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Research Article

Production Performance of White Fish in Two Different Culture Systems in Patuakhali, Bangladesh

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ABSTRACT

The present study was carried out to compare the production performance of white fish from traditional and modified traditional culture system of three upazila in Patuakhali district. For the research work, 10 traditional and 10 improve traditional farmer was selected from each Upazila. From the study average pond size of traditional farmers of Patuakhali sadar, Galachipa and Mirzaganj was found 4.56 ±0.29 decimal, 5.58 ±2.49 decimal and 4.6 ±1.32 decimal respectively and improve traditional farmers was 5.64 ±2.18, 5.65 ±2.18 and 5.24 ±2.73 decimal respectively. Average stocking density of traditional farmers was 207 ±57, 219 ±38 and 227 ±56 fingerlings/ decimal and that of improve traditional farmers was fixed which were 55 fingerlings/ decimal in Patuakhali sadar, Galachipa and Mirzaganj respectively. Average survival rate of traditional farming system was found as 62±6.21%, 65±5.25% and 61±11.25% respectively in Patuakhali sadar, Galachipa and Mirzaganj and that of improve traditional farming system was found as 76±5.16%, 80±4.97% and 77±5.87% respectively. In Patuakhali sadar upazila, average production of traditional farmer was found 4.71±0.7652 kg/decimal and that of improve traditional farmer was 10.67±0.8830 kg/decimal. In Galachipa upazila, average production of traditional farmer was found 4.47±0.7365 kg/decimal and that of improve traditional farmer was 10.66±0.3342 kg/decimal. In Mirzaganj upazila, average production of traditional farmer was found 4.47±0.4127 kg/decimal and that of improve traditional farmer was 10.43±0.4785 kg/decimal. The benefit cost ratio of traditional farmer: improve traditional farmer = 1:4.24. From the result it can be assumed that utilization of improve technology can increase the fish production two and half time more than that of current production. This will also help us to get back our country tradition "Mase Bhate Bangali".

Keywords: Traditional, Improve traditional, White Fish.

1. INTRODUCTION

Bangladesh is a densely populated country of 1,47,570 km^2 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 *beels*), lakes, canals, rivers and estuaries covering an area of 4.56 million ha [1].

Bangladesh is one of the world's leading inland fisheries producer with a production of 16,46,819 tones during 2003-2004, with marine catch total of 4,55,601 tones and a total production from aquaculture of 9,14,752 tones during 2003–2004. Bangladesh's total fish production for the year totaled above 2.1 million tones [1] FAO [2] ranked Bangladesh as sixth largest aquaculture producing country with its estimated production of 8,56,956 tones 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].

The history of fishing in Bengal is more than 4,500 years old [3]. For generations, people have harvested fish from ponds, rivers, flooded land, the coast and the deep sea, learning to cooperatively use fishing grounds and market their catch. Fish harvesting and marketing were traditionally considered undignified jobs, so fishers were mainly the low-caste Hindu tribes such as the Majhi, Jaley and Malo. Ponds and lakes continue to feature prominently in the landscape and the lives of rural people. Ponds were traditionally created as borrow pits excavated to supply soil for raising homesteads above flood levels during the wet monsoon. The ponds serve multiple purposes for the rural household, used not only for fish culture but also to supply water for washing, bathing and other household needs. Fish culture in such closed water bodies as ponds and lakes was recorded to have started in 350 BC on the Indian subcontinent [4].

In past, ponds are considered as a water body which is only for bathing and family users. But in course of time it has become as a huge source of income through fish culture. Bangladesh is one of the densely populated countries of the

world where 40.4% of her people live under poverty [5]. In this situation, aquaculture has become an increasingly important sector in Bangladesh in terms of its potential for contributing of food and nutrition, family income. During 1984-95, aquaculture production increased by 215.5% against 36.3% for crops and livestock in Bangladesh [6] and recently, carp species are contributing about 85.29% of total pond production of Bangladesh [7]. Carp species are very familiar and profitable due to their higher resistance against diseases and environmental stress.

In the past, fish farming was extensive and subsistence in nature, stocked with wild fry and fingerlings caught in rivers and cultured without the use of fish feeds. Following the introduction of technology for inducing carp to spawn in the late 1960s and the subsequent development of fishpond management technologies in the 1970s and 1980s, fish farming became widespread and market driven. Culturing various carp and exotic fish species in ponds and lakes became popular all over the country, with the broad participation of all religious and ethnic groups.

Today, about three quarters of Bangladeshis live in rural areas and remain largely dependent on agriculture and natural resources for food and livelihoods. However, some structural changes have occurred in the economy of Bangladesh over the past three decades [8] reducing the prominence of the agriculture sector in favor of the industrial and service sectors, as has been experienced in other developing countries in Asia. The Bangladesh economy has been growing at a respectable rate; average long-term gross domestic product (GDP) growth was 5.7% per year from fiscal year (FY) 1973 to FY2005 [9, 5, 10-15]. Although the agricultural GDP has more than doubled in absolute terms, its share of the national GDP declined dramatically from 54.6% during FY1973-75 to 19.7% during FY2003-05. This reflected the increasing prominence of the industrial and service sectors, which together contributed 45.4% of the GDP during FY1973-75 and 80.2% during FY2003-05. Despite the decline in the share of agriculture in the national GDP, the fisheries sector (including both capture fisheries and aquaculture) has maintained an average contribution of 4-6% to the national GDP [5]. Within agriculture, the contribution of fisheries has increased significantly from 7% during FY1973-75 to 15% during FY1993-95 and to 22% during FY2003-05. The fisheries sector experienced 8.9% growth per annum during the decade of 1985 to 1995, the highest growth rate in agriculture, then slowed to 3.7% per annum in the following decade. Several studies have suggested that Bangladesh needs to achieve sustained GDP growth of at least 8-10%, export growth of 20-25% and import reduction of 18-20% to be economically developed before 2025 [16, 17]. It appears that the fisheries sector can play a vital role in achieving higher growth in the national economy and exports. Recently, garments and fish have become Bangladesh's two most important exports.

