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IMPACT OF GENETICALLY IMPROVED FISH SPECIES AND TECHNOLOGY ON SELECTED HATCHERY AND FISH PRODUCTION IN BANGLADESH

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Abstract

The study was carried out in IAPP commanding areas from July to September 2015. A total of 8 hatchery and 240 farmers were selected for this study from Rangpur and Barisal region. About 153% Tilapia production increased which was from 34 to 86 lakh, which was 148% in Rangpur district. Thai koi production was increased about 320% in Rangpur and it was 152% in Barisal. It was observed that, per hatchery Tilapia profit was Tk. 17.35 lakh and Tk. 17.18 lakh in Rangpur and Barisal, respectively. While, total profit was 3.9 times more for Thai koi in Rangpur and it was about 1.7 times more in Barisal after IAPP-BFRI project implementation. Impact of improved germplasm on grow out system was estimated. Finding shows that before IAPP-BFRI project the average harvesting weight of tilapia fish was 122g but after using IAPP-BFRI germplasm, it increased to 194g in Rangpur district. In case of Thai Koi, the harvesting weight gain was 26% in Rangpur district and it was statistically significant at 1% level. Survey results also show that per acre profit was only Tk.86671 for Tilapia farming before IAPP whereas it was increased to Tk. 234853 after IAPP-BFRI intervention. At the same time, profit from Thai Koi was increased about 189% after IAPP-BFRI activities. Similarly, profit was increased about 86% in case of Pangus farming and this positive impact was statistically significant at 1% level. Therefore, it may conclude that, farmers can significantly increase Tilapia, Thai Koi and Pangus production as well as can maximize profit using IAPP technology.

Keywords: Genetically Improved, Hatchery, Fish Production, Bangladesh

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Introduction

Bangladesh is endowed with unique aquatic resources for fish and fisheries development. The inland water resources of this country are considered to be one of the richest in the world both in terms of area and its potential for fisheries development. Fisheries sector is contributing in food security through proving safe and quality animal protein; almost 60% animal protein comes from fish. It contributes 3.69% to our national GDP and around one fourth (23.12%) to the agricultural GDP (FRSS, 2016). It provides full time employment to about 1.20 million people and generates part time employment for 11 million people. Around 10% of total export earnings come from fisheries. It was argued that rural aquaculture plays a significant role in Bangladesh in view of its contribution towards national food and nutritional security, rural job opportunities and income (Mazid and Sinha, 2000). Rural aquaculture thus needs much more attention now than ever before. Although Bangladesh is rich in vast water resources but per hectare yield from ponds only 3.0 tones per year. This can further be augmented. The yield of inland fisheries is therefore could be increased substantially through adopting appropriate aquaculture technologies and judicious as well as efficient uses of existing resources. However, sustainable aquaculture technologies as well as quality fish fry are required in this country for increasing production of fisheries.

Integrated Agricultural Productivity Project (IAPP) is donor funded project. This project is implemented by Ministry of Agriculture and Ministry of Fisheries and Livestock, Bangladesh. Under this project eight agencies (DAE, DLS, DOF, BADC, BARI, BRRI, BFRI and SCA) are working together to promote productivity of crops, livestock and fish. During 2011-16, with the financial assistance GAFSP, BFRI has been working for developing improved generation of GIF tilapia, Thai Koi and Pangus. During the timeframe, BFRI have successfully developed 04

generation of GIF tilapia, 03 generation of Thai Koi and 02 generation of Pangus through selective breeding. These improved generations were distributed to eight selected private hatcheries of Rangpur and Barisal region for mass seed production. These selected hatcheries are being produced millions of quality fry from BFRI supplied improved generation and sold out among IAPP fisheries group member. The IAPP group members were growing table sized fish for economic welfare. The present study was undertaken to analyze the potential impact of quality fry production in hatcheries and culturing the improved generations on fish production and profitability of fish farming.

