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Impact of fish culture value chain development project on production, pond area, employment creation, and technical capability of participating farmers in some areas of Natore district, Bangladesh

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Abstract

This study examines the impact of the fish culture value chain development project of PKSf (Palli Karma Sahayak Foundation) implemented by United Development Initiatives for Program Action (UDDIPAN) on fish farmers in the Natore district. The project period was 20 months. With the views in mind, 600 project participating fish farmers were selected purposively from the study area. It is evident that 15.53% of farmers used lime regularly as a precautionary measure against fish stocks in their ponds but 84.46% of farmers applied lime irregularly. At present, 100% fish, farmers apply a moderate amount of lime during the preparation of fish farming ponds. The final assessment survey found that fish feeding increased by 95% of the farmers used regular and 5% of the farmers applied irregular food. The final fish marketing capabilities increased by 58.58% sold fish from farms, 20.32% from local markets, and 21.12% from national markets. Fry marketing increased by 83.57% sold fry to farmers, 16.27% to potters, and 6.18% to other places. Water change increased by 90% of the farmers change the water regularly and 10% of the farmers change the water irregularly in the pond after participating in the fish culture value chain development project of PKSf implemented by UDDIPAN. Fish production has been 14.77 kg per decimal in the pond. Finally, the study concludes that PKSf on fish culture value chain development project had positively influenced production, pond area, employment generation, and technical capability of participating farmers in the project area.

Keywords: Fish production, pond volume, employment creation, and technical build-up

Introduction

Bangladesh is blessed with vast and rich fisheries resources in the form of rivers, beels, haors, ponds, inundated crop fields, sanctuaries, a part of the Bay of Bengal, etc. and it is covering about an area of 5.33 million hectares (DoF, 2005) [7]. Fish and fisheries play a vital role in the socio-economic development of the country by fulfilling the animal protein demand, creating employment opportunities, alleviating the poverty of a large population, and earning foreign currency. It not only contributes 3.74% of the country's GDP but also shares 3.00% of the total export earnings (DoF, 2010) [10]. It represents the second largest export commodity after readymade garments.

Bangladesh is now the fifth-biggest fish producer in the world after China, India, Vietnam, and Indonesia (FAO, 2018) [11]. Approximately 60 percent of animal protein comes from fish, and the fisheries sector contributes 3.74 percent to the country's GDP. This is possible due to the rapid aquaculture growth in Bangladesh. Although the country has gained self-sufficiency in terms of agricultural production, productivity needs to be increased to meet the needs of the growing population. In that case, pond culture represents huge potentiality accounting for 44.43% of the total recorded production and 57.70% of the area under culture and it has the potential to increase further (DoF, 2019) [9]. Dominating species for pond aquaculture are Indian major carps and exotic carps (Hasan and Ahmed, 2002) [14]. However, the potentiality of carp polyculture is beyond the reach to be sustainable due to climate change which makes the fisheries sector of Bangladesh vulnerable to environmental degradation in various magnitudes; such as groundwater sinking and contamination through pollutants (DoF, 2017) [8].