The incidence of poverty in Bangladesh remains high. Although the poverty rate declined by an average of 1% per year from 1972 to 2005, the number of poor people, 56 million, remained almost same in 2005 as it was 2 decades earlier in 1983/84. About 44% of total population remains below the poverty line, as estimated with a head count index (HCI) of people falling below the income poverty threshold for food and other basic needs. The poverty threshold is based on an assessment of the costs of basic needs specific to Bangladesh, which include a 2,100 kilo-calorie food basket and minimal housing, education, health and clothing [18]. Most of the poor live in rural areas, as indicated by the higher rates of rural poverty. Neither national economic growth nor the redistribution of wealth among sectors has so far significantly contributed to poverty reduction. Based on the micro-level study, Hossain [19] indicated that the growth of off-farm activities in rural Bangladesh contributed a higher rate of poverty reduction than could have been achieved by people dependent only on agriculture. Moreover, income inequality among rural and urban households is widening [18, 20, 21]. More equitable growth remains an important goal for the government of Bangladesh (GoB). The fisheries sector is closely associated with poverty in the developing countries of Asia, including in Bangladesh. Fish (broadly defined as living aquatic resources) is associated with many dimensions of the poverty alleviation strategy in Bangladesh, as it provides food, livelihood and income, as well as generating foreign exchange.

Bangladesh is one of the densely populated countries of the world where 40.4% of her people live under poverty [5]. In this situation, aquaculture has become an increasingly important sector in Bangladesh in terms of its potential for contributing to food and nutrition, family income. During 1984-95, aquaculture production increased by 215.5% against 36.3% for crops and livestock in Bangladesh [6] and recently carp species are contributing about 85.29% of total pond production of Bangladesh [7].

Fisheries and aquaculture play a major role in nutrition, employment and foreign exchange earnings with about 12 million people are associated with the fisheries sector, of which 1.4 million people rely exclusively on fisheries related activities [22]. An estimated 9.5 million people (73 %) are involved in subsistence fisheries on the country's flood plains [23], the number of fishermen increases dramatically to 11 million between June to October each year. There are 3.08 million fish farmers, 1.28 million inland fishermen and 0.45 million fry collectors (fish and shrimp) in Bangladesh [24] and it is estimated that fisheries and related activities support more than 7 % of the country's population. Currently, more than 600 000 people are engaged in shrimp farming activities [25], it is also

estimated that around 14 000 fishermen (2.5 fishers per ha water body) are directly involved and 70 000 rural people are the direct beneficiaries of oxbow lake fisheries [26, 27].

There are an estimated 1.3 million fish ponds in the country, covering an area of 0.151 million ha, of which 55.30 % is cultured, 28.52 % is culturable and 16.18 % is unused. In 2002 the %age of production from the above three systems was 72.09, 20.01 and 7.90 respectively [28]. In general the size of fish ponds varies between 0.020 and 20 ha with an average of 0.30 ha. In Bangladesh, the highest number of ponds exists in the Barisal district (12.11%), followed by Comilla (9.36 %), Sylhet (9.10 %), Chittagong (8.02 %) and Noakhali (7.75 %) [28].

Historically people depended mainly on natural waters for supplies of fish; but as a result of declining catches of wild fish due to an increased fishing effort by the growing population as well as environmental degradation, people began to culture fish in enclosed waters. The polyculture of major and exotic carps and monoculture of striped catfish (*Pangasius hypophthalmus*), Nile tilapia and Java barb (*Barbonymus gonionotus*) and to some extent catfish (*Clarias batrachus*) are the most widely practiced culture system in Bangladesh. Three Indian major carps namely, *Labeo rohita*, *Catla catla* and *Cirrhinus mrigala* and one exotic carp, *Hypophthalmichthys molitrix* now account for more than 78 % of total pond production [29]. However, carp polyculture at the individual small holder level has the greatest potential for expansion since it can, through the implementation of more intensive culture systems including the application of fertilizers, use of supplemental feeding and improved management practices [30], provide a significant potential increase in income, by as much as 57 % or US$ 717/ha, this is more than the other culture practices in use [24]. At present annual average fish production using pond culture is 2609 kg/ha [1].

A total of 260 fish species have been recorded in the freshwaters of Bangladesh [31] of these it is estimated that about 200 species are truly freshwater while the rest are examples of estuarine and marine species.

Of these 200 species, 59 belong to 20 families that are commercially important, the majority of which are carps and catfish. At present, major carps such as *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala* and *Labeo calbasu* along with exotic carps such as silver carp (*Hypophthalmichthys molitrix*); grass carp (*Ctenopharyngodon idellus*) and common carp (*Cyprinus carpio*) are cultured in polyculture system in ponds. There are also not less than 40–50 small indigenous fish species which grow to a maximum length of 25 cm [32], some of the more commonly found species include *Puntius ticto*, *Amblypharyngodon mola*, *Colisa lalius*, *Anabas testudineus* and *Glossogobius giuris*. IUCN [33] reported that many of the small indigenous fish are now critically endangered or endangered.

Indian major carps and exotic carps are the most commonly stocked species in Kaptai Lake and in oxbow lakes. Haroon *et al*. (2002) reported a total of 92 species of fish and prawn from the Sylhet-Mynensingh basin of Bangladesh. Brackishwater giant tiger prawn (*Penaeus monodon*) and giant river prawn (*Macrobrachium rosenbergii*) are the main cultured species in coastal areas [23].

