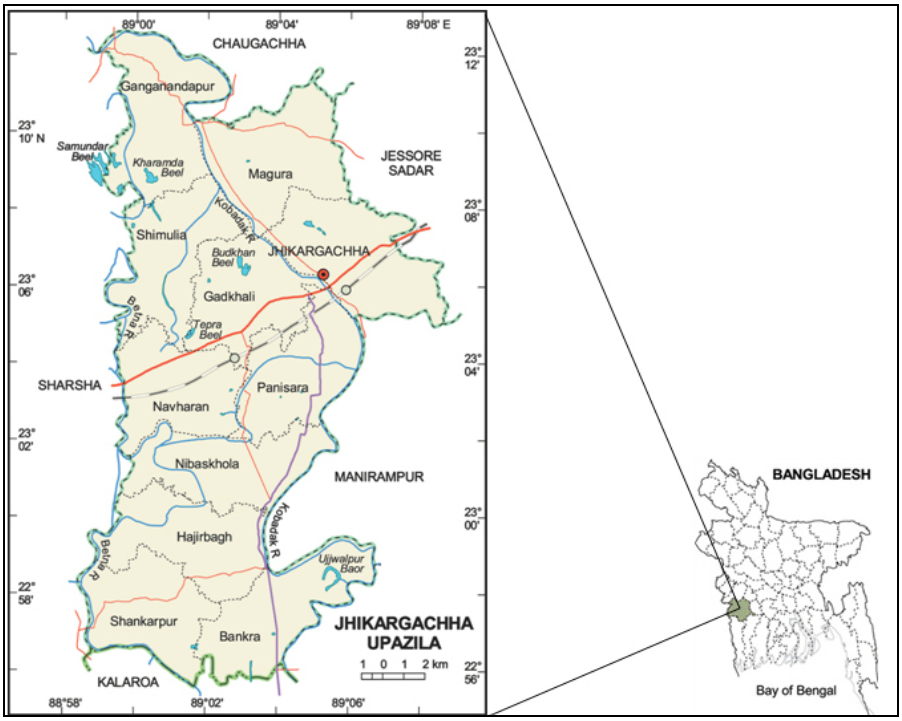

Fig 1: Map of the study area.

Field survey and selection of farmers

Weekly field survey was carried out between July 2012 and December 2012 to collect the necessary information. Random selection method was employed to select fish farmers in order to avoid any biasness in selection of the pangus farmers.

Interviews

Questionnaire. The questionnaire was purposively developed Interviews of the pangus farmers were taken with a prepared and pre-tested under field situation. Necessary modifications of the questionnaire were made after this pre-testing. This final version of questionnaire was used to collect data. However, all the data were cross-checked for ensuring the accuracy of data collected from the respondents.

Focus Group Discussion (FGDs)

The FGDs were conducted to identify the problems and to collect farmer's recommendation regarding the problems

identified. FGD is a very effective method for collecting large numbers of necessary information of interest within a short period of time.

Photography
Necessary relevant photographs were taken using digital camera. Necessary image editing was made by software Adobe Photoshop 8.00. However, editing was employed to such a level that did not affect or change the original subject or theme of the photos.

Collection of secondary data
Secondary data relevant to the present study were collected from various sources such as scientific journal articles, text books and others.

Statistical analysis
Collected data were tabulated and subjected to descriptive analysis by Microsoft Office Excel 2007 and Statistical Package for Social Sciences (SPSS) 15.00. Chi square test was applied to find is the any significant difference between number of male and female members in respondent's household. Data were analyzed at 95% confidence limit where possible after subjecting those (data) to SPSS.
The cost benefit ratio (CBR) analysis was carried out using the following formula-

$$(CBR) = \frac{\text{Total cost}}{\text{Total benefit}} \quad \text{(total benefit = total income-total cost)}$$

3. Results

Basic profile of the respondent's household

Age of the pangus farmers
The mean age of the farmers in the study area was found 41.28±12.19 years. The maximum and minimum age of the farmers was 67 and 18 years, respectively.