Materials and Methods

The investigation was carried out in IAPP areas from July to September 2015. Integrated Agricultural Productivity Project (IAPP) worked in 54 upazillas in Rangpur, Kurigram, Lalmonirhat, Nilphamari, Barisal, Jalokathi, Patuakhali and Borguna. The survey schedule was prepared to record the required information on various aspects of fish farming activities. A total of 8 hatchery and 240 farmers were selected from Rangpur and Barisal region for this study. After the schedule was finalized, the selected farmers were interviewed individually by personal interviews when they had little work on the farms. Before the actual interview was made, the aim and purpose of the study were explained to each hatchery operator and farmers.

Analytical technique

Data, thus collected, were analyzed in accordance with the objectives of the study. In this study, the tabular technique of analysis was used. The tabular technique of analysis included classification of the data in the form of tables. It is generally used to find out the crude association of difference between two sets of variables. This technique is based on arithmetic mean, percentage, ratio, etc.

Results

Table 1 shows the average fry production and its profitability status in Rangpur and Barisal district. Fry of Tilapia production has reached to about 87 lakh per hatchery per year after IAPP implementation, which was only 35 lakh before the project implying that Tilapia fry production has increased about 148% in Rangpur district. Same success was observed in Barisal. About 153% Tilapia production has increased which is from 34 lakh to 86 lakh. On the other hand, a significant change has occurred in case of Thai koi in Rangpur district. Thai koi production has increased about 320% in Rangpur and it was 152% in Barisal. Cost of production has increased with fry production but profitability has increased significantly for both places and species. It is found that per hatchery Tilapia profit was Tk. 17.35 lakh and Tk. 17.18 lakh in Rangpur and Barisal, respectively. On the other hand, total profit was 3.9 times more for Thai koi in Rangpur and it was about 1.7 times more in Barisal after IAPP implementation. Therefore, it can be concluded that, a significant success has achieved in case of fry production and profit in hatchery.

Table 1. Average fry production status.

Particulars	Rangpur				Barisal			
	Fish Species	Before IAPP	After IAPP	Increase (%)	Fish Species	Before IAPP	After IAPP	Increase (%)
Fry produced/year/ Farm (Lakh)	Tilapia	35.00	86.76	148	Tilapia	34.00	85.93	153
	Thai Koi	5.00	21.00	320	Pangus	26.00	65.60	152
Total cost of Fry production (Lakh)	Tilapia (0.30 Tk./fry)	10.50	26.03	148	Tilapia (0.30 Tk./fry)	10.20	25.78	153
	Thai Koi (0.32 Tk./fry)	1.60	6.72	320	Pangus (0.40 Tk./fry)	10.40	26.24	146
Total return of Fry production (Lakh)	Tilapia (0.50 Tk./fry)	17.50	43.38	148	Tilapia (0.50 Tk./ fry)	17.00	42.96	152.71
	Thai Koi (0.60 Tk./fry)	3.0	12.60	320	Pangus (0.70 Tk./fry)	25.20	45.92	82.22
Total profit (Lakh)	Tilapia	7.00	17.35	148	Tilapia	6.8	17.18	152.65
	Thai Koi	0.85	3.72	337	Pangus	14.80	19.68	32.97
No of farmer collected fry	Tilapia	205	426	107	Tilapia	178	360	102
	Thai Koi	54	262	385	Pangus	96	257	168

It was found that after IAPP implementation, fertilization rate for Tilapia fingerling has increased about 13 and 16 percent in Rangpur and Barisal district (Table 2). It was 11 percent and 5 percent for Thai Koi in Rangpur and Barisal respectively. On the contrary, hatching rate has increased for Tilapia from 84 percent to 95 percent in Rangpur and from 82 percent to 90 percent in Barisal. Survival rate shows the significant improvement which was increased about 8 to 9 percent for Tilapia and for Thai Koi it was increased about 9 percent after IAPP implementation.

Table 2. Average survival status during incubation.