Total fish production by Bangladesh in 2003 amounted to 2 102 026 tonnes (DoF, 2005) of which 914 752 tonnes or 43.5 % was produced by the aquaculture sector. Production from ponds and ditches totaled 795 810 tonnes, coastal aquaculture (shrimp and fish ponds) 114 660 tonnes, Kaptai lake 7 238 tonnes and from oxbow lakes 4 282 tonnes [1]. Aquaculture production in Bangladesh has increased 6–8 % per annum during the period 1991–2002 [34].

Both fisheries and aquaculture in Bangladesh play a major role in alleviating protein deficiency and malnutrition, in generating employment and foreign exchange earnings. Moreover, the fisheries sector contributes 5.10 %, of the country's export earnings, 4.91% of its GDP and provides 63 % of the national animal protein consumption [24]. Fish and fishery products are the country's third largest export commodity contributing 5.10 % of its exchange earnings, in 2002–2003 Bangladesh earned US$ 324 million of which shrimp alone contributed 72 % of the total by quantity and 89 % by value [24].

Islam and Dewan [35] carried out a study on resource use and economic returns in pond fish culture, in which they identified that pond fish production was mainly based on stocking fish seed, use of fertilizer and feed and human labor for different operations and management. They also observed that net return was positively influenced by price of output and economic use of both material inputs and labor.

Islam [36] made efforts to estimate the effects of seven factors on pond fish output using a Cobb-Douglas production function and found that fish seed, fertilizer and artificial feed, human labor, farm size, age of pond and number of pond owners were significant in explaining the variation in pond fish output, but the results varied across the different locations.

Rahman [37] explored the contributions of key variables to the production process of pond fish farming. He observed that ownership of pond, number of species and human labor had a negative impact on pond fish output, while depth of pond water, farm size, fish seed, fertilizer and artificial feed were found to be responsible for explaining the variation in pond fish output. He also identified higher feed prices as one of the major problems of pond fish production in the study area.

Rana [38] worked to find the influencing variables for pond culture and found that pond size and stocking of fingerlings had negative effects and pond ownership, feed, fertilizer and human labor had positive effects on pond fish production.

In analyzing the relationship between supplementary feed and fish production, Hossain *et al.* [39] showed that the average production of carp of 2133.30 kg/ha would be obtained in 105 days in a mixed culture system using supplementary feed (rice bran and mustard oil cake in a ratio of 1:1) at 5% of total fish body weight daily in two installments. During this research work, the respondents opined that sometimes feeds were not sufficiently available to them and feed prices went beyond their ability to pay.

Das [40] determined the profitability and effects of specific factors on fingerling production under non-government organization (NGO) supervision. She found that producing fingerling in a nursery pond was highly profitable and pond size, cost of spawn stocked, material cost, feed cost, human labor cost and management cost had significant impacts on nursery operations.

Nurunnahar [41] observed net return and resource use efficiency of carp poly culture in the Kushtia district of Bangladesh. She found carp poly culture to be a profitable business and other than human labor, inputs were used in an efficient manner. She also found that the poly culture farmers expected higher fish prices as production costs were higher due to higher prices of inputs, especially fish feeds.

Islam [42] worked on the profitability and technical efficiency of hatchery operation and observed hatchery farms to be highly profitable. Education, experience and training received by the hatchery operators were found to be the most important factors explaining technical efficiency.

Presently most of the pond in Patuakhali district is under traditional culture from where highest yearly production 3 to 5 Kg/decimal. Further more different types of fish diseases, low growth rate, water pollution lowered the fish production. Lack of knowledge on fish culture is the main cause of the less production from large water body. This not only hampers the fish production but also hampers the fish demand fulfillment as well as the economy of the country.

Comparative study on production performance of white fish between traditional and modified traditional culture system that are being widely practiced in Patuakhali, Bangladesh is necessary to address economic return in aquaculture.

The present study was carried out to compare the production performance of white fish from traditional and modified traditional culture system Patuakhali with the following objectives:

- To know the production performance in traditional and modified traditional culture systems.
- To observe the economic feasibility of two culture methods
- To find out the effect of stocking density on survival and production in different culture system.
- To know the socio-economic status of the fish farmers involved in both culture system.

2. MATERIAL AND METHODS

The survey was conducted in the three different upazilas (Patuakhali sadar, Galachipa and Mirzagonj) of Patuakhali district of Bangladesh. Ten ponds of each culture system from each area of Patuakhali Sadar, Golachipa and Mirzagonj were selected for this study. Table 1 shows the area of each pond of both culture systems-

The study was conducted from March 1, 2008 to 30 April, 2009. A combination of the following survey techniques were used for data collection. Series of individual interview, semi-structured interview and observation of daily activities were the primary sources of required data and information for this research. A structured questionnaire was used for formal interviews with different farmer who were involved in fish culture. Primary data were collected by using following methods:

A structured questionnaire for individual respondents was used as the instrument for survey. For this purpose, fish farmers of 60 selected ponds were interviewed. The questionnaire was designed on the basis on coordination scheme. Farmers were interviewed at their houses and/or pond sites. The interviews focused on history of fish farming, culture systems, pond preparation technology, feeding technology, harvesting, diseases, and constraints of economic return from white fish culture.

