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Economics of Periphyton-Based Aquaculture Production in Bangladesh

F.A. Huda, [1]M.M. Salehin and [2]M.I. Khan
Department of Agricultural Economics, [1]Department of Rural Sociology,
Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[2]Department of Agricultural Economics,
Bangabandhu Seikh Mujibur Rahman Agricultural University, Gazipur- 1703, Bangladesh

Abstract: The study evaluates the production practice and relative profitability of periphyton-based aquaculture both on-station and on-farm situation. The findings of this study are that with relatively lower production cost, this technology yields better than that of existing fish production practice. The net return was estimated 24086 Taka ha^{-1} on-farm and 33306 Taka ha^{-1} on-station from periphyton-based aquaculture for three months while it was 9796 Taka ha^{-1} on farm and 16744 Taka ha^{-1} on-station without this technology. The study also confirmed that it is an economically viable technology of fish production and the adopters could get better yield and net return from adopting such technology if positive steps undertaken for extension.

Key words: Periphyton-based aquaculture, net return, Bangladesh

Introduction

The rice-based diet of Bangladesh is complemented by fish. In this country, fish represents 70% protein source (BBS, 2000). Unfortunately the inland natural fisheries production in Bangladesh declined steadily due to over fishing, siltation of water bodies etc. So different nutrition related problems of the poor people of the society are increasing as a consequence of human modification to the environment.

For the improvement of this situation, scientists in Bangladesh have developed different technologies of fish culture. The extension of these technologies for increasing production is becoming increasingly reliant on extended resources like feed, fertilizer etc. But in a resource constrained country like Bangladesh where more than 75% of households spend 90% of their income on basic needs (BBS, 1995), many cannot afford to provide even rudimentary supplementary feeds for their fish ponds (O'Riordan, 1994). As a result scope for intensified fish culture by supplementary feed is not expending as expected.

An alternative means of increasing fish culture based on the natural production and home supplied cheaper inputs could be a solution for a poor country like Bangladesh. The periphyton based aquaculture is such type of fish production diet designed by fisheries scientists.

The traditional "acadjas" of Ivory Coast, West Africa and katham of Bangladesh are brush-parking based fish alternative devices used by fishermen (Welcomme, 1972, Wahab *et al*., 1994). Dense masses of tree branches on bamboo are placed in lakes, lagoons, on rivers and the fish are attracted by provision of shelter from predators and suitable breeding place in which natural food are abundant. Beveridge *et al*. (1998) argued that this type of fish attracting device called periphyton based aquaculture, served as a model for cheaper and efficient fish production in different fish feed deficit countries.

Wahab *et al*. (1998), found that inclusion of substrate for periphyton production in earth pond system results in increased production of fish such as rohu (*Labeo rohita*) and calbasu (*Labeo calbasu*) by different trials on perihyton-based aquaculture production in on-station research in Bangladesh. However, it is unknown whether this technology is profitable or economically viable at pond-based aquaculture.

This study attempts to examine the economics of periphyton-based aquaculture system in-terms of efficiency of resource uses. The results of the study also generate information which immense use to the existing and prospective producers in making decision on their scarce resources on periphyton-based aquaculture production practice and help to increase overall production.

The specific objectives of the study include:

- To examine the production practices and input use in periphyton-based aquaculture
- To asses the profitability of pond fish culture both with and without periphyton situation
- To examine resource use efficiency in periphyton-based aquaculture.

Materials and Methods

The study undertaken on the basis of different on station research on periphyton-based aquaculture conducted by fishery scientist of Bangladesh Agricultural University and some on-farm ponds managed by the farmer under the instruction of Care Life project's extension worker in Kishorgonj district. On-station fish culture was under scientific management but in on-farm farmer managed by himself following the extension worker's technical support. On station experiment conducted for the period of 1995 to 1997 at the Faculty of Fisheries in Bangladesh Agricultural University, Mymensingh. Amongst the experiment, data of 15 ponds with priphyton and data of 15 ponds without periphyton were collected. To compare the results with on-farm ponds managed by farmers, a total number of 30 ponds were purposively selected, of which 15 with and 15 without periphyton situation in Kishorgonj district. The data of on-farm level were collected for the period of March to August 2000 by a set of questionnaire. It is a privilege of study that experimental data recorded properly on-station.

Data analysis: The collected data were checked for consistency and were summarized, tabulated and analyzed in accordance with the objectives of the study. A simple tabular method, cost and return analysis were done to achieve the objective of the study.

On the basis of cost and return analysis, the following algebraic equation was developed to determine the profitability of pond fish culture with and without periphyton situation both on-station and on-farm (Miah, 1990).

$$\Pi = P_bB - P_{Xi}X_i - TFC$$

Where,

Π = Profit or net return
P_b = Per unit price of fish (Taka/kg)
B = Quantity of fish sold
P_{xi} = Per unit price of ith inputs
X_i = Quantity of ith inputs
I = (1,2,3,.....n)
TFC = Total fixed cost.

