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Economic analysis of tilapia farming in some selected area of Dinajpur District: A comparison between monoculture and polyculture

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Abstract

The study was conducted to assess the cost and return from tilapia farming. Fifty homestead aquaculture ponds practicing monoculture and polyculture of tilapia (25 farmers from each category) were selected for this study. Data had been collected through face to face interview by using a structured questionnaire during April to September 2015 from the selected farmers of Dinajpur districts. The results from the survey revealed that both the tilapia monoculture and polyculture farming were profitable. However, the average total cost per hectare per production period was found higher (Tk. 332,712.08) in tilapia monoculture than tilapia culture with carps (Tk. 241,722.34). Moreover, the net margin was also found higher in tilapia monoculture with benefit cost ratio 1.51. Whereas, the benefit cost ratio in polyculture farming was 1.34.

Introduction

Bangladesh has huge potential for tilapia farming due to its rapid growth rate and high market value, thus become one of the most popular commercial culturable species in Bangladesh (ADB, 2005; Rahman, 2012). A considerable number of farmers in the rural area have been involved in tilapia farming due to its profitability. The fish attains a marketable size usually 100 to 150 gm within four months of its culture period, which allows the farmer to get minimum of two yields in a year (Hussain *et al*., 2000; Hussain *et al.*, 2004). Tilapia can be cultured with different fish species such as African catfish (Ibrahim *et al*., 2010), *Macrobrachiam rosenbergii* (Goda *et al.*, 2010; Asaduzzaman *et al.*, 2009) and carp fish (Frei *et al.*, 2007). Fish farmers in Dinajpur district are also not exception. Most of the farmers in Dinajpur district are practicing the tilapia farming with different carp species, while others are involved in commercial tilapia monoculture. However, in these areas, tilapia farmers are not technically advanced like the other parts of Bangladesh (Barman *et al.*, 2003).

Though Hasan *et al.* (1997) observed productivity analysis of tilapia monoculture and polyculture, information about cost and benefit of tilapia monoculture and polyculture is very few (Rahman *et al.* 2012). Moreover, farmers often have inadequate information about the marginal impact of factors affecting the production. They can adopt new and improved technology but sometimes due to some constraints such as, lack of capital or lack of proper knowledge on farming and also lack of information on input-output relationship in farm level lead to lower output as well as failure to exploit the technology. Therefore, for viable and sustainable aquaculture, it is urgent need to identify the important cost components, input-output parameter relationships. All information will be heplful for management practice. In addition, it is very much essential for the management and development of a farm to know the production cost and performance as well. Considering the importance of economic analysis, the current study was undertaken to observe the potentiality in tilapia farming through assessing the cost and return from homestead tilapia monoculture and polyculture farming of Dinajpur district.

Methodology

The study was conducted in Sadar Upazila of Dinajpur district where most of the farms of the district are located. Data were collected from April to September 2015 following a simple random sampling technique in order to assess costs and returns from tilapia monoculture and tilapia culture with carps from a total of 50 farmers (25 from each farming). The individuals

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were selected for face to face interviews using a structured questionnaire. Again the gathered information were crosschecked by interviewing the key informants (relevant NGOs, Department of Fisheries staffs in the field level). In the present study, descriptive statistics (sum, average, percentage, ratio etc.) were used for different cost and return analysis.

Cost-benefit analysis

Several variable costs like stocking cost, liming cost, fertilizers and chemical cost, labour and marketing cost were estimated during the period of farming. There were some fixed costs such as land rent, pond preparation as well. In addition, Interest on Operating Cost (IOC) was calculated by taking into account the variable cost in this study. The standard formula for calculation of interest on operating capital is as follows:

Interest on Operating Capital = Al.i.t (Miah, 1988)
Where,
Al = Total investment/2
i = interest which is 10 per year
t = time duration of the culture period

Cost and return analysis were performed on both variable and total cost basis. To achieve the objectives of the study a simple tabular analysis was done.