Direct field observation was also accomplished in order to get the additional information on the culture practices and to justify cost-benefit aspects. The information collected

Table 1: Area of research pond in different upazilla

No. of the pond	Patuakhali Sadar		Golachipa		Mirzagonj	
	Traditional In decimal	Improve traditional In decimal	Traditional In decimal	Improve traditional In decimal	Traditional In decimal	Improve traditional In decimal
1	4.15	4.85	4.36	4.30	5.25	4.13
2	4.15	9.64	4.78	5.68	4.52	3.10
3	4.40	7.88	8.21	4.02	3.79	3.28
4	4.44	6.24	5.62	3.66	5.05	7.78
5	4.44	3.97	3.53	7.40	3.23	3.13
6	4.71	6.54	3.31	6.40	4.59	3.05
7	4.71	3.86	3.21	3.72	4.08	3.62
8	4.80	3.21	4.13	10.37	3.54	9.25
9	4.98	7.02	4.59	3.51	7.58	9.64
10	4.85	3.2	11.02	4.82	3.03	3.21

from direct observation was useful for validation of data collected through structured questionnaire interviews. Photographs were taken to record different fish culture activities.

Crosscheck interviews were conducted with key informants such as school teachers, local leaders, social workers, *Upazila* Fisheries Officers and relevant NGO workers to validate collected primary data.

Data on white fish culture was collected from relevant Government and non-government organizations such as DoF, and relevant NGOs. In addition, more secondary data was collected from the related journal articles, books, reports and related web page.

Twenty farmers from each Upazila were selected who were involved in white fish culture in traditional method. Among them 10 farmers from each Upazila were given training on modified traditional culture method.

Traditional culture system is less expensive culture technique for farmers. They just released some fish fry in their pond. No fertilizer and fish feed used in this method. No management was carried out for fish culture. This method fully depended on natural feed. Stocking density was not defined.

This is a bit expensive culture method. In this method, dike repair, aquatic weed removal, unwanted hunter fish remove, liming, fertilizing, primary feed test was done. Stocking density was defined. No supplementary feed used in this method.

Total cost was divided into two categories- fixed costs (rental value, pond excavation, bamboo fence, equipment and accessories costs – blue net, harvest equipment etc.) and variable costs (seed, feed, labor, lime, fertilizer, and other costs- transport cost, harvest cost, etc.). All calculation was based on per decimal per crop.

The **c**ost-benefit ratio in white fish culture was calculated by the following formula (Shang, 1990).

Total costs = Fixed cost + Operating cost (variable cost);
Gross return = Total production × sale price per unit production;
Gross margin = Gross return- Variable cost
Net return = Gross return – Total cost;
Cost-benefit ratio = Total benefit / Total cost;
ROI = (Net revenue/Total investment) × 100.
The following table 2 shows the cost-benefit analysis.

Table 2: Cost and returns of white fish farming per decimal pond

No.	Particulars	Value (Tk.)
A	Fixed cost (Tk/deci/year)	***
B	Variable cost (Tk/deci/year)	***
C	Gross cost (A+B)	***
D	Yield (kg/deci/year)	***
E	Average unit price (Tk/kg)	***
F	Gross return (Tk/deci/year)	***
G	Gross Margin (F-B)	***
H	Net Return (Tk/deci/year)	***
I	Benefit- cost ratio	***
J	Return of investment	***

Source: Karim R. T. and Saifuddin M. S. (USAID), August 2005

Collected data from various sources were coded and entered into a database system using Microsoft Excel software. Numerical data which were collected in local units due to familiarity for respondents, converted into international units before transfer into computer. Preliminary data sheets were compared with the original coding sheets to ensure the accuracy of the data entered. At each stage of survey, data

were checked, edited and coded at the field-level. Data were summarized using descriptive statistics.

3. RESULTS

3.1. Socioeconomic profile of the farmers

3.1.1. Age distribution

The average age of the traditional farmers was found 34.28±6.8175 years. While the maximum and the minimum age of the traditional farmers was 48 years and 21 years respectively. Most of the traditional farmers (53.33 %) were found within the range of 31 to 40 years (Fig. 1). Conversely the average age of improve traditional farmers was found 36.28±5.7497 years where as the maximum and minimum age was found 50 years and 28 years respectively. Most of improve traditional farmers (46.67%) were found within the range of 31 to 40 years (Fig. 1).

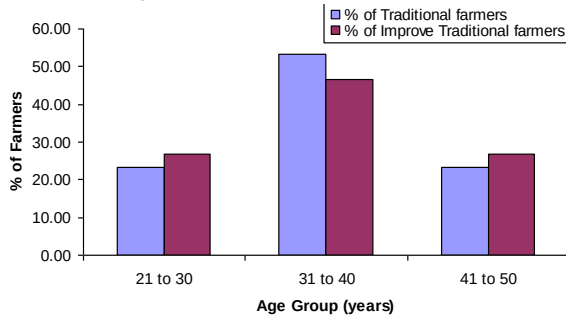

Fig. 1: Age group distribution of farmers in the study area

3.1.2. Sex distribution

In case of traditional farmers 80% was male (Fig. 2).

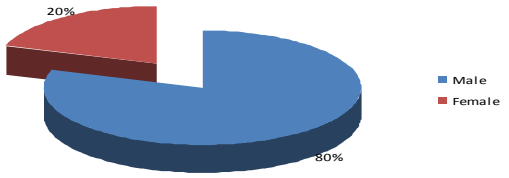

Fig. 2: Sex distribution of traditional farmers in the study area

In case of improve traditional farmers male percentage (70%) was found less than that of traditional farmers (Fig. 3).

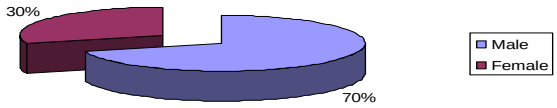

Fig. 3: Sex distribution of improve traditional farmers in the study area

3.1.3. Marital status

All most all traditional farmers (90%) were married. But in case of improve traditional farmers percentage of married farmers was slightly less (73%) than that of traditional farmers. About 17% improve traditional farmers were found as widowed (Fig. 4).