Occupation of the respondents
Occupation was categorized into two major types- primary and secondary on the basis of income of the respondents. Two types of primary occupation were recorded, fish culture and crop farming. Fish culture was found as the primary occupation, in terms of income, for 95% farmers (Figure 2).

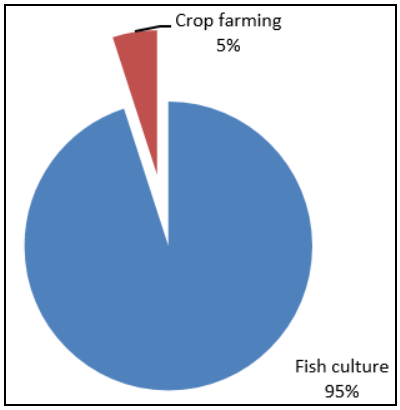

Fig 2: Primary occupation of the respondents

Every respondent (100%) in the study area had secondary occupation that generated income. The most common secondary occupation was crop farming (60%) (Figure 3).

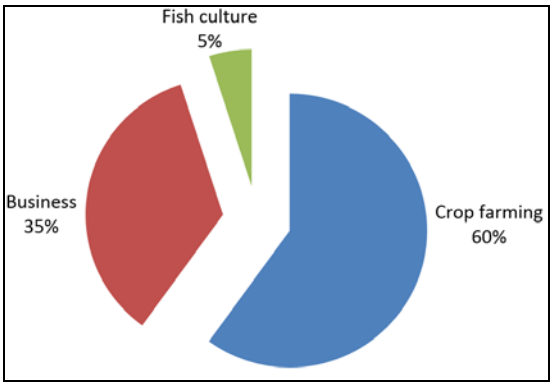

Fig 3: Secondary occupation of the respondents

Experience in fish culture
All the respondents were experienced in fish culture. The mean experience was found 9.48±3.12 years with the minimum and maximum experience of 5 and 24 years respectively.

Family members and sex
Mean member of the respondent's family was found 6.28±2.45 with the maximum and minimum members of 12 and 3 respectively. Considering all the members of the respondent's family, 53.78% was found male and remaining 46.22% was female members. The mean male and female members in a family were found as 3.76±2.13 and 2.9±1.46 respectively.
The value of chi square was found 1.4382 (p=0.230, df=1) which significantly differs from the expected ratio (1:1).

Culture ponds details

Pond size
The mean pond size was 0.41±0.21 ha (0.343 to 0.478 at 95% CL). The minimum and maximum size was recorded 0.13 ha and 0.97 ha respectively.

Pond ownership
Among the surveyed fish ponds, 32.50% ponds were owned by the respondents themselves. 67.50% culture ponds were leased ponds. In case of leased ponds, the average number of owners was 3.44±1.69. Average lease value was found 535364.70±468224.20 BDT/ha/yr. The maximum and minimum lease value was found 2636517.00 BDT/ha/yr and 177333.30 BDT/ha/yr respectively. All the ponds were of rectangular shape and of perennial nature.

Pond management techniques

Bottom and dike repairing
All the culture ponds (100%) were prepared at the beginning of a new culture season. While preparing bottom and dike of the ponds, the farmers drained the pond water out and dried under the sun for few days and excess bottom mud was removed. The pond operator employed manpower (haired labor) during this time.

Control of unwanted species
Only 10% farmers used rotenone in their ponds for controlling unwanted species from their culture ponds. As all the ponds dried at the beginning culture season that is why most of the farmers did not apply any chemical in their pond. Instead they apply various commercially available chemicals for the purification of the pond water. All these items (rotenone and chemicals) were applied through broadcasting.

Control of aquatic vegetation

No aquatic vegetations were found in the study ponds during the period of study. This is because there was less chance of growing these vegetations as the ponds dried every season. If somehow any vegetation grew into a culture pond, the fish farmer eradicated it manually with the help of simple devices like bamboo sticks.