The following profit (Π) equation was used to assess the profitability:

$$\Pi i = \sum_{i=1}^{n} Qi\ P - TC$$

$$= \sum_{i=1}^{n} Qi\ Pi - (VC + FC)$$

Where
i = 1,2,3,…n
Πi = profit from i^{th} tilapia production (Taka per ha per production period)
Qi = Quantity of the i^{th} product;
Pi = Average price of the i^{th} product
TC = Total Cost; VC= Variable Cost; FC = Fixed Cost

Gross Return

Gross return was calculated by simple multiplying the total volume of output of it's per unit of price in the harvesting period (Dilon and Hardaker, 1993).

Gross Margin

Gross margin calculation was done to have an estimate of the difference between total return and total variable costs.
GM = TR–TVC

Net Return/Margin

Net return was calculated by deducting total costs (variable and fixed) from gross return (Total return).
NM = TR–TC

Results

Cost analysis

Different variable and fixed cost were associated in tilapia farming. The average total variable cost acquired 88.84% (tilapia monoculture) and 82.52% (tilapia polyculture) of the total cost of production during the production period (Fig. 1). The variable costs include stocking, feed, labor, liming, fertilization and chemical, marketing cost etc. (Fig. 2). Some pre-stocking management costs were also observed in farming as pond preparation, liming, fertilizer application etc. On the other hand, post-stocking management mainly involved feeding, liming, fertilization and using of different chemicals as disinfection during the production period (Table 1).

The average total fixed cost per hectare per production period were Tk. 43,795.18 (13.16% of the total cost of production) and Tk. 42.102.55 (17.42% of the total cost of production) for tilapia monoculture and polyculture respectively (Table 1, Fig. 1). Land rent was also found alike in tilapia monoculture (Tk. 30,755.93 per ha) and tilapia polyculture (Tk. 30,713 per ha). However, pond preparation cost was higher for tilapia monoculture (Tk. 7,223.07 per ha) than tilapia polyculture (Tk. 6,398.44 per ha).

However, stocking of fingerlings is one of the major input costs in tilapia farming. Farmers were found to purchase fingerlings from the local fry sellers and/or from hatcheries. The stocking cost was calculated based on the actual prices paid. The average stocking cost per hectare per production period constituted Tk. 65,607.09 and Tk. 52.847.45 for tilapia monoculture and polyculture respectively (Table 1).

Present study also revealed that feed cost comprised the highest share in monoculture (Tk. 125,295.85 per ha per production period) followed by polyculture (Tk. 71,419.18 per ha per production period). In addition, farmers were found to use lime in the pond before winter for disinfection purpose. The average liming cost per production period constituted 1.89% and 1.36% of the total cost for tilapia mono and polyculture respectively (Fig. 2). Moreover, farmers were also found to apply two types of fertilizers: organic (mainly cow dung); inorganic (urea and TSP) and different types of chemicals (Geolite for ammonia reduction, Oxy-plus or Oxy flow for supplying dissolved oxygen; antibiotics to treat bacterial disease; KMnO4 as disinfectants), during culture period. However, the average cost per production period for fertilizers and other chemicals were 2.89% and 4.22% of total cost in tilapia mono and polyculture (Fig. 2).

Moreover, human labor is required in different operations including management starting from pond preparation to harvesting and finally for marketing. Comparatively higher labor cost per production period

was occurred in tilapia monoculture (Tk. 71,021.70 per ha) than polyculture (Tk. 53,492.14 per ha). Whereas, average marketing cost constituted about 3.34% and 3.46% of the total cost in case of tilapia monoculture and polyculture respectively. Average total cost per ha was Tk. 332,712.08 for tilapia monoculture which was more than tilapia polyculture (Tk. 241,722.34).