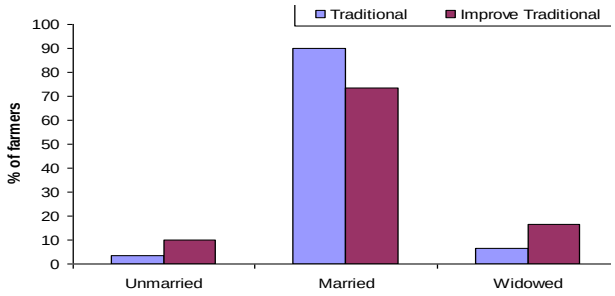

Fig. 4: Marital status of farmers in the study area

3.1.4. Educational status

Educational attainment is a commonly used to measure of human capital. Among the traditional farmers 6.67% had no formal education, 53.33% had education above below SSC level. No respondents had education postgraduate level (Fig. 5). In case of improve traditional farmers no one was found illiterate, 46.67% had education above below SSC level. Among improve traditional farmers 3.33% farmers was found who completed post graduation level.

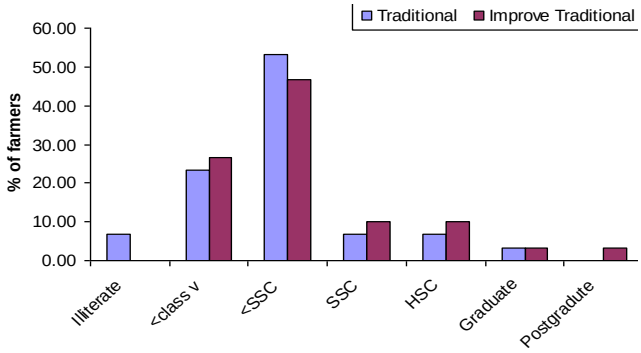

Fig. 5: Education status of farmers in the study area

3.1.5. Household Member of the respondents

Most of the respondents (40%) had family member within 2-4 in number (Fig. 6). The maximum and the minimum number of family number of traditional farmers were 11 and 2 respectively. The average number of the respondent's family member was 5.56 ± 2.3305. On the other hand the maximum and minimum number of improve traditional farmers were 10 and 2 respectively where as the average number of the respondent's family member was 5.09±1.7905.

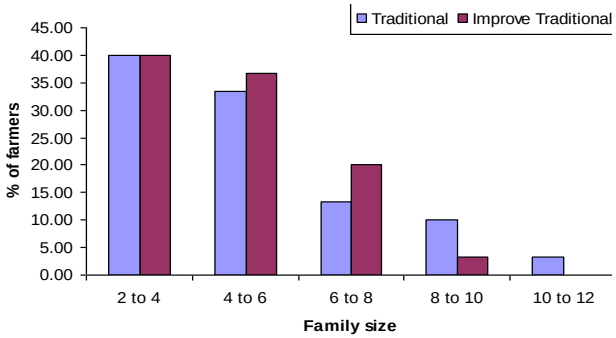

Fig. 6: Family size of farmers in the study area

3.1.6. Occupational status

Occupation is defined as an activity that the people pursue for earning their living. Agriculture was the main or primary occupation of most of the people in the study area. In addition, the people in this area were also engaged in other occupations in order to solve their financial problems.

3.1.6.1. Primary occupation

Agriculture was the primary occupation of 35% traditional farmers. Second highest primary occupation of traditional farmers was found as aquaculture (23.33%). Alternately agriculture was found as primary occupation (36.67%) of improve traditional farmers but second highest primary occupation was found as house wives because 30% of improve traditional farmers were female.

3.1.6.2. Secondary occupation

Among the traditional farmers aquaculture was found as highest secondary occupations which was 73.33% and among improve traditional farmers aquaculture was found as highest secondary occupation which was 60.00% (Table 3).

Table3: Distribution of occupation in the study area

	Traditional Farmers		Improve Traditional Farmers	
Occupation	**Primary (%)**	**Secondary (%)**	**Primary (%)**	**Secondary (%)**
Agriculture	35.00	5.00	36.67	23.33
Aquaculture	23.33	73.33	16.67	60.00
Daylabor	18.33	20.00	10.00	16.67
House wife	15.00	0.00	30.00	0.00
RikshaDriver	1.67	0.00	0.00	0.00
S.Buisness	1.67	0.00	3.33	0.00
Wood maker	1.67	0.00	0.00	0.00
Tailor	1.67	0.00	0.00	0.00
Tea stall	1.67	0.00	0.00	0.00
Poultry farm	0.00	1.67	3.33	0.00

3.2. Aquaculture status

3.2.1. Stocking density

In case of traditional farmers in Patuakhali sadar, Galachipa and Mirzagonj, highest pond area found 4.98 decimal, 11.02 decimal and 7.58 decimal respectively and lowest 4.15 decimal, 3.21 decimal and 3.03 decimal where average pond areas was found 4.56 ±0.29 decimal, 5.58 ±2.49 decimal and 4.6 ±1.32 decimal respectively. In case of untrained traditional farmers in Patuakhali sadar, Galachipa and Mirzagonj, highest stocking density was 319, 290 and 339 fingerlings/ decimal respectively, lowest 125, 166 and 120 fingerlings/decimal respectively and average stocking density was 207 ±57, 219 ±38 and 227 ±56 fingerlings/ decimal.

In case of improve traditional farmers in Patuakhali sadar, Galachipa and Mirzagonj, highest pond area found 9.64, 10.37 and 9.64 decimal respectively, lowest 3.2, 3.51 and 3.05 decimal respectively and average 5.64 ±2.18, 5.65 ±2.18 and 5.24 ±2.73 decimal respectively. In case of trained farmers in Patuakhali sadar, Galachipa and Mirzagonj, stocking density was fixed which were 55 fingerlings/ decimal.

