The Bangladesh Journal of Agricultural Economics, 42(2): 65-77, 2021

FINANCIAL PERFORMANCE AND PRODUCTIVITY DETERMINANTS OF FISH FARMS IN BANGLADESH

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ABSTRACT

Financial performance gives insight into key indicators of the financial health of the fish farms. Therefore, the study focused on financial performance and factors affecting productivity of pangas and tilapia fish farms in Bangladesh. Based on random selection, 636 fish farms consisting of 323 pangas and 313 tilapia were chosen from seven districts and interviewed directly. Descriptive statistics was used to evaluate the financial performance of the farms. In addition, a Cobb-Douglas type production function was used to determine the effect of factors on productivity of the pangas and tilapia farms. The study revealed that the pangas and tilapia farms were commercially profitable as the BCR is higher than unity. The break-even production and sale value ensure that both farms were profitable. The study also revealed positive net worth for both of the fish farms, which implies that the farmers are able to cover their current liabilities. The current ratio was >1 and positive working capital ensured the liquidity of farms. Besides, higher equity to asset ratio, lower debt to asset ratio, and lower debt to equity ratio indicates the better solvency of the farms. Conversely, higher debt structure ratio for both pangas and tilapia indicated the shortage of long-term debt. Furthermore, the study showed the significant positive relationship of fingerling quantity, feed cost, and water cleaning cost with productivity while debt structure ratio had negative relation to the productivity. Therefore, the study suggests providing long-term debt more for improving the financial performance of pangas and tilapia fish farms.

Keywords: Financial performance, productivity, profitability, financial position, aquaculture

I. INTRODUCTION

Financial success is a key strength of farms which depends on the efficiency of management of a specific farm. The management means the proper use of resources

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such as labor, fingerlings, feed, medicine, equipment, land, etc. (Kumar and Engle, 2016). To achieve the highest possible productivity, the inputs must be in the right proportions and quality (Hossain *et al.,* 2022). These inputs are more expensive and require more capital to obtain (Alam *et al.,* 2012). Therefore, the fish farmers need high investment whereas high investment of capital tends to earn the high profit (Kimani *et al.,* 2020; Pomeroy, 2007). Capital is critical for fish farm to be an efficient, sustainable, and profitable. On the other hand, current flow of capital appears to be insufficient in developing countries (Quagrainie *et al.,* 2010). Fish farmers are frequently impoverished and lack the capital to afford the inputs in abundance (Alam *et al.,* 2012). Besides, aquaculture needs careful and extensive financial analysis to be successful commercially (Engle, 2012). The appropriate balance sheet is a key component of the financial position to identify the strength and weakness of fish farm (Engle, 2012). Farmers with insufficient assets face difficulties in case of production (Mitra *et al.,* 2019a). Besides, the liabilities are debt obligations (i.e., account payable) that are owed to the bank or feed suppliers. Debt servicing and cash flow both are required to manage the fish farms intensively. The risk of cash flow increases with the decrease of equity of the farm (Engle and Kumar, 2011). However, a drop in net worth within the balance sheet implies a declining financial condition, which might be dangerous, yet it does not necessarily signal that the farm is doomed. Declining net worth indicates that more investigation is required to determine the exact reasons for the financial situation's worsening and to determine corrective measures (Engle, 2012). Furthermore, to have a better understanding of the farm's financial health, the fish farmers need to have knowledge about the financial ratios. The ratios are based on financial accounting information, found in the balance sheet disclosed by the annual accounts of fish farmers (Misund, 2017). Financial ratios are useful in making management decisions and planning the farm's long-term strategy (Engle, 2012). In addition, the fish farmers can borrow short-term or long-term debt from the different formal and informal institutions by seeing the condition of financial ratios (Misund, 2017).