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This phenomenon is mostly true for the northern part of Bangladesh, which is a typical tract region characterized by red or yellow clay soil, limited rainfall, and a lack of water sources in the dry season. In these consequences, poor survival and reduced growth of cultured fish species are evident frequently in this area (Hossain, 2011) [27]. The appropriate technique is thus felt necessary to increase fish production in the vulnerable areas due to climate change. Mixed fish culture is a popular technique to increase biomass in animal rearing and this practice is often followed for the production of beef cattle (Sarma *et al.*, 2014) [24] and crab (Ferdoushi, 2013) [12] in Bangladesh. Stocking of overwintered and larger size fish species in mixed fish culture is considered beneficial to mitigate the fish culture problem of lower water columns under drought-prone areas because overwintering is a proven technique to obtain the fast growth of fish (Alam *et al.*, 2002; Jobling, 2010) [2, 17] and larger stocking size under lower density can help to obtain maximum fish biomass within a shorter period (Grover *et al.*, 2000) [13]. However, appropriate selection of species combination; judicious utilization of inputs like feed and fertilizers; and proper application of good aquaculture practices (GAP) should also be considered important for the sustainability of carp mixed culture technique. The selection of suitable species combinations in a polyculture system is important to obtain maximum fish production through the total utilization of different trophic and spatial niches of a pond. Species combination should include species with diversified feeding habits that should include surface, column, and bottom feeder fish species (Bhanu *et al.*, 2018; Azad *et al.*, 2004) [6, 5]. Appropriate species combinations can also improve the pond environment. Surface feeder silver carp can control unwanted algal bloom and the bottom feeder mrigal, common or mirror carp can help in the re-suspension of bottom nutrients to water while stirring the bottom mud in search of food (Talukder *et al.*, 2018) [26]. On the other hand, where there is an effort for aquaculture intensification, there is a chance of environmental degradation and disease occurrence, especially in feed and fertilizer-based systems. Public health is therefore being of prime concern. It is suspected that the organic wastes improve the nutrients levels in the ponds, a situation that will increase the plankton productivity and it is ideal for fish growth, but enhances the conditions where pathogenic bacteria can introduce into the ponds and increase the risk of transfer of some zoonotic disease from the fish to the human (Herbst *et al.*, 2008) [15]. Good aquaculture practice (GAP) is a series of activities from pond preparation to harvesting necessary to maintain the proper hygienic condition of the culture ponds (Schwarz *et al.*, 2010) [25]. Poor construction and maintenance of the ponds result in unfavorable Physico-chemical condition of the pond water that interferes with the productivity of fish in the pond (Mondal *et al.*, 2013) [20]. Some research efforts are to mitigate the low alkalinity and high turbidity problems and to use a larger stocking size of fish than traditional practice (Talukder *et al.*, 2018) [26] to increase fish production in carp polyculture ponds under the project area. Unfortunately, no comprehensive effort is taken for safe fish production through mixed carp culture in ponds under the project area of Bangladesh. The specific objectives of this study were to monitor the mixed carp culture; to evaluate fish growth, yield, and economics of carp mixed culture in ponds under the project area of Bangladesh. Fisheries are the most importantly cheap and available animal protein sources in our daily food.

About 60% of the animal protein supply comes from fisheries resources. It is estimated that about 12 million people in the country earn their livelihood from fisheries and its related activities, in which more than 1.3 million people are directly engaged in the fisheries sector (Anderson, 1997) [4]. Nowadays, many people of Bangladesh come forward to practice aquaculture to uphold their livelihood. The fishermen's community, whose livelihood depends on only fish and fisheries, is left behind due to various constraints (Ali *et al.*, 2008) [3]. But some NGOs and microcredit financing organizations have come forward to help them solve their financial and other technical problems. They are now started to be involved in aquaculture on their own or hire sanctuaries instead of float fishing to change their fates (Ahmed *et al.*, 2007) [1]. The finding of the study would also be useful in choosing the client as well as for planning, executing, and evaluating the training programs. Although the study was done in a specific area of Bangladesh, the findings apply to other areas of the country, where the socio-cultural context is relevant to the study area and aquaculture is being practiced. The findings of the study would be immensely used by the Government policymakers, beneficiaries, extension workers, development planners, and NGO community of the country. Moreover, the findings would enhance the intellectual competence of the researcher and also contribute significantly to the development of the fisheries sector at the national level. Therefore, the present study was undertaken to assess the impact of the PKSF Fish culture value chain development project on production, employment generation, and technical capability of participating farmers in some areas of the Natore district.

Materials and Methods

Study area

One hundred twenty (120) farmers from Natore sadar upazila, Two hundred forty (240) farmers from Gurudaspur upazila, and Two hundred forty (240) farmers from Singra upazila in Six hundred (600) fish farmers under Natore districts were selected for the study to assess the impact of PKSF Fish culture value chain development project on their fish production, marketing, and technical capability.

Method of data collection

The selected fish farmer respondents were competent to furnish proper responses to the question included in the interview schedule. The researcher who acted as the interviewer was well adjusted to the socio-cultural environment of the study area. Thus, the researcher during data collection was free from bias.

The collected data from the sample fish farmer-beneficiaries using the personnel interview schedule before involvement in the Fish culture value chain development project from 01 July 2012 to 01 September 2012. Before starting data collection, the researcher discussed the objective of the study with the respondents, Senior Upazila Fisheries Officer and Agriculture Extension Officer of Natore sadar upazila, Gurudaspur upazila, and Singra upazila under Natore district for their cooperation in collecting data. After completing the interview, it was checked and edited in case of necessity. Out of 620 fish farmers targeted, data were collected from 600 fish farmer-beneficiaries. The rest twenty fish farmer was unavailable due to migration, change of occupation, etc. The collected data were analyzed as per the objective of the study. After completing the Fish culture Value Chain Development project

i.e., final data were collected from the trained farmer’s beneficiaries using a personnel interview schedule from 01 December 2013 to 31 January 2014. The collected data were analyzed as per the objective of the study.