3.2.2. Species selection

Species selection was done according to price of species. Four types of species combination were found that usually stocked by untrained farmers. Species combination were

1. Tilapia, Pangas, Thaiputi, Commoncarp, Grasscarp, Silvercarp
2. Rui, Katla, Silvercarp, Grasscarp, Pangas and Thaiputi
3. Silvercarp, Grasscarp, Bigheadcarp, Pangas, Tilapia and Mrigale
4. Rui, Katla, Kalboush, Grasscarp, Thaiputi, Tilapia and Pangas

Highest used combination was combination 2 and lowest was combination 4 (Fig: 7)

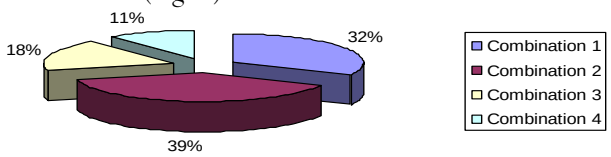

Fig 7: Percent of traditional farmers used different species combination

The farmers who were trained for improve culture use the define combination which was 10% Grasscarp + 30% Katla + 30% Rui + 30% Mrigale.

3.2.3. Feed and feeding

Usually no artificial feed was used by the farmers through the culture period. Some of traditional farmer used rice bran, wheat bran, rice and kitchen wastage as feed irregularly. No fertilizer used by the farmers for primary production. Among different supplementary feed, rice bran

was used as highest percent and lowest using supplementary feed was wheat bran (Fig 8).

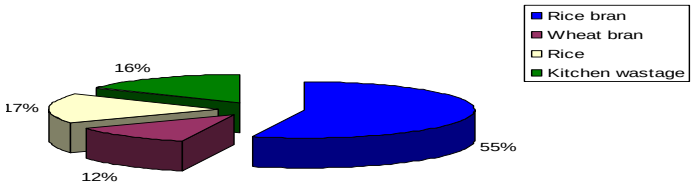

Fig 8: Percent of feed ingredients used as supplementary feed

But in case of improve culture farmer, it was trained to give importance on primary production of pond rather than use of supplementary feed. For this all farmers used both inorganic fertilizer (Urea and TSP) and organic fertilizer (Cow-dung and Oilcake) to confirm primary production. They also used rice-bran and wheat-bran as supplementary feed.

3.2.4. Survival rate

From the data it was found that the highest survival rate of traditional ponds of Patuakhali sadar, Galachipa and Mirzagonj was 72%, 78% and 74% respectively and the lowest survival rate was 50%, 55% and 48% where average survival rate was found as 62±6.21%, 65±5.25% and 61±11.25% respectively.

On the other hand it was found that the highest survival rate of improve traditional ponds of Patuakhali sadar, Galachipa and Mirzagonj was 85%, 90% and 85% respectively and the lowest survival rate was 70%, 75% and 70% where average survival rate was found as 76±5.16%, 80±4.97% and 77±5.87% respectively.

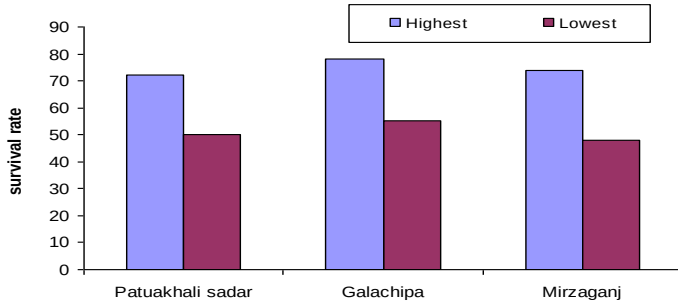

Fig 9: Survival rate of traditional ponds of different upazila

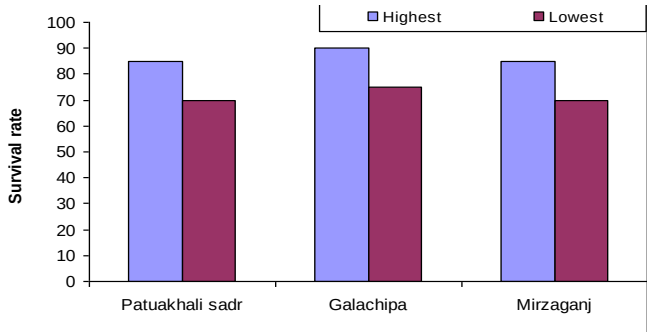

Fig 10: Survival rate of improve traditional ponds of different upazila

3.2.5. Production performance

In Patuakhali sadar upazila, highest production of untrained farmer was found 5.84 kg/decimal, lowest production was found 3.61 kg/decimal and average production was found 4.71±0.7652 kg/decimal. On the other hand highest production of trained farmer was found 11.67 kg/decimal, lowest production was found 9.08 kg/decimal and average production was found 10.67±0.8830 kg/decimal.

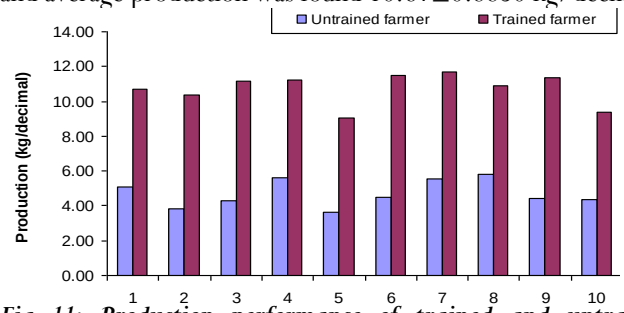

Fig 11: Production performance of trained and untrained farmers of Patuakhali sadar

In Galachipa upazila, highest production of untrained farmer was found 5.29 kg/decimal, lowest production was found 3.45 kg/decimal and average production was found 4.47±0.7365 kg/decimal. On the other hand highest production of trained farmer was found 11.20 kg/decimal, lowest production was found 10.16 kg/decimal and average production was found 10.66±0.3342 kg/decimal.

