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Economic Loss from Fish Diseases on Rural Freshwater Aquaculture of Bangladesh

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Abstract: Prevalence of fish disease has negative economic impact on aquaculture but the extent of this impact is not well documented. In order to quantitative economic impact of fish disease on rural freshwater aquaculture, a questionnaire survey and Participatory Rural Appraisal (PRA) tools were used in five districts of Bangladesh namely Mymensingh, Comilla, Jessore, Natore and Dinajpur. The study was conducted from January to December 2003. A total of 500 fish farmers were interviewed and 25 PRA session were conducted. The present study indicated that there were average economic loss of Tk.20,615/ha/year (US$344) to farmers from fish diseases which was equivalent to approximately 15% of the actual production. These losses varied among different districts and with different size of farms. The average loss as high as Tk.26,817/ha/year (US$447) was observed in Comilla district followed by Dinajpur Tk.23,412 (US$390), Mymensingh Tk.19,685 (US$328), Jessore Tk.18,177 (US$303) and Natore Tk.15,037 (US$251). Fish production also varied among different districts. The average highest (19.2%) loss of actual production was seen in Comilla district while the lowest (7.9%) were observed with farmers from Natore district. In general, small size farms suffered from highest average loss (19.6%) than the bigger size farms (14% for medium and 11.2% for large farm). Prevalence of fish disease varied among different districts with highest prevalence (18.2%) was seen in Jessore followed by Comilla (13.4%), Mymensingh (11.4%), Dinajpur (10.4%) and Natore (5.6%).

Key words: Economic loss, fish diseases, rural aquaculture, Bangladesh

INTRODUCTION

Prevalence of disease is considered as one of the major reasons of poor fish production in aquaculture worldwide. A global estimate of disease losses to aquaculture by World Bank in 1997 was in the range of US$ 3 billion per annum[1]. Epizootic ulcerative syndrome of fish and white-spot disease of cultured shrimp has sufficiently demonstrated the economic impacts of aquatic animal disease on aquaculture[2]. Reduction of income due to disease problems have been reported by many others in different countries[3,4]. Such loss affects the livelihood of people involved in aquaculture and the community in which they occur through reduced food availability and loss of income and employment, as well as other associated social consequences[1].

Studies of fish diseases in Bangladesh are limited to diagnosis, characterisation and control of pathoges involved. Some studies have been undertaken only on socioeconomic aspects of developing pond fish culture[5-8]. Only a few studies have been carried out on the economic impact of fish disease. The most severe economic impact of fish diseases in Bangladesh was due to the occurrence of EUS in 1988 and the loss was estimated at about US$ 3.38 million in 1988[9]. Because of the fear that EUS may be harmful to human health, fish price dropped to 25-40% of their pre-disease level during the outbreaks in severely affected districts. The impact has been severe on small-scale, mixed species fisheries and aquaculture activities in rural areas[10]. In a study, Hasan and Ahmed[11] also reported economic loss due to diseases. They found 7.6% loss of net profit in carp hatcheries and nurseries of two districts of Bangladesh. However, they did not assess the loss of fish due to disease in grow-out ponds of rural farmers and thus do not reflect the overall economic impact in rural aquaculture.

Since most of rural the fish farmers do not understand the signs of diseases, they do not report incidences of diseases. As a result, the economic impact of these diseases on fish farmers are difficult to quantify. The impacts may be even more severe to small-scale fish farmers particularly if fish culture provides a major portion of their livelihood. There is a need to understand not only the prevalence of various diseases and pathogens but also the need to understand the economic losses resulting

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from disease outbreak. Assessing the economic impact of disease in rural aquaculture is vital in order to develop farmers-oriented primary fish health management packages and in determining the optimal investment for fish disease control. Field survey is most practical way in collecting such information directly from a large number of farmers. Therefore, questionnaire interview and Participatory Rural Appraisal (PRA) tools were used in this study to quantify the extent financial loss due to fish disease in rural freshwater aquaculture of Bangladesh.

MATERIALS AND METHODS

Study area: The study focused on five districts of Bangladesh namely Mymensingh, Comilla, Natore, Dinajpur and Jessore. These were selected because of their substantial contribution to freshwater aquaculture production of the country.

Data collection: Data was collected through the questionnaire interview and Participatory Rural Appraisal (PRA) with fish farmers. For questionnaire interview, a set of preliminary questionnaire was prepared. This was field tested with a few fish farmers of each representative location and necessary modifications were made based on their feedback. For the interview, simple random sampling method was followed. A total of 500 farmers (100 farmers from each district) having different farm size was interviewed. Prior to field survey, background information on the number, location and distribution of fish farms and aquaculture activities was collected.

PRA tools including Focus Group Discussion (FGD) was conducted with rural fish farmers to get an overview of particular issues of fish health and disease. A total of 25 FGD sessions in different districts were conducted where each group size was between 6 and 12 farmers. Cross check interviews were conducted with key informants such as District Fisheries Officer, Upazilla Fisheries Officer, NGO workers working with aquaculture, fishermen leader and village old man where information was contradictory.