Results and Discussion

Changes in liming to the pond of the fish farmer under the value chain development project

Table 1 shows that liming to the pond of the fish farmer has been improved due to the involvement of the fish culture value chain development project. The pre-assessment survey showed that 15.53% of farmers used lime regularly as a precautionary measure against fish stocks in their ponds, but 84.46% of farmers applied lime irregularly (Table 1). At present, 100% fish, farmers apply a moderate amount of lime during the preparation of fish farming ponds (Table 1).

Table 1: Change in liming to the pond of the fish farmer after joining of PKSf project

Categories	% of respondent	
	Before	After
Regular	15.53	100
Irregular	84.47	0
Total (%)	100	100

Changes in applying inorganic fertilizer to the pond of the fish farmer

Applying inorganic fertilizer to the pond of the fish farmer has been improved due to the involvement of the fish culture value chain development project. The pre-assessment survey showed that 15.17% of farmers used inorganic fertilizer regularly as a precautionary measure against fish stocks in their ponds, but 84.83% of farmers applied inorganic fertilizer irregularly (Table 2). At present, 100% fish farmers apply a moderate amount of inorganic fertilizer during the preparation of fish farming ponds (Table 2).

Table 2: Changes in applying inorganic fertilizer to the pond of the fish farmer after joining of PKSf project

Categories	% of respondent	
	Before	After
Regular	15.17	100
Irregular	84.83	0
Total (%)	100	100

Changes in fish feeding in the pond of the fish farmer

Apply to feeding in a fish pond of the farmer has been improved due to involvement of the value chain development project, which UDDIPAN has implemented. A preliminary survey revealed that 15.35% of 600 farmers used regular and 84.75% irregular feed (Table 3). The final assessment survey found that 95% of the farmers used regular and 5% of the farmers applied irregular food (Table 3).

Table 3: Changes in fish feeding in the pond of the fish farmer after joining of PKSf project

Categories	% of respondent	
	Before	After
Regular	15.35	95
Irregular	84.65	5
Total (%)	100	100

Changing water exchange in the fish pond of the farmer

Water exchange in the fishpond of the farmer has been

improved due to the involvement of the value chain development project, which UDDIPAN has implemented. The pre-assessment survey showed that 15.5% of the selected farmers in the project area changed the water regularly after fish stocks, 4.5% of farmers changed water irregularly and 80% of farmers did not change the water (Table 4). The final assessment shows that 90% of the farmers change the water regularly and 10% of the farmers change the water irregularly in the pond (Table 4).

Table 4: Changing water exchange in the fish pond of the farmer after joining of PKSf project

Categories	% of respondent	
	Before	After
Regular	15.5	90
Irregular	4.5	10
Never	80	0
Total (%)	100	100

Extension of mixed fish culture

Mixed fish culture has been extended under the fish culture value chain development project, which UDDIPAN has implemented. A preliminary survey shows that the 333 no. of farmers in mixed fish culture and 456 no. of pond and pond volume was 78928 decimal (Table 5). The final assessment survey found that 2225 no of farmers in mixed fish culture, 3256 no. of the pond, and 215635 decimal pond volume extended (Table 5).

Table 5: Extension of mixed fish culture under value chain development project

Categories	Before	After
No. of farmers	333	2225
No. of pond	456	3256
Pond volume (decimal)	78928	215635

Received technical support for fish culture

Farmers are received technical support for fish culture has been improved due to the involvement of the fish culture value chain development project, which UDDIPAN has implemented. Preliminary survey results show that 22.7% of the 600 farmers consulted the government fisheries office, 43.41% consulted skilled fish farmers and 33.62% did not seek technical advice for fish farming (Table 6). The final assessment survey found that 8.5% of the farmers received advice from the government fisheries office, and 22.5% from the skilled fish farmers for fish farming (Table 6).

Table 6: Changes in the receivable capacity of farmers for technical support of fish culture after joining of PKSf project

Categories	% of respondent	
	Before	After
Govt. fisheries office	22.77	77.5
Skilled farmer	43.41	22.5
Never	33.82	0
Total (%)	100	100

Fish marketing

The farmer has improved the fish marketing system due to the involvement of the fish culture value chain development project, which UDDIPAN has implemented. According to a preliminary survey, 16.34% of 600 farmers sell fish from farms, 46.16% from the local market, and 37.5% from the national market (Table 7). The final assessment survey found

that 58.56% sold fish from farms, 20.32% from local markets, and 21.12% from national markets (Table 7).