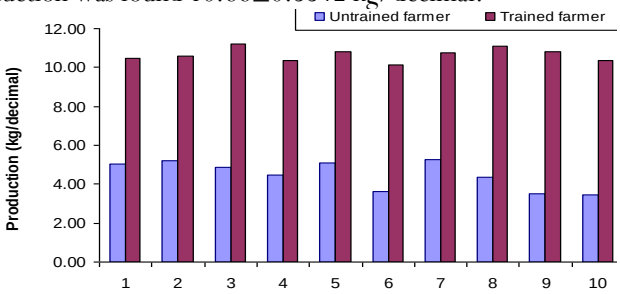

Fig 12: Production performance of trained and untrained farmers of Galachipa

In Mirzaganj upazila, highest production of untrained farmer was found 4.95 kg/decimal, lowest production was found 3.7 kg/decimal and average production was found 4.47±0.4127 kg/decimal. On the other hand highest production of trained farmer was found 11.29 kg/decimal, lowest production was found 9.76 kg/decimal and average production was found 10.43±0.4785 kg/decimal.

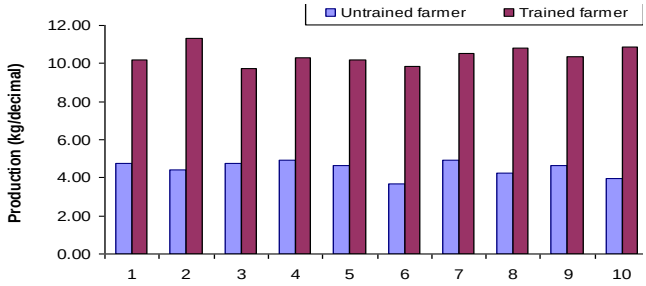

Fig 13: Production performance of trained and untrained farmers of Mirzaganj

From the above data of traditional farmers, it was found that within 3 upazilas of Patuakhali district highest production was found as 5.84 kg/decimal in Patuakhali sadar upazila, lowest production was 3.45 kg/decimal in Galachipa where highest average production was found 4.71±0.7652 kg/decimal in Patuakhali sadar upazila and lowest average production was found 4.47±0.7365 kg/decimal in Galachipa.

In contrast, from the above data of improve traditional farmers, it was found that within 3 upazilas of Patuakhali district highest production was found as 11.67 kg/decimal in Patuakhali sadar upazila, lowest production was 9.76 kg/decimal in Mirzaganj where highest average production was found 10.67±0.8830 kg/decimal in Patuakhali sadar upazila and lowest average production was found 10.43±0.4785 kg/decimal in Mirzaganj.

3.3. Cost-benefit analysis

Table 4: Item wise costs involved in traditional fish farmers per decimal pond per crop.

Costs type	Costs Item	Average cost (Tk/deci)	SD	No of sample(n)	% Total cost
A. Fixed costs					
	Pond excavation	180	11	30	21.66
	Sub-Total(A)	180	11		
B. Operating costs					
B1. Pond preparation					
	Labor cost	160	7	30	19.25
	Sub-total (B1)	160	7		
B2.Pond management					
	Fingerlings	326	28	30	39.23
	Feed cost	75	3	30	9.03
	Sub-total (B2)	401	31		
B3. Harvesting					
	Labour	50	4	30	6.02
	Net	25	2	30	3.01
	Transport	15	2	30	1.81
	Sub-total (B3)	90	8		
Total fixed costs(A)		180	11		21.66
Total operating costs (B1+B2+B3)		651	46		78.34
Total costs (A+B)		831	57		100.00

Table 5: Costs and return of investment of traditional fish farming per decimal pond per crop

No	Particulars	Average costs (Tk./deci)	SD
A	Fixed cost	180	11
B	Variables cost	651	46
C	Gross cost (A+B)	831	57
D	Yield	4.55	0.14
E	Average unit price (Tk./kg)	82.5	9.35
F	Gross return (Tk./deci/crop)(D× E)	375.375	
G	Gross Margin (F-B)	-275.625	
J	Net return/Crop (F-C)	-455.625	
K	Benefit- cost ratio(F/C)	0.45	

Table 6: Item wise costs involved in improve traditional fish farmers per decimal pond per crop

Costs type	Costs Item	Average cost (Tk/deci)	SD	No of sample(n)	% Total cost
A. Fixed costs					
	Pond excavation	210	17	30	21.66
	Sub-Total(A)	210	17		
B. Operating costs					
B1. Pond preparation					
	Labor cost	130	13	30	17.65
	Lime	15	0	30	2.04
	Organic fertilizer	14	0	30	1.90
	Inorganic fertilizer	12	0	30	1.63
	Sub-total (B1)	171	13		
B2.Pond management					
	Fingerlings	82.50	1.75	30	11.13
	Lime	7.50	0.5	30	1.02
	Organic fertilizer	52.50	1.75	30	7.06
	Inorganic fertilizer	48.00	2.50	30	6.52
	Feed cost	40	3.75	30	5.43
	Sub-total (B2)	230.50	10.25		
B3. Harvesting					
	Labour	75	3	30	10.18
	Net	25	1	30	3.39
	Transport	25	3	30	3.39
	Sub-total (B3)	125	7		
Total fixed costs(A)		210	17		28.51
Total operating costs (B1+B2+B3)		526.50	30.25		71.94
Total costs (A+B)		736.50	47.25		100.00

Table 7: Costs and return of investment of improve traditional fish farming per decimal pond per crop