However, fish farmers need to keep records in terms of stocking, feeding, and harvesting quantity for each of the ponds (Engle, 2012). In developing countries, like Bangladesh, the fish farmers are not aware of record-keeping mostly. Not only that but also the fish farmers are less educated and therefore it is difficult to keep records accurately by them. They cannot properly analyse the financial condition of their farm. But they need to know the actual financial scenario of their farm. Only the financial analysis can give insight into the financial condition of the farm. Therefore, the aim of this study was to evaluate the financial performance and factors affecting productivity of fish farms in Bangladesh. Based on the research aim, the study reviewed several research articles by focusing productivity (Rahman *et al.,* 2021a; Prodhan and Khan, 2018), efficiency (Mitra *et al.,* 2019b; Alam *et al.,* 2012; Khan and Alam, 2003), risk (Khan *et al.,* 2021; Rahman *et al.,* 2021b; Khan *et al.,* 2018; Khan, 2012; Sarker *et al.,* 2016) and credit (Mitra *et al.,* 2019a) along

with profitability (Shawon *et al.*, 2018). But, to the best of our knowledge, there was no exhaustive study on financial performance of aquaculture in Bangladesh. A study of Rahman *et al.* (2020) evaluates the financial performance from the point of management practices and managerial ability of pond aquaculture. There is ample opportunity to work with financial positions to measure financial performance of aquaculture. Therefore, the study evaluated the financial position by the financial ratios in the balance sheet along with the profitability for the measurement of the financial performance. Besides, the study also assessed the factors which are affecting the productivity of fish farms in Bangladesh. Finally, based on the findings, the study will provide some specific policies for fish farms in Bangladesh. Better decisions can be made with respect to borrowing and managing capital assets when the owner clearly understands the financial strengths and weaknesses of the farm. Further, the creditors will realize about the financial position before providing credit to the farmers.

II. METHODOLOGY

Study area, sample size and data

Bangladesh is prominent for producing fish particularly for pangas and tilapia due to favourable weather conditions. Seven districts namely namely Mymensingh, Bogura, Cumilla, Chattogram, Khulna, Bhola and Jashore were purposively selected based on the production of pangas and tilapia. All districts are contributing 81.73% and 56.75% of total production for pangas and tilapia in Bangladesh respectively (DoF, 2016). A total of 636 fish farms comprising 323 pangas and 313 tilapia farmers were randomly selected from these districts (Table 1). A well-structured and pre-tested interview schedule was developed which organized with the information on different cost items, production, assets and liabilities. A face-to-face interview method was followed to collect the data from the chosen area in 2017.

Table 1. Sample distribution of pangas and tilapia farmers

District	Pangas		Tilapia	
	Sample size (No.)	%	Sample size (No.)	%
Mymensingh	133	41.18	66	21.09
Bogura	57	17.65	-	
Jashore	32	9.91	60	19.17
Khulna	-		24	7.67
Cumilla	59	18.27	87	27.80
Chattogram	22	6.81	46	14.70
Bhola	20	6.19	30	9.58
Total	323	100.00	313	100.00

Source: Field survey, 2017

Statistical analysis

The study emphasized total cost, total return, gross return, gross margin, net return, gross profit margin, net profit margin, benefit-cost ratio, and break-even point of the farms for measuring profitability of the pangas and tilapia farms. Break-even point is a point of no profits no loss. After break-even point, a portion of each value of return contributes to profits. Three types of break-even points i.e., break-even production, break-even price and break-even sale value (Shawon *et al.,* 2018) were calculated in this study. This break-even point was used to assess the relationship between production volume, fixed costs, per unit sales price, and variable costs. These were calculated as follows:

$$\text{Break} - \text{even production} = \frac{\text{Fixed costs}}{(\text{Sales price per kg} - \text{variable cost per kg})} \quad \ldots\ldots\ldots\ldots\ldots(1)$$

$$\text{Break} - \text{even price} = \frac{\text{Fixed costs}}{\text{Volume of production}} + \text{Variable costs per kg} \quad \ldots\ldots\ldots\ldots\ldots(2)$$

$$\text{Break} - \text{even sale value} = \text{Break} - \text{even production} \times \text{average price of fish} \ldots\ldots\ldots(3)$$

The study used balance sheet to assess the financial position of pangas and tilapia fish farms. Moreover, the study also measured some ratios to see the financial position of the farms. The current ratio is a quick indicator of a firm's liquidity. Current assets will be sold or turned into saleable products in the near future and will generate cash to pay debt obligations that come due. It was calculated as:

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{current liabilities}} \quad \ldots\ldots\ldots\ldots\ldots(4)$$

Working capital is the difference between current assets and current liabilities. It represents excess amount of money available from current assets after current liabilities have been paid which was calculated by the equation:

$$\text{Working capital} = \text{Current assets} - \text{current liabilities} \ldots\ldots\ldots\ldots\ldots(5)$$