Liming

Lime stone ($CaCO_3$) was applied in all the culture ponds. During the preparation of culture pond, the mean lime application rate was found 229.30±118.70 kg/ha. The minimum and maximum application was recorded 76.57 kg/ha and 545.87 kg/ha respectively. All the farmers applied lime through broadcasting.

Fertilization

Both organic and inorganic fertilizers were used in the culture ponds during preparation of ponds and after stocking of culture species. These fertilizers include cow dung, urea and triple super phosphate (TSP). At the time of pond preparation, the mean application rates of these fertilizers were- cowdung, 240.52±124.03 kg/ha (79.04 to 565.63 kg/ha); urea, 160.55±81.49 kg/ha (49.40 to 365.56 kg/ha); and TSP, 158.20±80.25 kg/ha (49.40 to 365.56 kg/ha) (Figure 4). Fertilization application rate during post stocking management varied from those of pre stocking applications. Application rate of various fertilizers during post stocking management were recorded as- cow dung, 155.12±79.10 kg/ha (49.4 to 358.15 kg/ha); urea, 158.27±79.85 kg/ha (46.93 to 370.50 kg/ha); TSP, 79.90±42.93 kg/ha (24.70 to 185.25 kg/ha).

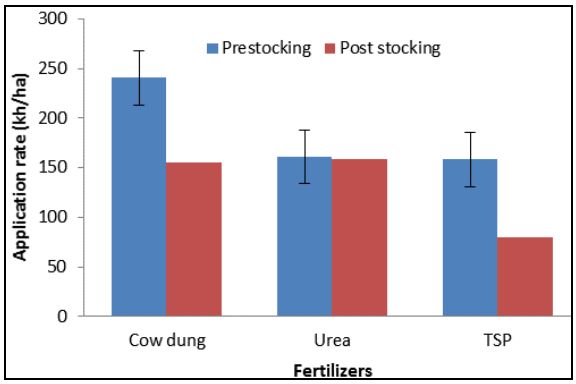

Fig 4: Fertilization status during pre and post stocking management

Stocking of fish seeds

Five species of fin fishes, viz. Thai pangus (Pangasius hypophthalmus), Rui (Labeo rohita), Catla (Catla catla), silver carp (Hypophthalmichthys molitrix) and Mrigel (Cirrhinus cirrhosis) were stocked in the farmer's ponds. The average stocking density was found 7377 individuals/ha including 93.10% P. hypophthalmus seeds and 6.90% others (L. rohita, C. catla, C. cirrhosus and H. molitrix). Majority Thai pangus (P. hypophthalmus) seeds were brought from Mymensingh district by the farmers of the study area. The mean stocking density was found 6871.60±761.22 individuals/ha with the minimum and maximum stocking density of 5827 individuals/ha and 7800 individuals/ha respectively. Average stocking weight of individual fish was 110±12.40 g (100 to 125 g).

Fig 5: Source of Thai pangus seeds

In case of Rui (L. rohita), the mean stocking density was found 69.67±20.18 individuals/ha with the minimum and maximum stocking density of 27 individuals/ha and 114 individuals/ha respectively. Average stocking weight of individual fish was 116.90±17.45 g (100 to 166 g). In case of Catla (C. catla), the mean stocking density was found 57.00±13.68 individuals/ha with the minimum and maximum stocking density of 27 individuals/ha and 90 individuals/ha respectively. Average stocking weight of individual fish was 130±5.55 g (125 to 140 g). In case of Mrigel (C. cirrhosus), the mean stocking density was found 86.15±13.76 individuals/ha with the minimum and maximum stocking density of 50 individuals/ha and 104 individuals/ha respectively. Average stocking weight of individual fish was 128±2.53 g (125 to 130 g). In case of Silver carp (H. molitrix), the mean stocking density was found 182.20±91.34 individuals/ha with the minimum and maximum stocking density of 68 individuals/ha and 419 individuals/ha respectively. Average stocking weight of individual fish was 115.40±12.78 g (100 to 130 g).