Profitability analysis

Profitability analysis includes analysis of gross revenue, gross margin, net return or margin and benefit cost ratio. The farmers involved in tilapia monoculture received the highest average gross return (Tk.782,940.60) per hectare per production period followed by tilapia polyculture (Tk. 522,750.80). Corresponding with average gross revenue, average gross margin was found quite higher in case of tilapias monoculture (Tk. 494,017.70) than tilapia polyculture (Tk.323,131.00) with carps (Table 1). Considerable variation in average net margin was also observed between two farming systems of tilapia culture, which were Tk. 450,222.52 for tilapia monoculture and Tk. 281,028.46 for tilapia culture with carps. The benefit cost ratios were estimated as 1.51 and 1.34 for tilapia monoculture and tilapia polyculture respectively.

Table 1. Different costs (Tk. per ha) in tilapia monoculture and polyculture

Cost Type	Tilapia Monoculture n=25	Tilapia Polyculture n=25
Variable Cost (VC)		
Stocking	65,607.09±10,578.33	52,847.45± 13,988.01
Feed	125,295.85±27,332.53	71,419.18± 10,687.94
Liming	6,279.40±1,469.50	3,290.63± 261.79
Fertilization and chemical	9,606.14±1,171.00	10,205.66± 1,830.07
Labor	71,021.70±3,393.40	53,492.14± 3,749.56
Marketing	11,112.71±5,207.02	8,364.74± 1,162.45
Total Variable Cost (VC)	288,922.90±33,689.50	199,619.80± 16,825.28
2. Fixed Cost (FC)		
Land rent	30755.93±2,969.82	30,713.61± 1,756.61
Pond preparation	7,223.07±842.24	6,398.44± 685.93
Interest	5,816.18±1,053.04	4,990.49± 420.63
Total Fixed Cost (FC)	43,795.18±3,415.35	42,102.55± 1,705.36
Total Cost (VC+FC)	332,718.08±34,881.26	241,722.34± 17,425.62
Farm size (ha)	0.17±0.01	0.20±0.02
Price per kg of fish	128.4±3.45	101.40±5.31
Yield per ha per production period	6,095.96±407.86	5,157.36±329.23
Gross Revenue (Tk per ha per production period)	782,940.6±59,211.86	522,750.8± 40,797.89
Gross Margin (Tk per ha per production period)	494,017.70±59372.85	323,131.00± 38,519.14
Net Margin (Tk per ha per production period)	450,222.52±59,349.77	281,028.46± 38427.59
Benefit Cost Ratio	1.51±0.28	1.34± 0.19