Analysis of data: The data was analyzed using tabular and descriptive statistical techniques. The summary tables were prepared in accordance to the objective of the study. The technique of analysis included the classification of tables into meaningful result by arithmetic mean, percentage and ratios. The economic loss from fish diseases were calculated from the difference between expected production and actual production per hectare per year. The expected production reported by the farmers who had disease problems was verified with the neighboring farmers who do not have any diseases.

RESULTS

General farming and farmer's informations

Farmers category: All together, data from 500 farmers (100 from each district) were analysed. The survey split farmers into three categories depending on their pond area. The first category comprised of small farmers having less than 0.2 ha pond area which represented about 44.4% of the total farmers interviewed. The second category was medium farmers who had pond area between 0.2 and 0.4 ha and the third category was larger farmers having pond area over 0.4 ha. The medium and large category farmers represented 36% and about 19.6% respectively. Dinajpur district had the maximum number (59 out of 222) of small farmers followed by Mymensingh and Jessore district. Comilla district had maximum number (42 out of 98) of large farmers whereas Dinajpur (7 out of 98) and Jessore had the minimum (Table 1).

Farmers age, family size, experiences and education: The majority of farmers interviewed were male (95%), with an average age of 38 years and an average family size of 6. The average experience of fish culture by the farmers was 7 years, where maximum experience of 20 years was found only with 3 farmers from Jessore district. Farmers of Natore district were found more expert, devoted and shown their keen interest in fish culture than farmers from other districts. Average age of farmers from Mymensingh district was found minimum (33 years) and in Dinajpur district was found maximum (41 years) (Table 2).

All farmers interviewed were educated up to at least secondary school level with 43.0% up to high school level but under Secondary School Certificate (SSC) followed by 32.8% SSC and 16.2%, upto higher secondary level. Only 7.6% respondent, most of which from Natore district, were educated up to graduation level. The female respondents interviewed considered themselves to be housewives and were mainly educated to primary school level.

Overall 45.4% of the farmers were found cultured fish for income generation and 41.4% farmers cultured for both income and family consumption. However, only 13.2% farmers said that they culture fish only for household consumption and considered as non-cash receipt.

Pond conditions: Maximum ponds (72.8%) of the studied area were perennial and a few of ponds were seasonal (27.2%). However, in Dinajpur district, maximum 72% ponds was found seasonal. Most of the ponds were rain fed (51.4%) and only 5% farmer used deep tube-well water for fish culture. Overall, about 48% fish farmer said that they did not dry their ponds before the start of fish culture while 32% farmer said they dried their pond on their own and about 20% said that their ponds became

Table 1: Summary of responded in different districts

Farm category (ha)	Mymensingh	Comilla	Natore	Dinajpur	Jessore	Overall	Percent (%)
<0.2	55	30	27	59	51	222	44.4
0.2-0.4	29	28	48	34	41	180	36.0
>0.4	16	42	25	7	8	98	19.6
Total	100	100	100	100	100	500	100.0

Table 2: Average age, family size and experience of fish farmers in the different study areas

District	Average age of farmers (Years)	Average family size (no.)	Experience of fish culture (Years)
Mymensingh	33	6	6
Comilla	39	5	6
Jessore	40	7	8
Natore	38	5	6
Dinajpur	41	6	8
Average total	38.2	6	7

Table 3: Prevalence of fish diseases (%) in different districts and farms categories

Farm category (ha)	Mymensingh	Comilla	Jessore	Natore	Dinajpur	Average (%)
<0.2	14.6	15.5	20.0	6.3	12.5	13.8
0.2-0.4	10.6	14.6	19.8	5.1	11.8	12.8
>0.4	9.0	10.2	14.9	5.3	7.1	9.3
Average	11.4	13.4	18.2	5.6	10.5	11.8

Table 4: Cost of fish disease control (Tk/ha/year). (1US$=Tk.60)

Farm category	Mymensingh	Comilla	Dinajpur	Jessore	Natore	Average
<0.2	2,784	2,505	2,653	1,899	2,584	2,485
0.2-0.4	3,110	2,934	3,134	2,200	3,016	2,879
>0.4	3,542	3,695	3,369	2,628	3,525	3,352
Average	3,145	3,044	3,052	2,242	3,042	2,905

Table 5: Summary of average expected and actual fish production and the economic loss (Tk/ha/year) of the farmers due to fish diseases in different study areas (1 US$=Tk60)

Farm	Mymensingh			Comilla			Natore		
category (ha)	Expected production	Actual production	Loss	Expected production	Actual production	Loss	Expected production	Actual production	Loss
<0.02	141,400	120,850	20,550 *(17.0)	127,250	98,800	28,450 *(28.8)	185,560	169,950	15,610 *(9.1)
0.2-0.4	153,700	134,946	18,754 *(14.0)	175,250	146,500	28,750 *(19.6)	214,250	198,500	15,750 *(7.9)
>0.4	185,500	165,750	19,750 *(11.9)	195,750	172,500	23,250 *(13.4)	216,500	202,750	13,750 *(6.7)
Average	160,200	140,515	19,685 *(14.3)	166,083	139,267	26,817 *(20.6)	205,437	190,400	15,037 *(7.9)