The equity ratio is an investment leverage or solvency ratio that measures the amount of assets that are financed by owners' investments by comparing the total equity to the total assets which was calculated as:

$$\text{Equity to asset ratio} = \frac{\text{Total equity}}{\text{Total asset}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

Debt to assets ratio is a ratio which measures debt level of a business as a percentage of its total assets. The formula of debt asset ratio is given below:

$$\text{Debt to asset ratio} = \frac{\text{Total liabilities}}{\text{Total asset}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)$$

The debt-to-equity ratio is a financial, liquidity ratio that compares a farm's total debt to total equity. The debt-to-equity ratio shows the percentage of company financing that comes from creditors and investors. Following equation was used to calculate the debt-equity ratio:

$$\text{Debt to equity ratio} = \frac{\text{Total liabilities}}{\text{Total equity}} \quad \text{……..…..(8)}$$

Debt structure ratio means the amount of the debt that must be paid in the coming year and that the majority of the debt is whether from short-term loans or long term loans. Following formula was used for calculating debt structure ratio:

$$\text{Debt structure ratio} = \frac{\text{Current liabilities}}{\text{Total liabilities}} \quad \text{…….……..….(9)}$$

Furthermore, Cobb-Douglas type production function was used to determine the factors affecting the production of pangas and tilapia fish farm together. Since the operation or production management of pangas and tilapia farms is almost the same, the study combined the data of pangas and tilapia farmers to identify the production factors. Production function can be written as follows:

$$ln\ Y_i = \beta_0 + \beta_1\ ln\ X_1 + \beta_2\ ln\ X_2 + \beta_3\ ln\ X_3 + \beta_4\ ln\ X_4 + \beta_5 ln\ X_5 + \beta_6 ln\ X_6 + \beta_7\ ln\ X_7 + \beta_8 ln\ X_8 + \beta_9 ln\ X_9 + U_i$$

Where, Yi= yield (kg/hectare), X_1=human labour cost (Tk/hectare), X_2=quantity of fingerling (number/hectare), X_3 =feed cost (Tk/hectare), X_4 = water cleaning cost (Tk/ hectare), X_5 = farm size (decimal), X_6 = debt to equity ratio, X_7 = debt to asset ratio, X_8 = current ratio, X_9 = debt structure ratio, β_0 = intercept, β_i =coefficients of respective variables, and U=error term.

III. RESULTS AND DISCUSSION

Measurement of profitability

Table 2 showed the different value of cost items of pangas and tilapia farms. The study revealed that per hectare feed cost was Tk. 1216814 (69.04%) for pangas and Tk. 979380 (68.97%) for tilapia which was higher among the variable costs. This result was consistent with the study of Mitra *et al.* (2019b) and Rahman *et al.* (2019). It was evident that the farmers used commercial feed more than the traditional feed for culturing the pangas and tilapia fishes. They did it for higher growth of the fishes. Usually, the price of commercial feed was much higher and therefore the farmers had to pay more compared to other variable costs. The respective land use cost was Tk. 114775 (6.51%) and Tk. 117780 (8.29%) for pangas and tilapia farm respectively which was higher among the fixed costs. The demand and utilization of land are increasing day by day particularly for pangas and tilapia farming. On the other hand, the value of land is increasing also. Therefore, the farmers have to incur more cost in the case of pangas and tilapia farms.

Table 2. Per hectare cost of pangas and tilapia farm

Cost item	Tk/hectare	
	Pangas	Tilapia
Variable costs		
Hired labour	106807 (6.06)	70108 (4.94)
Fingerling	158730 (9.01)	147898 (10.42)
Feed	1216814 (69.04)	979380 (68.97)
Water cleaning	87178 (4.95)	72276 (5.09)
Other	2409 (0.14)	5878 (0.41)
Total variable cost	1571938 (89.19)	1205432 (84.89)
Fixed cost		
Permanent labour	63693 (3.61)	86448 (6.09)
Land use	114775 (6.51)	117780 (8.29)
Equipment	11966 (0.68)	10267 (0.72)
Total fixed cost	190434 (10.81)	214495 (15.11)
Total cost	1762372 (100.00)	1419927 (100.00)

Note: Values in parentheses shows the percentage of costs
Source: Field survey, 2017