Particulars	Rangpur				Barisal			
	Fish Species	Before IAPP	After IAPP	Increase (%)	Fish Species	Before IAPP	After IAPP	Increase (%)
Fertilization (%)	Tilapia	80	90	13	Tilapia	80	93	16
	Thai Koi	75	83	11	Pangus	78	82	5
Hatching (%)	Tilapia	84	95	13	Tilapia	82	90	9
	Thai Koi	82	85	4	Pangus	79	85	8
Survival (%)	Tilapia	80	86	8	Tilapia	81	88	9
	Thai Koi	76	83	9	Pangus	80	85	6

Table 3 shows the average survival rate of fry and weight of fry after treatment. Survival rate of fry during hormone treatment has increased about 10 and 9 percent in Rangpur and Barisal for Tilapia, respectively. On an average, average weight was gained from 140 mg/fry to 200 mg/fry during hormone treatment in Rangpur and it has increased from 120 mg/fry to 270 mg/fry in Barisal.

Table 3. Average survival status of fry during hormone treatment.

Particulars	Rangpur				Barisal			
	Fish Species	Before IAPP	After IAPP	Increase (%)	Fish Species	Before IAPP	After IAPP	Increase (%)
Survival rate of fry	Tilapia	83	91	10	Tilapia	83	91	9
Average weight of fry after treatment		140 mg/fry	200 mg/fry	43		120 mg/fry	270 mg/fry	125

Table 4 shows the survival rate of fry and average weight gain of fry after treatment during primary nursing stage. It was found that after IAPP survival rate of Tilapia increased about 16 percent and 8 percent in Rangpur and Barisal, respectively during nursing period. On the other hand, survival rate was very low (55%) before the IAPP project for Thai Koi in Rangpur but it reached to 67 percent after commencement of the project. In Barisal survival rate was good (82%) and it also increased to 88 percent after project implementation. In Rangpur, about 180 percent weight has gained for Tilapia after project implementation and it was 140 percent in Barisal. On the other hand, weight has gained about 88 percent for Thai Koi in both places.

Table 4. Average survival status during primary nursing stage.

Particulars	Rangpur				Barisal			
	Fish Species	Before IAPP	After IAPP	Increase (%)	Fish Species	Before IAPP	After IAPP	Increase (%)
Survival rate of fry	Tilapia	70	81	16	Tilapia	85	92	8
	Thai Koi	55	67	22	Pangus	82	88	7
Average weight of fry after treatment (g)	Tilapia	3.0	8.4	180	Tilapia	5.0	12.0	140
	Thai Koi	4.0	7.5	88	Pangus	25.0	47.0	88

Table 5 shows how many people were trained through this project and how much area has increased due to project implementation. It was found that after project implementation, average hatchery staff increased about 60 percent and 80 percent in Rangpur and Barisal district, respectively. Through this project, a total of 6 hatchery staffs were trained in Rangpur and it was 8 staff in Barisal. In case of physical structure, after project implementation, hatchery area was increased from 8 acre to 13 acre in Rangpur district but there no change was observed in Barisal. On contrary, breeding pond area has increased about 66 percent and 50 percent in Rangpur and Barisal, respectively. On the other hand, nursery area has increased from 5 acre to 7 acre in Rangpur and it has increased from 4 acre to 7 acre in Barisal.

Table 5. Capacity building (Manpower & Infrastructure).

Particulars	Rangpur			Barisal		
	Before IAPP	After IAPP	Increase (%)	Before IAPP	After IAPP	Increase (%)
Average hatchery Staff (No.)	10	16	60	10	18	80
Average hatchery staff trained (No.)	2	6	200	3	8	166
Physical Structure						
Area of hatchery (Acre)	8	13	50	30	30	0
Breeding pond (Acre)	3	5	66	10	15	50
Nursery pond (Acre)	5	7	40	4	7	75

Grow out Results

Impact of IAPP was estimated in various steps of production such as harvesting weight gain, production gain, survival rate increased, production cost increased or decreased and profit earn. Table 6 shows the average harvesting weight of Tilapia and Thai Koi in greater Rangpur and Barisal district. Two sample mean comparison test was performed to estimate whether the impact of IAPP technology is significant or not. Finding shows that before IAPP the average weight of tilapia fish was 122 (g) per fish at harvesting time but after using IAPP technology, it increased to 194 gm per fish in Rangpur district. It implies that farmers are able to gain about 59% harvesting weight using IAPP technology in Rangpur district, which was statistically significant at 1% level. In case of Thai Koi, the harvesting weight gain was 26% (from 80 gm to 101 gm) in Rangpur district and it was statistically significant at 1% level.