n indicates sample size. Data presented as mean ± standard deviation

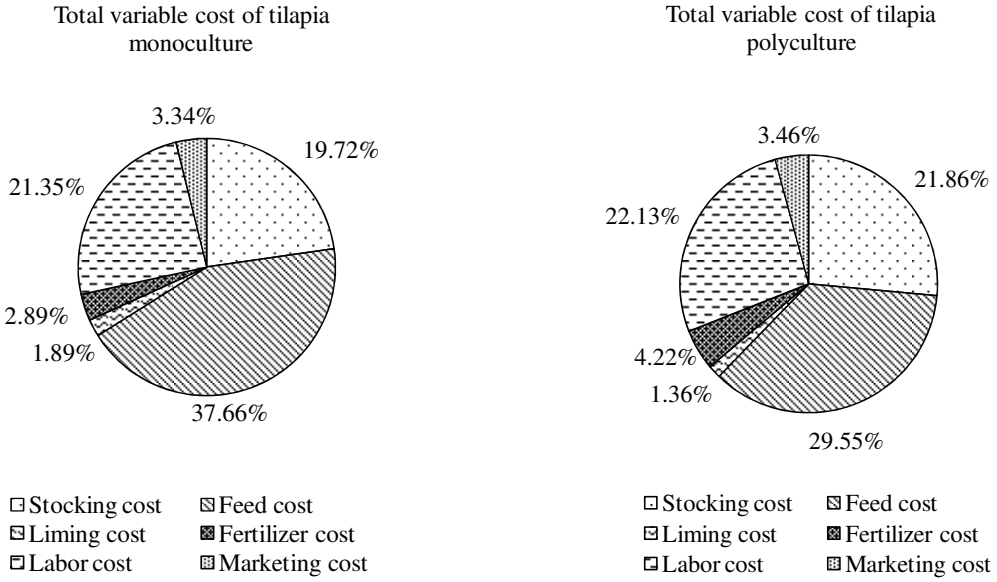

Fig. 1. Costs of tilapia monoculture and polyculture in the study area

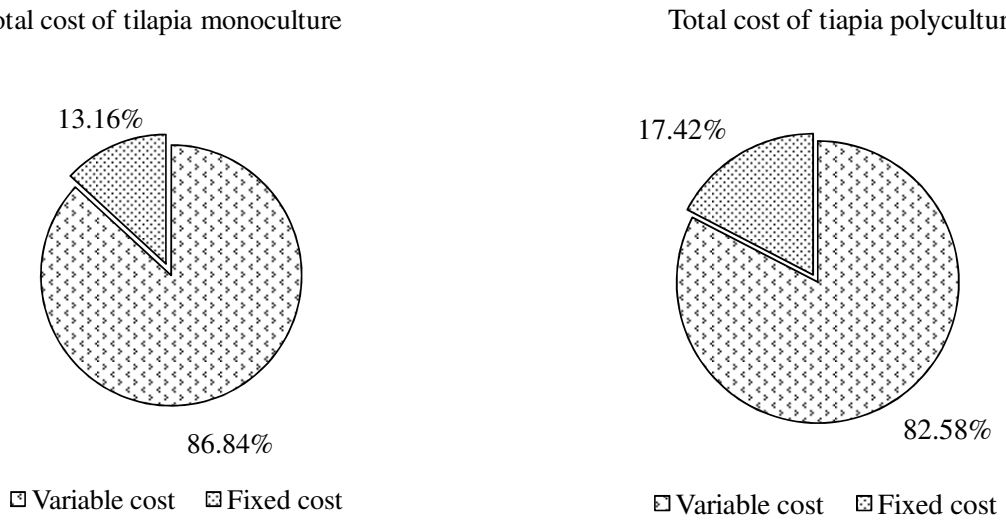

Fig. 2. Total variable cost of tilapia farmers in the study area

Discussion

In tilapia farming, variable costs accounted for 94% (Ahmed, 2007) and 81.83% (Boateng *et al.,* 2013) of total cost. Present survey also revealed the similar findings. Moreover, Abdelghany and Ahmad (2002) reported the total cost (US$/ha) as Tk. 2759.00 (215202.00 BDT/ha) in tilapia polyculture which is also alike with the present observation. Among different variable cost, the feed cost was the major cost in both tilapia-farming systems. Rahman *et al*., (2012) recorded similar observation in intensive tilapia culture where the cost of feed constituted the highest cost item. While in polyculture, tilapia can take the advantage of many natural foods available in ponds, which may be a reason of less average feed cost in mixed culture system of tilapia. On the other hand, labor cost was found the second major cost. Boateng *et al.,* (2013) also observed labor cost (10%) as second major proportion of the total of tilapia production following feeding cost. However, labor cost would vary under each particular case, location and season. In addition, marketing cost was more than 3% of the total variable cost in both farming practices. As marketing cost associates with the market distance from the farms and with the production level.

Maximum gross revenue was reported in monoculture farming than polyculture system. It might be due to higher production. The outcome of benefit cost ratio specify that tilapia monoculture farmers were able to recover Tk. 1.51 whereas, tilapia polyculture farmers were get back a return of Tk. 1.34 per Tk. 1.0 investment which may be due to higher revenue with minimum production costs. Khan *et al.,* (2008) also observed higher benefit cost ratio (1.46) for tilapia monoculture in Mymensingh.

Conclusion

Findings from the above survey carried different cost benefit information, which will be helpful for the farmers in homestead and commercial tilapia farming system. It is also clear that both tilapia mono and polyculture is profitable. However, the average total cost of tilapia monoculture was found maximum due to high feed cost. Therefore, different supplementary low cost feed with proper application of technical knowledge will encourage the tilapia farmers to continue their sustainable homesteads and commercial fish farming in Bangladesh.

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