It is evident from Table 3, that per hectare production of pangas and tilapia were 25510 kg and 17239 kg with respective to total return of Tk. 2193860 and Tk. 1672183. So, return from pangas fish farming was higher than that of tilapia farming. This is because of higher growth rate and per hectare productivity of pangas was higher than the tilapia. Gross margin was also higher for pangas farm (Tk. 621922) than tilapia (Tk. 466751). This result is in line with the study of Aktar *et al.* (2018) in where they found Tk. 1315191 as gross margin for large pangas farm. It is because pangas producer retains more money after incurring the variable costs associated with the production than that of tilapia. It was observed that net return for pangas farm was estimated at Tk. 431488 and for tilapia it was Tk. 252256. It means that these amounts of money are received by the farmers after all costs have been paid. Gross profit margin for pangas was 28.35% which indicates the managing cost of sales and other expenses was 71.65%. In other words, about 28.35% of the revenue was available that earned from total sale in the farm after covering the costs. On the other hand, gross profit margin for tilapia farms was 27.91% indicating managing cost of sales and other expenses was 72.09%. About 27.91% of revenue was available that earned from total sale of tilapia farming after covering the costs. The study of Shawon *et al.* (2018) found 59% gross profit margin for shrimp farmers in the coastal areas of Bangladesh. It was evident form the study that the net profit margin for pangas was 20% that converted 20% of its sale into net income. On the other hand, this margin for tilapia was 15.09% which converted 15.09% of its sale into net income. This result is related to the study of Shawon *et al.* (2018) in where they calculated 42% net profit margin for shrimp farmers. The estimated BCR was 1.24 and 1.18 for pangas and tilapia farms respectively. This result was consistent to the study of Sathiadhas *et al.* (2009). It

implies that by investing Tk. 1, pangas and tilapia farms earn Tk. 1.24 and 1.18 which indicates that both the farms were profitable.

It is revealed in Table 3 that the break-even production was 7811 kg/hectare and 7922 kg/hectare for pangas and tilapia farms respectively. It is evident that total production of both pangas (25510 kg/hectare) and tilapia (17239 kg/hectare) exceeded the break-even production, indicating that both farms were profitable. The break-even prices for pangas and tilapia were Tk. 69 and Tk. 82 per kg. At this price, both farms can cover the cost of production by selling fishes. On the other hand, the study revealed that the average weighted price per kg of pangas and tilapia were Tk. 86 and Tk. 97 respectively. Since the average weighted price covers the break-even price both the farms were profitable. The respective break-even sale values were Tk. 671765 and Tk. 768450 of pangas and tilapia respectively. Total return of both pangas (Tk. 2193860) and tilapia (Tk. 1672183) farms exceeds the break-even sale value. It ensured the profitability of pangas and tilapia fish farming in the study area. Based on the profitability, it is said that the overall financial performance was satisfactory for pangas and tilapia farms.

Table 3. Profitability of pangas and tilapia fish farms

Particulars	Pangas	Tilapia
Total production (kg/hectare)	25510	17239
Total return (Tk/hectare)	2193860	1672183
Gross margin (Tk/hectare)	621922	466751
Net return (Tk/hectare)	431488	252256
Gross profit margin (%)	28.35	27.91
Net profit margin (%)	20	15.09
Benefit cost ratio	1.24	1.18
Break-even quantity/production (Tk/hectare)	7811	7922
Break-even price (Tk/kg)	69	82
Break-even sale value (Tk/hectare)	671765	768450

Source: Field survey, 2017

Assessing financial position

In this study financial performance was also measured based on the financial position by using the balance sheet of farms (Table 4). In terms of current assets, the study estimated Tk. 1601055 and Tk. 745597 as cash in hand for pangas and tilapia farms respectively. It indicates that farmers were capable of refinance in both farming to the following year. In addition, Tk. 79590 and Tk. 13918 as the value of fish stocked in the ponds were estimated for pangas and tilapia farm respectively. This stock can be reared for the next year or harvested to consume or sold within current production period. In the case of non-current assets, the respective land values were Tk. 6779264 and Tk. 4146786 for pangas and tilapia farm respectively. The corresponding machinery and equipment (pump, shallow tube-well, paddle wheel, pH meter, feeding bowl, etc.) values appeared at Tk. 39000 and Tk. 73994

for pangas and tilapia farm respectively. The result indicates that the value of land and machinery both are farm's long-term investments that would be used in the current year as well as the next year. Total liabilities were Tk. 1389873 for pangas and Tk. 787010 for tilapia farms. As current liabilities, corresponding accounts payable was Tk. 621795 and Tk. 308642 and the value of payments on debt due was Tk. 428607. The values of the current portion of long-term debt were Tk. 339471 and Tk. 231437 for pangas and tilapia respectively. It was found pangas farmers used more credit than tilapia farmers, because more capital was needed for pangas culture than that of tilapia.