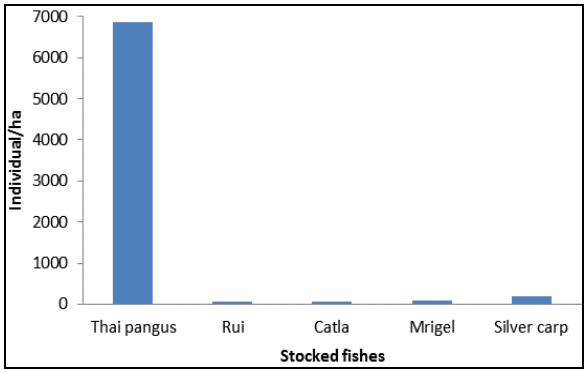

Fig 6: Stocking density of different fish species

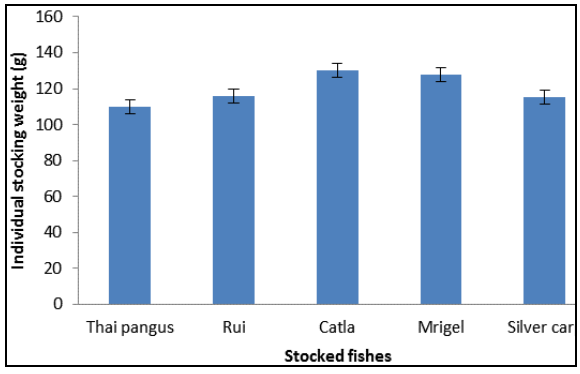

Fig 7: Average stocking weight of individual fish

Supplementary feeding

Three supplementary feeds were applied into the surveyed ponds to improve the growth of stocked fish species. These feeds were rice bran, mustard oil cake and commercial pangus feeds (pellet). Feeds were applied daily by all the farmers in the study area. In the case of rice bran, the daily mean application rate was found 444.23±236.41 kg/ha. The maximum and minimum daily application rate was found 1086.8 kg/ha and 148.20 kg/ha respectively.

In case of the mustard oil cake, the daily mean application rate was found 228.29±116.96 kg/ha. The minimum and maximum daily application rate was found 74.10 kg/ha and 543.40 kg/ha respectively. The daily application rate of commercial pangus feed was912.91±468.05 kg/ha. The maximum and minimum daily application rate was found 2173.60 kg/ha and 296.40 kg/ha respectively.

Fig 8: Feeding in a culture pond

Harvesting and production of fishes

Final harvesting was done at the end of the culture cycle generally after 5-6 months of initial stocking. The overall production was found 6672.84 kg/ha. Whereas the species-wise mean production was found as 6161.56±1262.64 kg/ha (P. hypophthalmus), 98.51±5.04 kg/ha (L. rohita), 101.68±8.40 kg/ha (C. catla), 150.65±17.20 kg/ha (C. cirrhos us) and 160.83±26.26 kg/ha (H. molitrix) (Table 4.1).

Table 1: Production of fishes

Fish species	Production (kg/ha)		
	Minimum	Maximum	Mean±SD
P. hypophthalmus	748.48	9500.0	6161.56±1262.64
L. rohita	089.82	112.27	98.51±05.04
C. catla	091.48	134.76	101.68±8.40
C. cirrhosus	095.00	237.50	150.65±17.20
H. molitrix	101.33	247.00	160.83±26.26

Marketing of fishes

All the fishes grown in the study area were marketed to fish landing centers and markets of three districts- Chuadanga, Dhaka and Jessore. Majority 47.50% fish farmers marketed their fishes to Chuadanga followed by Dhaka (30.00%) and Jessore city (22.50%). Mode of transportation was recorded mechanized vans, pickups and sometimes trucks.