Table 7: Changing the fish marketing system of the farmer after joining of PKSf project

Categories	% of respondent	
	Before	After
Fish farm	16.34	58.56
Local market	46.16	20.32
National market	37.5	21.12
Total (%)	100	100

Fish fry marketing

The farmer has improved the fish fry marketing system due to the involvement of the fish culture value chain development project, which UDDIPAN has implemented. A preliminary survey revealed that 27.73% of nursery farmers sold fry to farmers, 52.25% to Patilowala, and 20.02% to other places (Table 8). The final assessment survey found that 73.57% sold fry to farmers, 18.27% to potters, and 8.16% to other places (Table 8).

Table 8: Changing the fish fry marketing system of the farmer after joining of PKSf project

Categories	% of respondent	
	Before	After
Fish farmers	27.73	73.57
Patilowala	52.25	18.27
Others	20.02	8.16
Total (%)	100	100

Impact of PKSf project on fish production, pond area, profit & employment generation

Fish fry production

Fish fry Farmers have increased fish fry production with the involvement of the fish culture value chain development project, which UDDIPAN has implemented. The preliminary survey revealed that no. of 149000 fry production from *Hypophthalmichthys molitrix* (silver carp), no. of 116500 fry production from *Labeo rohita* (Rui), no. of 129583 fry

production from *Cirrhinus cirrosus* (mrigel), no. of 35000 fry production from *Clarias batrachus* (magur), no. of 65000 fry production from *Heteropneustes fossilis* (shing) (Table 9). The final assessment survey found that no. of 250000 fry production from *Hypophthalmichthys molitrix* (silver carp), no. of 275000 fry production from *Labeo rohita* (Rui), no. of 200000 fry production from *Cirrhinus cirrosus* (mrigel), no. of 110000 fry production from *Clarias batrachus* (magur), no. of 130000 fry production from *Heteropneustes fossilis* (shing) (Table 9). Mollah *et al.* (2011)^[19] and Rahman *et al.* (2015)^[22] in earthen ponds, and Moniruzzaman *et al.* (2015)^[21] in floating cages, whereas they also reported higher survivability at lower stocking density. However, the survival rate of the fishes during the present study was higher compared to the findings of Talukder *et al.* (2018)^[26], Khan *et al.* (2018)^[18] and Roy *et al.* (2002)^[23] might be due to the improvement of pond environment through good aquaculture practices.

Table 9: Changing of fish fry production from 1kg fish spawn of farmers after joining of PKSf project

Species	No. of fish fry from 1kg fish spawn	
	Before	After
<i>Hypophthalmichthys molitrix</i>	149000	250000
<i>Labeo rohita</i>	116500	275000
<i>Cirrhinus cirrosus</i>	129583	200000
<i>Clarias batrachus</i>	35000	110000
<i>Heteropneustes fossilis</i>	65000	130000

Pond volume of fish culture

According to the project pre-evaluation survey, the total land area of 600 selected farmers in the project area was 67773.5 decimal. In other words, the average amount of land per farmer was 112.95 decimal (Figure 1). As a result of training and various types of technical assistance provided under the project, at present, according to the final evaluation report, *Heteropneustes fossilis* and *Clarias batrachus* with the carp species of 600 farmers, the total area under carp and catfish farming stood at 130456 decimal (Figure 1).

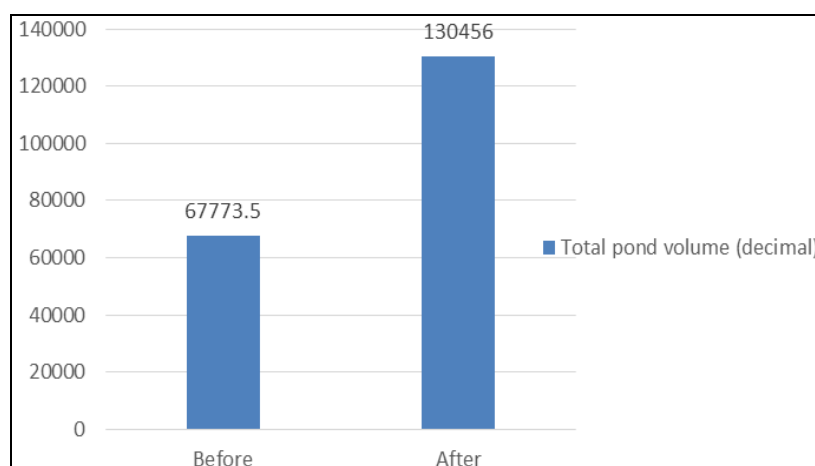


Fig 1: Area of the cultivated pond before and after the involvement of the PKSf project