The estimated net worth was positive for both pangas (Tk. 7109036) and tilapia (Tk. 4193285) farms respectively. It indicates that both the farms were solvent and good in terms of financial health. In other words, if the farm was sold, the assets' worth was sufficient to cover the liabilities owed on the farm's assets. The current ratio for panagas and tilapia farms was calculated 1.60 and 1.37 respectively which is greater than 1. It means both farms have sufficient liquidity to repay current liabilities with current assets. The working capital attached with pangas farm was Tk. 630243 and it was Tk. 203942 for tilapia farm. This positive result indicates that both the farms are capable of expanding their farm operations in near future after repaying current liabilities. In addition, farmers might be able to handle any undesirable financial situation to run their farm. Both values of equity to asset ratio were 0.84 for pangas and tilapia farms. This ratio indicates that 84% of the capital had been invested by the farmers from own sources. Besides, since both ratios are greater than 70%, the farms are at lower risk position and capable to borrow money from the financial institutions. In the case of pangas and tilapia farming, both debts to asset ratio were 16% (0.16). This ratio is lower than 30% for both farms. Therefore, both farmers will be able to pay back their loan. In this case, the fish farmers and the creditors both were in financially riskless position. In addition, the fish farmers could take loan from the financial institutions in case of difficulties. Debt to equity ratio for pangas farm was 0.20 and it was 0.19 for tilapia farms. In both cases, it is less than 1 which indicates that the amount of debt is lower than the amount of capital of the farmers. Therefore, the farmers were in stable financial condition. In addition, the value of debt-to-equity ratio permits to the creditors to provide loan to the fish farmers. Finally, the value of debt structure ratio was 0.76 and 0.71 for pangas and tilapia farms respectively. It implies that the farmers were in burden in the case of short-term debt. The results imply that 76% debt of pangas farm and 71% debt of tilapia farm must be paid in the following year. Based on the foregoing, it can be said that the financial performance was satisfactory of pangas and tilapia farms in Bangladesh.

Table 4. Balance sheet of pangas and tilapia fish farms (31st December 2016)

Categories	Pangas farm	Tilapia farm
Assets (Tk)		
1. Current assets		
Cash in hand	1601055	745597
Fish inventory	79590	13918
Total current assets	1680645	759515
2. Non-current assets		
Land	6779264	4146786
Other fixed asset/machinery & equipment	39000	73994
Total non-current assets	6818264	4220780
3. Total assets	8498909	4980295
Liabilities (Tk)		
4. Current liabilities		
Accounts payable	621795	308642
Payments due on debt	428607	246931
Total current liabilities	1050402	555573
5. Non-current liabilities		
Current portion of long-term debt	339471	231437
6. Total liabilities (Tk)	1389873	787010
7. Net worth/equity (Tk)	7109036	4193285
8. Liquidity		
Current ratio (1/4)	1.60	1.37
Working capital (1-4) (Tk)	630243	203942
9. Solvency		
Equity to asset ratio (7/3)	0.84	0.84
Debt to asset ratio (6/3)	0.16	0.16
Debt to equity ratio (6/7)	0.20	0.19
Debt structure (4/6)	0.76	0.71

Source: Filed survey, 2017

Factors affecting the productivity of fish farms

The results of Cobb-Douglas production type function to measure the effects of factors on productivity of fish farms are presented in Table 5. Production function is best fit to explore the input output relationship. This model is free from multicollinearity problem, but heteroscedasticity problem was found, and so robust standard error was used to eliminate the problem.