Fig 9: Transportation of harvested fishes for marketing

Cost benefit ratio (CBR)

The mean cost was calculated 304526.80 BDT/ha, whereas the mean gross income and profit was 653342.40 BDT/ha and 348815.60 BDT/ha respectively. The average CBR was found 1:1.15 (cost: benefit) indicating profitability of Pangus culture with carps (Table 4.2).

Table 2: Cost benefit details

Financial issues	Amount (BDT/ha)		
	Minimum	Maximum	Mean ± SD
Cost	304525.20	304533.50	304526.80±01.96
Gross income	570594.70	792894.70	653342.40±63414.94
Profit	266068.40	488368.40	348815.60±63414.94
CBR	1:0.87	1:1.60	1:1.15±0.21

Problems identified

From the results of interviews and FGDs, several problems were identified. High mortality rate of stocked fish seeds was the most common problem identified in the study area, reported by 22.50% farmers.

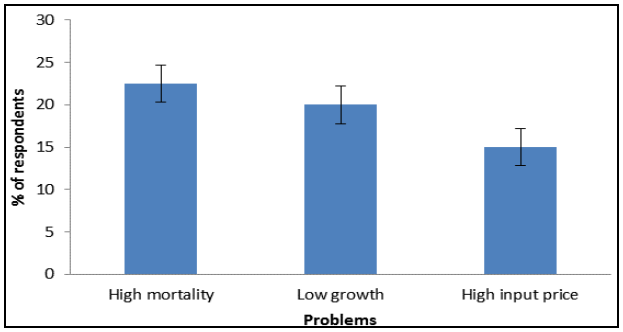

Fig 10: Different problems recorded from the study area

4. Discussion

The mean age of the farmers in the study area was found 41.28±12.19 years. The maximum and minimum age of the farmers was 67 and 18 years, respectively. Islam *et al*., (2014) [16] found there was no fish farmer below 20 years of age. Results showed that the highest numbers of fish farmers were between 31 and 40 years indicating middle age people. Sharif *et al*. (2015) [30] stated that the percentage of age distribution was 5% farmer was 25-35 years, 10% farmer was 35-40 years and rest 85% farmer has the age of 40 and above.

Fish culture was found as the primary occupation, in terms of income, for 95% farmers. Every respondent (100%) in the study area had secondary occupation that generated income. The most common secondary occupation was crop farming (60%). Asif *et al*., (2015) [2] reported that 87% traders have secondary business like rickshaw business, fruit business, cloth business, fish trading etc.

Long term experience in fish culture and training on fish culture can make anyone a successful fish farmer. Similar findings also reported Chaki (2011) [6] who mentioned that experience and training on fish culture affects the final fish production and their production was found 47% high than that of non-trained farmer's production. Pekar *et al*., (2002) [26] reported same type of findings that lack of experience and proper training of fish farmer hinders a lot to the total amount of yield. The mean male and female members in a family were found as 3.76±2.13 and 2.9±1.46 respectively. Islam *et al*., (2015) [17] revealed that the maximum age level was 20-30 years old. Among the fishermen 66% was male and 34% was female. The mean pond size was 0.41±0.21 ha (0.343 to 0.478 at 95% CL). The minimum and maximum size was recorded 0.13 ha and 0.97 ha respectively. The pond size was found suitable for better management as per recommendations by DoF (2004) [11]. Collins (1971) [9] reported that pond size has certain influence on fish growth. Asif *et al*., (2014) [1] the average depth of pond in the study area was found 2.45 meter.

All the culture ponds (100%) were prepared at the beginning of a new culture season. Only 10% farmers used rotenone in their ponds for controlling unwanted species from their culture ponds. As all the ponds dried at the beginning culture season that is why most of the farmers did not apply any chemical in their pond. No aquatic vegetations were found in the study ponds during the period of study. This is because there was less chance of growing these vegetations as the ponds dried every season. Limited growth of aquatic weeds may be useful in maintaining water quality and may serve as shelter and substrate for food organism in ponds (Pillay, 1990) [27]. Excess aquatic weeds take the nutrients elements of the fertilizer used in the ponds and decrease the power of productivity (Islam, 1998) [18]. Islam (2001) [19] suggested that aquatic weed less pond is suitable for aquaculture. Excess floating aquatic vegetation hampers sunlight penetration in the water reducing photosynthesis. It provides refuge for the enemies and competitors of fish (FAO, 1997) [12]. For pond and water quality management lime, urea and TSP are mostly used. Bleaching powder, Timsen, EDTA, Polgard, Virex, Aquakleen, Germnill, Pond safe were widely used as disinfectant. Health management and disease treatment were the major activities where farmers were seen to use a lot of chemicals (Chowdhury, *et al*., 2015) [8].