No	Particulars	Average costs (Tk./deci)	SD
A	Fixed cost	210	17
B	Variables cost	526.50	30.25
C	Gross cost (A+B)	736.50	47.25
D	Yield (kg/decimal)	10.60	0.14
E	Average unit price (Tk./kg)	132.85	14.10
F	Gross return (Tk./deci/crop)(D× E)	1408.21	
G	Gross Margin (F-B)	881.71	
J	Net return/Crop (F-C)	671.71	
K	Benefit- cost ratio(F/C)	1.91	

4. DISCUSSION

Information of age distribution of the respondents is important in estimating potential work force in the selected community. Education, health and employment planning largely rely on the information of age distribution. The average age of the traditional fish farmers was 34.28±6.8175 years and improve traditional farmers was 36.28±5.7497 years. The average age of coastal fishermen and shrimp fry collector has been reported between 40 and 42.4 years [43]. Marital process is a way to establish linkages among different families. Again, relationship through marital process open up the choice of opportunities for potential livelihood strategies. Most of the respondents (both traditional and improve traditional fish farmer) in the study area were married. However, no one was found divorced. The small sample size would be responsible for such result.

The formal education helps in the acquisition of required skills for a job which demands non-traditional skills and imparts knowledge about different occupational opportunities. The present results show that only 6.67% traditional farmers were illiterate in the study area. Most of traditional farmers (53.33%) had minimum level of formal education at SSC level. No illiterate respondents found in case of improve traditional farmers which may be the error of small sample size. Most of improve traditional farmers (46.67%) had minimum level of formal education at SSC level. Most surprising findings were 3.33% improve traditional farmers completed graduation level and 3.33% completed post graduation level.

The mean family size of traditional fish farmers was 5.56 ± 2.3305 (n = 30) and that of improve traditional farmers was 5.09±1.7905 (n = 30), which is lower the mean national family size of 5.6 people/household [44]. This would be due to awareness developed among the respondents through education.

Most of the traditional farmers were engaged in agriculture (35%) as primary occupation. From the study area 23.33% traditional farmers were found who engaged in aquaculture as their primary occupation. Among improve traditional farmers 36.67% was found who depended on agriculture as their primary occupation. In case of improve traditional farmers 30% was found whose primary occupation was house wife. On the other hand it was found that 73.33% traditional farmers and 60% improve traditional farmers depend on aquaculture as their secondary occupation. The main reason behind this result was every family has a pond for domestic works. Some of them had additional occupation in poultry, day labor and agriculture as secondary occupation. Many respondents in the study area had changed their occupation from other business to fish farming due to comparatively higher profitability in less invest and less labor.

BBS [28] reported that the pond size of Bangladesh is 0.02 ha to 20 ha where average size is .30 ha. From the study it was found that the average pond sizes of traditional farmers of three upazila were 4.56 ±0.29 decimal, 5.58 ±2.49 decimal and 4.6 ±1.32 decimal respectively and the average pond sizes of traditional farmers of three upazila were 5.64 ±2.18, 5.65 ±2.18 and 5.24 ±2.73 decimal respectively in Patuakhali sadar, Galachipa and Mirzagonj. The reason of small size pond was identified as it was not actually excavate for fish culture; it was excavate for their domestic work.

Growth and production of fish mainly depends on the stocking of fingerlings at fixed number in different layer of pond which make less competition for food. Stocking density and stocking rate of a pond actually depend on its physico-chemical parameters and culture management. After different experiments, scientist gave a general recommendation about stocking density. According to Haroon et al. [45] stocking density should be 3000-3500 piece/hector. From the study it was found that all traditional farmers used unbelievably high stocking density (averagely more/less 200 fingerlings/ decimal without any concern of layer wise distribution). In case of selected farmers who were trained for improve traditional culture followed the recommended number (Carp poly-culture training manual) which was 55 fingerlings/ decimal (10% Grasscarp, 30% Katla, 30% Rui and 30% Mrigale).

In 2007, traditional farming system was followed by all the farmers (n=60) of all three upazilas of Patuakhali district. 30 farmers were trained for improve traditional farming system in 2008. In 2008, average production of traditional farmers was found as 4.71±0.7652 kg/decimal in Patuakhali sadar upazila, 4.47±0.7365 kg/decimal in Galachipa upazila and 4.47±0.4127 kg/decimal in Mirzaganj upazila. From the data analysis it was found that the overall average production of traditional farmers of Patuakhali district was 4.55±0.6381 kg/decimal. And average production of improve traditional farmers was found as 10.67±0.883 kg/decimal in Patuakhali sadar upazila, 10.66±0.3342 kg/decimal in Galachipa upazila and 10.43±0.4785 kg/decimal in Mirzaganj upazila. From the data analysis it was found that the overall average production of improve traditional farmers of Patuakhali district was 10.59±5652 kg/decimal.

Now if the average production of improve traditional culture system is compared with the average production of traditional culture system, production increased about 6.04 kg/decimal.

From the cost-benefit analysis, it was found that benefit cost ratio of traditional farmers of Patuakhali district was 0.45 in 2008. Whereas benefit cost ratio of improve traditional farmers was 1.91. So the benefit cost ratio of **traditional farmer: improve traditional farmer = 1:4.24**.

5. CONCLUSION

Bangladesh is a small country with high dense population. It has very few resources against its demand. But also the utilization of the resources is very poor. Almost all sector, we are adopted with traditional technology which makes the production level very poor. To conquer this problem, current research was done which was completed with a small sample size due to financial and infrastructural limitations. But the result shows the lightening future of aquaculture sector if improve traditional technology can be adapted to the fish farmers. From the result it can be assumed that utilization of improve technology can increase the fish production two and half time more than that of current production. For this Government and other related NGO's should have to take proper step to make the fish farmers adapted with improve technology. This not only increases the fish production but also fulfill the protein demand of our country. This will also help us to get back our country tradition "Mase Bhate Bangali".

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