The study revealed that the quantity of fingerling positively affects the return with the co-efficient of 0.14 of pangas and tilapia fish farm. It implies that fish production increases with the increase in quantity of fingerling and vice-versa. It was found during field survey that the farmers usually applied recommended number of fingerlings, but in most cases, fingerlings may die due to water pollution, low level of oxygen, various diseases, predators, etc. during culture period. Therefore, the productivity of pangas and tilapia decreases with the decrease of

fingerlings. In contrast, previous study such as Aktar *et al.* (2018) found that the fingerling quantity is not statistically significant. In addition, the feed costs positively affect the productivity of pangas and tilapia. It implies that the productivity increases with the increases of feed cost. Since the farmers culture fish for commercial purpose therefore they seek commercial and quality feed for their farm. The price of the commercial feed is relatively high in market. They use more high value commercial feed for better production. On the other hand, using more feed is a determinant of high cost. Thus, the productivity increases with the increase of feed cost. The water cleaning cost and productivity have a significant positive relationship. It was evident that frequent exchange of water enhances growth rate of fish which leads higher production (Mitra et al., 2019b). In addition, lime, salt and bleaching powder are used to clean water of pond that led the farm's cost. Thus, the water cleaning cost tends the productivity of pangas and tilapia fish farm. The study reported that there was a negative significant relationship between debt-to-equity ratio and productivity. It means that the production decreases with the increase of debt-to-equity ratio for pangas and tilapia fish farms. It is because, the meaning of increasing the debt-to-equity ratio is to increase the debt than the equity that may burden to the farmer. Thus, the productivity may hamper with the increase of debt-to-equity ratio. The regression coefficient of debt structure ratio was negative and statistically significant with productivity of the fishes. Burden of short-term debt may hamper fish production decision. Farmers always must think about their pay back of current debt which later negatively affects optimum input use decision. Thus, short term debt leads lower productivity of the farm.

Table 5. Estimated co-efficient, standard error and p-value of Cobb-Douglas type production function

Factors	Co-efficient	Std. Error	P>t
Constant	-0.977	0.391	-1.743
Human labour cost (Tk)	0.008	0.022	0.717
Quantity of fingerling (number)	0.135***	0.024	0.000
Feed cost (Tk)	0.642***	0.025	0.000
Water cleaning cost (Tk)	0.038**	0.016	0.019
Farm size (decimal)	0.006	0.022	0.794
Debt to equity ratio	-0.079***	0.026	0.002
Debt to asset ratio	0.004	0.005	0.415
Current ratio	-0.001	0.004	0.823
Debt structure ratio	-0.977**	0.047	0.029

*** = significant at 1% level and ** = significant at 5% level

IV. CONCLUSION

The study was conducted to evaluate the financial performance of pangas and tilapia farms in Bangladesh. The study found higher return for pangas than that of tilapia farm. Both fish farms were profitable as BCR appeared to greater than 1. Total return of each farm exceeded the break-even sale value which also ensures the profitability of the farms under the study. Positive net worth indicates good financial health for both of pangas and tilapia farms. Current ratio and positive working capital ensured that both of the farms were able to repay the current liabilities and invest for next year. The calculated equity to asset ratio was larger while debt to asset ratio and debt to equity ratio was smaller indicates the better solvency of the farms. In contrast, larger debt structure ratio indicates both of the farms were in burden for short-term debt. However, it is evident from the study that the overall financial performance was satisfactory for both farms. Furthermore, the quantity of fingerlings, feed cost and water cleaning cost significantly and positively affected the productivity. A negative significant relationship among debt-to-equity ratio, debt structure ratio and productivity were also found in this study. The study suggests to creditors provide loans to both farmers for expand their farms as they are at satisfactory levels in case of financial position. Also, the study suggests increasing the fingerling quantity than required for avoiding the negative effect of mortality in order to maximize the production. In addition, the government should give subsidy on commercial feed for encouraging the farmers. The farmers should take proper initiatives about water cleaning techniques to enhance production. Since the short-term debt was a burden and tends to lower the productivity, the fish farmers need long-term debt for the betterment of financial performance of their farm.

ACKNOWLEDGEMENTS

At first, our thanks go to the Danish International Development Agency (DANIDA) for its financial support for the project “Upgrading Pangas and Tilapia Value Chains in Bangladesh,” project code: 14-06KU, under which this research was conducted. Secondly, we are grateful to the farmers and government personnel of Bangladesh for sharing their valuable information during conducting the research.

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