According to (2004) [11] at least 2 kg of stone lime should be applied during preparation of the pond which is more than the present findings. However DoF (2004) [11] also mentioned that lime dose should be based on pH of water, but in the present study the farmer did not consider this issue while applying lime. After stocking of fish, the farmers of the study area did not apply lime on regular basis. They generally apply it when water quality was going bad. However, the application rate was around 250 kg/ha. Lime could be applied 2 or 3 times in a year to prevent parasitic disease outbreak.

At the time of pond preparation, the mean application rates of these fertilizers were- cowdung, 240.52±124.03 kg/ha (79.04 to 565.63 kg/ha); urea, 160.55±81.49 kg/ha (49.40 to 365.56 kg/ha); and TSP, 158.20±80.25 kg/ha (49.40 to 365.56 kg/ha). Application rate of organic fertilizer i.e. cow dung was as per recommended range (5-7 kg/decimal) by DoF (2004) [11]. Excess dose of organic fertilizers can reduce the dissolved oxygen level of water. The most efficient and economical dose of TSP is 0.16 kg/decimal/year. Natarajan *et al*. (1990) [25] suggested that urea and TSP should be applied at 0.80 kg/decimal/yr and 1 kg/decimal/yr respectively in fish culture ponds. Jhingran and Pullin (1985) [22] suggested different doses of organic and inorganic fertilizers for increasing growth and survival of fry and fingerlings.

Majority Thai pangus (P. hypophthalmus) seeds were brought from Mymensingh district by the farmers of the study area. Sharif and Asif (2015) [29] reported that Carp hatchlings that produced in hatcheries were commonly Indian Major Carps, Exotic Carps like Silver carp, Grass carp, Black Carp, Bighead carp, Common carp, Mirror carp and other species like Pangus, Punti, Thai punti, African magur, Koi and Tilapia. Hatchlings production of Indian major carps was 24720 kg, Exotic carps were 21754 kg, and other species were 2966 kg respectively in 2013 at Jessoresadar. The mean stocking density was found 6871.60±761.22 individuals/ha with the minimum and maximum stocking density of 5827 individuals/ha and 7800 individuals/ha respectively. Average stocking weight of individual fish was 110±12.40 g (100 to 125 g). Barman and Mustafa (2006) [5] noted that stocking of large size fingerlings (12-15 cm) of desired species at the beginning of the season showed better survival and higher level of production. In case of Rui (L. rohita), the mean stocking density was found 69.67±20.18 individuals/ha with the minimum and maximum stocking density of 27 individuals/ha and 114 individuals/ha respectively. Average stocking weight of individual fish was 116.90±17.45 g (100 to 166 g). In case of Catla (C. catla), the mean stocking density was found 57.00±13.68 individuals/ha with the minimum and maximum stocking density of 27 individuals/ha and 90 individuals/ha respectively. Average stocking weight of individual fish was 130±5.55 g (125 to 140 g). In case of mrigel (C. cirrhosus), the mean stocking density was found 86.15±13.76 individuals/ha with the minimum and maximum stocking density of 50 individuals/ha and 104 individuals/ha respectively. Average stocking weight of individual fish was 128±2.53 g (125 to 130 g). In case of silver carp (H. molitrix), the mean stocking density was found 182.20±91.34 individuals/ha.