Fish production

The main achievement of the successful implementation of the value chain development project is to increase the production of horn and catfish with carp. According to the pre-assessment, the fish production per decimal was 7.55 kg but now it produces 12.77 kg per decimal (Figure 2). Mollah

et al. (2011)^[19] and Rahman *et al.* (2015)^[22] in earthen ponds, and Moniruzzaman *et al.* (2015)^[21] in floating cages, whereas they also reported higher survivability at lower stocking density. However, the survival rate of the fishes during the present study was higher compared to the findings of Talukder *et al.* (2018)^[26], Khan *et al.* (2018)^[18] and Roy *et*

al. (2002) [23] might be due to the improvement of pond environment through good aquaculture practices.

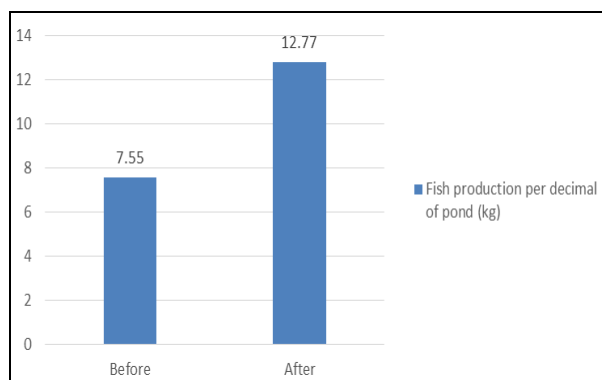


Fig 2: Fish production per decimal of pond before and after the involvement of the PKSF project

Profit

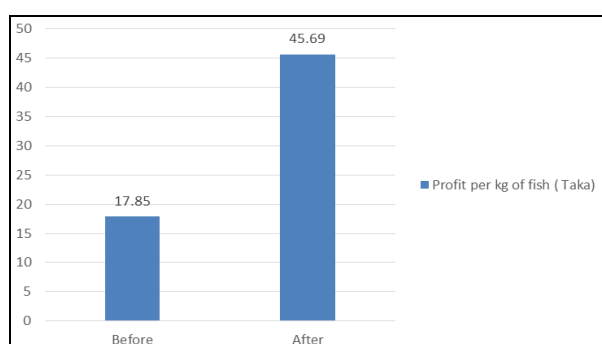


Fig 3: Profit per kg of fish before and after the involvement of the PKSF project

Earlier, the profit per kg of fish production was 17.85 BDT, which now risen to 45.69 BDT (Figure 3). The increase in fish production per decimal has resulted in an increase in profit per kg as a result of effective market linkages between farmers and exporters.

Employment generation

According to the pre-assessment at the beginning of the project, a total of 990 people were engaged in fish farming on 600 fish farmers (Figure 4). According to the final assessment survey, the number of people employed on the farms of 600 fish farmers is 2248 (Figure 4).

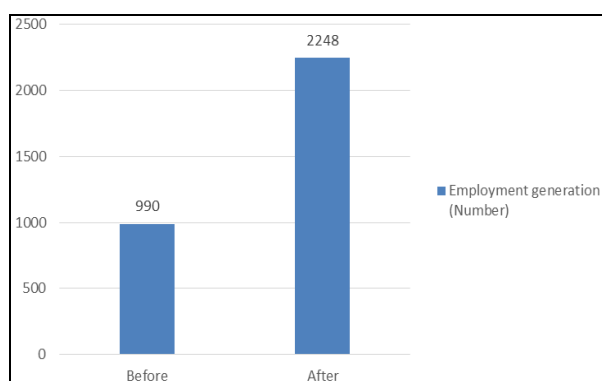


Fig 4: Employment generation of the working area before and after the involvement of the PKSF project

Conclusion

Fish farming is profitable farming for the participating

farmers under the PKSF project. The findings indicated that the project participants were able to increase their fish production, creating employment opportunities and pond volume after joining the PKSF project. In the context of fish production, employment creation, and increased pond volume, a fish farming activity played a crucial role as an instrument for poverty alleviation.

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