Finally, the findings were condensed by using average to meaning full results.

Results and Discussion

Pond environment and production practices: Both on-station and

Corresponding Author: F.A. Huda, Lecturer, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

Table 1: Comparative performance of periphyton-based aquaculture

Items of comparison	On-station			On-farm		
	With	Without	*Differences	With	Without	*Differences
Yield of fish (kg ha^{-1})	1108	629	479	988	638	350
Gross returns (Tk ha^{-1})	55400	31450	23950	49400	31900	17500
Gross cost (Tk ha^{-1})	22094	14706	7388	25314	22104	3210
Net return (Tk ha^{-1})	33306	16744	16562	24086	9796	14290
Benefit cost ratio (BCR)	2.5	2.1	0.4	1.95	1.44	0.51

Source: Authors' calculation: * The differences in per hectare yield of fish and net return were found statistically significant at 1.0 % level of significance

on-farm fish culture was carried out for three months. On-station earthen ponds were rectangular in shape and sized (75 cm^2). First, all experimental ponds were drainage renovated and cleaned of aquatic vegetation eradication. After renovation, narrow bamboo sticks were installed vertically into the bottom mud spaced 30 cm apart. Five days latter ponds were limed (CaO) @ 250 kg ha^{-1} and filled with water. The ponds were left for 15 days to allow sufficient production of periphyton on the substrate. The ponds were subsequently fertilized fortnightly with manure, urea and T.S.P. @ 5000, 50 and 50 kg ha^{-1} respectively, throughout the culture period (Wabab *et al.*, 1999).

The farmers of on-farm prepared their ponds according to the advice of extension worker, which was same as on-station preparation. But they uses different types of substrate namely, branches of bamboo, jute stick, branches of tree etc. as convenience of home supply. The ponds were different in size ranged from 20 to 80 decimal.

After sufficient growth of periphyton on substrates, all ponds were stocked with same sized fingerlings of rohu (*Labeo rohita*) at a density of 1 m^{-2} in on-station. On-farm average stocking density was 3 m^{-2} with same species.

The management practice were same in without periphyton situation except using substrate both on-station and on-farm.

Production performance and relative profitability of periphyton-based aquaculture: The results of this study clearly indicate that periphyton based aquaculture production is highly profitable both in on-station and on-farm condition than without periphyton. It is evident from the results (Table 1) that percentage of fish yield is far better under periphyton technology (on-station 1108 kg ha^{-1}, on-farm 988 kg ha^{-1} per three month) than the yield of fish without periphyton (on-station 629 kg ha^{-1}, on-farm 638 kg ha^{-1} per three month). Wahab *et al.* (1999) also found that the growth and production was significantly higher in the ponds with bamboo substrates as compare to the ponds with out substrates. He argued that fish production with periphyton situation was 1.7 times higher than that of without substrates over a culture period of four months. Huchette (1997) assessed the potentiality of periphyton based cage aquaculture in Meghna-Gumti river (Bangladesh) and found that periphyton situation can easily yield 1800 kg ha^{-1} per month (here the yield is higher than pond fish culture within a short time due to riverine environment). The present study also supports the above findings of different scientists. Thus the study found that on-station performance is better of in terms of net return, under periphyton situation because of fisheries scientists' proper supervision and management. Despite of different cost involve under periphyton aquaculture for cost of substrates earn much higher amount of net return (Tk. ha^{-1} 33306 on-station, Tk. ha^{-1} 24086 on-farm) than the return obtained from the without periphyton situation (Tk. ha^{-1} 16744 on-station, Tk. ha^{-1} 9796 on-farm). In fact incremental cost for substrates (on station Tk. ha^{-1} 7388, on farm Tk. ha^{-1} 3210) is higher than incremental benefit (on station Tk. ha^{-1} 16562, on firm Tk. ha^{-1} 14290). Nevertheless per hectare yield and net return are found statistically significant in this study. Undiscounted benefit cost ratio (BCR) estimated 2.5 on-station and 1.95 on-farm with periphyton, which reveled that per Taka investment on periphyton based aquaculture production in on-station easily return Tk. 2.5 and Tk. 1.95 in on-station respectively. That's why this periphyton-based technology of pond fish culture is a economically viable technology.

Under the circumstances periphyton based aquaculture technology has got a lot of comparative and positive advantages over the simply pond fish culture.

The overall findings of the research suggest that periphyton based aquaculture in an economically viable technology. It can increase fish production with cheaper local resources. At the same time, it can intensify fish culture cope with environment and contribute for sustainable economic development of the country. The concerned government agencies should take positive steps to train-up the farmers who are interested to adopt the technology. For this reason provision should be made by Upazila Agriculture Extension office to train up the interested individual farmer every year on these technologies. Finally, the present study provides the most valuable information for farmers, researcher, farm management specialist and policy makers regarding the profitability of periphyton-based aquaculture.

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