Table 6. Average harvesting weight (g) of Rangpur and Barisal region.

Particulars	Harvesting weight (g)				
	Fish Species	Before IAPP	After IAPP	Increase (%)	t-value
Rangpur	Tilapia	122	194	59	12.93
	Thai Koi	80	101	26	18.05
Barisal	Tilapia	127	170	34	17.65
	Pangus	741	1035	40	16.06

Tilapia and Pangus species was used to assess the impact of IAPP technology in Barisal district. Result shows that before IAPP, on an average per tilapia weight was 127 g at harvesting time but it grew up to 170 gm after IAPP. It implies that about 34% harvesting was gain from per tilapia after using IAPP technology and this gain was statistically significant at 1% level. On the other hand, about 40% harvesting weight was gain (from 741 g to 1035 g) from per fish after using IAPP technology in case of pangus species and this gain was significant at 1% level.

To assess the impact of IAPP on productivity, per acre fish production was estimated for Tilapia, Thai Koi and Pangus in Rangpur and Barisal district (Table 7). Result reveals that per acre Tilapia fish productivity increased 1.99 times after using IAPP technology and it has reached to 4799 kg acre^{-1}. On the other hand, a remarkable change has been achieved in Thai Koi. Before IAPP, farmers were able to produce about 2002 kg Thai Koi in one acre of pond area but after using IAPP technology, farmers produced 3655 kg Thai Koi within the same area of pond implies that 82% productivity can be increased through using IAPP technology in case of Thai Koi. This productivity gain was statistically significant at 1% level for both species of fish.

Table 7. Average production (kg acre^{-1}) of Rangpur and Barisal region.

Particulars	Production (Kg acre^{-1})				
	Fish Species	Before IAPP	After IAPP	Increase (%)	t-value
Rangpur	Tilapia	2413	4799	99	15.29
	Thai Koi	2002	3655	82	28.56
Barisal	Tilapia	2489	3195	28	14.20
	Pangus	7810	11176	43	17.57

On the other hand, farmers were able to increase production about 28% in case of Tilapia after using IAPP technology in Barisal district. The productivity increased from 2489 kg acre^{-1} to 3195 kg acre^{-1}, which was significant at 1% level. A notable achievement was found in case of Pangus production in Barisal. Result reveals that on an average Pangus productivity has increased about 43% after using IAPP technology. Before IAPP technology, farmers produced only 7810 kg Pangus in one acre of pond area but it has increased to 11176 kg after IAPP project.

Before, IAPP project, the survival rate was 82% and 77% for Tilapia and Thai Koi respectively in Rangpur district but after IAPP project, it has increased to 91% and 89%, respectively (Table 8). On an average, survival rate was increased 10% and 15% for Tilapia and Thai Koi, which was statistically significant at 1% level.

Table 8. Average survival rate of Rangpur and Barisal region.

Particulars	Survival rate				
	Fish Species	Before IAPP	After IAPP	Increase (%)	t-value
Rangpur	Tilapia	82	91	10	19.55
	Thai Koi	77	89	15	20.56
Barisal	Tilapia	72	90	25	48.18
	Pangus	74	89	20	27.03

On average, 25% survival rate has increased for Tilapia which was 72% before IAPP but after IAPP is increased to 90%. On the other hand, Pangus survival rate has increased about 20% (from 74% to 89%) and it was statistically significant at 1% level. This increase of survival rate was lead to increase the productivity and profitability of the farm.