In the case of rice bran, the daily mean application rate was found 444.23±236.41 kg/ha. The maximum and minimum daily application rate was found 1086.8 kg/ha and 148.20 kg/ha respectively. In case of the mustard oil cake, the daily mean application rate was found 228.29±116.96 kg/ha. The minimum and maximum daily application rate was found 74.10 kg/ha and 543.40 kg/ha respectively. The daily application rate of commercial pangus feed was 912.91±468.05 kg/ha. The maximum and minimum daily application rate was found 2173.60 kg/ha and 296.40 kg/ha respectively. In Bangladesh, irregular feeding is found in most cases, but regular daily feeding is essential to get better production (Islam, 2001) [19]. According to DoF (2004) [11] application of supplementary feeds depends on availability of natural foods in water; they reported that feeds should be supplied at 3-5% of total fish biomass but during winter this range will be 1-2%.

The overall production was found 6672.84 kg/ha. Whereas the species-wise mean production was found as 6161.56±1262.64 kg/ha (P. hypophthalmus), 98.51±5.04 kg/ha (L. rohita),

101.68±8.40 kg/ha (C. catla), 150.65±17.20 kg/ha (C. cirrhosus) and 160.83±26.26 kg/ha (H. molitrix). Harvesting was carried out by seine nets in the early morning. Average fish production was calculated 6672.84 kg/ha which was found much more the production mentioned by Azimuddin (1998) [3] obtained a yield of 11.45-15.46 kg/decimal fish production from rural ponds. Majid (1997) [23] who mentioned that average annual fish production in Bangladesh is about 1000 kg/ha which is much lower than that of present findings.

All the fishes grown in the study area were marketed to fish landing centers and markets of three districts- Chuadanga, Dhaka and Jessore. Majority 47.50% fish farmers marketed their fishes to Chuadanga followed by Dhaka (30.00%) and Jessore city (22.50%). Rahaman *et al*. (2015) [28] The proportion of respondents identifying poor road and transport facilities was24%. Only 20% and 12% of traders identified lack of money for this business. Haque *et al*. (2010) [14] stated that, at present, the fish farmers are not getting their actual price due to lack of scientific transportation and also for the malpractices in the marketing system. Three types of marketing channel were found to be operated in the selected markets. The shorter marketing chain which included the fish farmers, retailers and consumers was found to be more beneficial to the fish producers (Hossain *et al.*, 2015) [15].

The mean cost was calculated 304526.80 BDT/ha, whereas the mean gross income and profit was 653342.40 BDT/ha and 348815.60 BDT/ha respectively. The average CBR was found 1:1.15 (cost: benefit) indicating profitability of Pangus culture with carps. The profit level found much higher than the findings of Islam *et al*. (2008) [20] who mentioned the production cost of BDT 129,800 per ha in carp grow-out ponds, but the cost-benefit ratio reported by him was 1:1.54 which is higher than the present findings (1:1.15). Islam and Rashid (2004) [21] reported that most of the farmers adopted improved traditional farming and their average return was 366 BDT/decimal/yr.

From the results of interviews and FGDs, several problems were identified. High mortality rate of stocked fish seeds was the most common problem identified in the study area, reported by 22.50% farmers. The present findings differs from the findings of Mohsin and Haque (2009) [24], who reported carp farmer's problems as follows- feed problem (14%), fish poaching (6%) and poisoning (4%).

5. Conclusion

The present study was conducted in Jhikargacha sub-district of Jessore district with the view for evaluation of the status of polyculture of Pangasiushypophthalmus with carps from July to December 2012. The Pangasius hypophthalmus culture with other species is a very profitable business in Jessore region. This polyculture practice can change the socioeconomic condition of fish farmer and related people of this area.

6. Recommendation

Considering the findings of the present study, the following are suggested for the development of aquaculture practices of the study area-

- Low cost feeds from locally available ingredients should be used instead of high prized commercial feed.
- Quality fish seeds should be ensured from local sources to avoid high transportation cost.
- Further research efforts are necessary to improve the production of fish.

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