In this section, we only show the comparative scenario of production cost for before and after IAPP. Finding shows that, production cost was Tk. 56 for producing per kg of Tilapia fish before IAPP but after project, it increased to Tk. 66 implies that production cost has increased about 17% for Tilapia in Rangpur region. Alternatively, cost for per kg Thai Koi production has increased about 15% (from Tk. 70 to Tk. 81) and these increases was statistically significant (Table 9).

Table 9. Average Production cost (Tk./kg) of Rangpur and Barisal region.

Particulars	Production cost (Tk/kg)				
	Fish Species	Before IAPP	After IAPP	Increase (%)	t-value
Rangpur	Tilapia	56	66	17	15.44
	Thai Koi	70	81	15	14.99
Barisal	Tilapia	68	84	23	28.04
	Pangus	73	84	15	15.81

On the other hand, Tilapia production cost was higher in Barisal compared to Rangpur. Before IAAP, per kg Tilapia production cost was only Tk.68, which grew upto Tk. 84 after IAAP, implies that about 23% production cost has increased after IAAP implementation for Tilapia in Barisal region. On the contrary, cost of Pangus production has increased by 15% in Barisal after IAPP technology, which is same as Rangpur.

Table 10 represents per acre profit on the basis of species in Rangpur and Barisal region. Result reveals that per acre profit was only Tk.86671 for Tilapia farming before IAPP whereas it increased to Tk. 234853 after IAPP i.e. profit increased 2.7 times or 170% after IAPP in Rangpur region. At the same time, profit from Thai Koi has increased about 189% after IAPP (from Tk. 78273 to Tk. 226976). These increased rates were statistically significant at 1% level.

Table 10. Average profit (Tk./acre) of Rangpur and Barisal region.

Particulars	Net Profit (Tk/acre)				
	Fish Species	Before IAPP	After IAPP	Increase (%)	t-value
Rangpur	Tilapia	86671	234853	170	16.54
	Thai Koi	78273	226976	189	24.15
Barisal	Tilapia	71550	118300	65	14.39
	Pangus	116000	215833	86	16.84

On the other hand, the percentage of increase of profit is comparatively lower in Barisal than Rangpur region. In case of Tilapia, per acre profit increased about 1.65 times which was statistically significant at 1% level. Similarly, profit increased about 86% after using of IAPP technology in case of Pangus farming and this positive impact was statistically significant at 1% level. Therefore, it may conclude that, farmers can significantly increase Tilapia, Thai Koi and Pangus production as well as can maximize profit using IAPP technology.

Discussion

Before involvement with IAPP, most of the farmers stocked fry from local fry traders. But after involvement with IAPP, farmers stocked fry in their ponds from selected IAPP assisted hatchery to ensure good quality fish fry for increased fish production. After engaged with IAPP, most of the farmers of followed BFRI evolved technologies to get more fish production. Prior to IAPP, the farmers' average fish production of Tilapia, Koi and Pangus were 2,451, 2,002 and 7,810 kg $acre^{-1}$, respectively. After involvement of IAPP intervention, the farmers' fish productions were 3,997; 3,655 and 11,176 kg $acre^{-1}$, respectively. Islam and Haque (2010) stated that the average yield was 1,144 kg $acre^{-1}$ in Northwest Fisheries Extension Project, which was remarkable less than the present study. According to FRSS (2016), the national average pond fish production in Bangladesh was 1,558 kg $acre^{-1}$. From the above, fish production was being increased because of the involvement with IAPP and farmers used genetically improved fry and BFRI evolved culture technology for their culture management.

Fish farming has a positive impact on aquaculture production but numerous types of constraints affect potentiality of fish farming in the Rangpur and Barisal region. Very poor retention capacity of soil, sudden tidal flow, flash flood, sudden cyclone, lack of loan facilities, low quality and scarcity of fish seeds in proper time etc. Rahman (2003) stated that the major constraints of carp farming were lack of money and production cost. Khan *et al.* (1998) identified that the lack of knowledge about fish culture was one of the most important problems. Hossain *et al.* (1992) observed that the largest problems faced by the fish farmers are multiple ownerships.

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