Table 5: Continue

	Jessore			Dinajpur		
Farm category (ha)	Expected production	Actual production	Loss	Expected production	Actual production	Loss
<0.02	125,890	105,850	20,040 *(18.9)	146,800	118,200	28,600 *(24.2)
0.2-0.4	145,342	127,782	17,560 *(13.7)	163,750	142,350	21,400 *(15.0)
>0.4	167,520	150,740	16,780 *(11.1)	178,250	158,015	20,235 *(12.8)
Average	146,251	128,124	18,127 *(14.6)	162,933	139,522	23,412 *(17.3)

*Percent loss of the actual production

Table 6: Average economic loss (Taka/ha/year) of the farmers due to fish diseases in different study areas (1US$=Tk.60)

Farm category (ha)	Mymensingh	Comilla	Natore	Dinajpur	Jessore	Overall average
<0.2	20,550	28,450	15,610	28,600	20,040	22,650
0.2-0.4	18,754	28,750	15,750	21,400	17,560	20,442
>0.4	19,750	23,250	13,750	20,235	16,780	18,753
Average	19,685	26,817	15,037	23,412	18,127	20,615

Table 7: Average economic loss percentage (%) of actual production of the farmers due to fish diseases in different study areas

Farm category (ha)	Mymensingh	Comilla	Natore	Dinajpur	Jessore	Overall average
<0.2	17.0	28.8	9.1	24.2	18.9	19.6
0.2-0.4	14.0	19.6	7.9	15.0	13.7	14.0
>0.4	11.9	13.4	6.7	12.8	11.1	11.2
Average	14.3	20.6	7.9	17.3	14.6	14.9

dried naturally at the end of winter season. All the farmers practiced carp polyculture system.

Prevalence of fish disease: The average prevalence of fish diseases in farmers ponds was noticed highest (18.2%) in Jessore district followed by comilla (13.4%), Mymensingh (11.4%) and Dinajpur (10.4%). Natore district had the minimum prevalence of disease (5.6%). Average prevalence of disease in small farmers ponds was the highest (13.8%) followed by medium (12.3%) and large farmers ponds (9.3%) (Table 3). About 37% farmers considered fish diseases as a major problem, while 38% thought that disease as a moderate problem and 24.2% farmers considered it as a minor problem.

Disease control cost: Large category farmers spent more money (Tk.3,352/ha/year) for the control (including prevention and treatment) of fish diseases than medium (Tk.2,879/ha/year) and small category farmers (Tk.2,485/ha/year). The highest disease control cost (Tk.3,145/ha./year) was found in Mymensingh district and the lowest (Tk.2,242/ha/year) was in Jessore district (Table 4).

Fish production: Fish production varied with different districts. Farmers were asked about their expected production when they had no disease problems and the actual production obtained due to disease problems at the end of the production cycle. Natore district had the highest average expected production (Tk.205,437/ha/year), while Jessore district had the lowest (Tk.146,251 /ha/year). Average actual production, that the farmers received after selling fish at the end of the production cycle was also highest in Natore district (Tk.190,400/ha/year) and the lowest in Jessore district (Tk.128,124/ha/year.). Mymensingh, Comilla and Dinajpur district had almost similar actual production of Tk.140,515, Tk.139,267 and Tk.139,522/ha/year, respectively (Table 5). Variations were also found in the actual fish production in different farm categories of the study area. The average actual production increased with increasing the farm size.

Economic loss due to fish disease: The results of the study indicated that there were substantial financial losses of Tk.20,615/ha/year to farmers from disease. These losses varied in different districts and with the size of farms. The economic loss was estimated by the differences between the expected production and actual production. Prevention and treatment cost of fish diseases was not calculated. The highest average loss as high as Tk.26,817/ha/year was found in the fish farmers of Comilla districts followed by Dinajpur (Tk.23,412), Mymensingh (Tk.19,685), Jessore (Tk.18,127) and Natore (Tk.15,037) districts, respectively (Table 6). In general, small sized farms (<0.2 ha) suffered from highest average loss (Tk.22,650/ha/year) than the bigger sized farms (Tk.18,753/ha/year) (Table 6). The average highest percentage (20.6%) of loss of actual production was seen in Comilla district while the lowest (7.9%) were found with farmers from Natore district. The small farmers of each district had more percentage of loss than the large farmers (Table 7).

DISCUSSION

The results of this study indicated the cost of fish diseases is approximately 15% to income of fish farmers from fish. This loss varied with different parts of the country as well as with the size of farms.

The average overall loss was Tk.20,615/ha/year to farmers. Brown and Brooks[12] reported average loss of farmers of six districts of Bangladesh due to fish disease was 18.5% of total average yearly income from fish production. Hasan and Ahmed[11] also reported economic loss due to fish diseases. They found 7.6% loss of net profit in carp hatcheries and nurseries of two districts of Bangladesh. However, they did not assess the loss of fish due to disease in grow-out ponds of rural farmers and thus could not reflect the overall economic impact in rural aquaculture. In another study on the impact of fish diseases in northern region of Bangladesh, Amin[13] found financial loss of farmers due to fish diseases was from Tk.5,000 to Tk.25,000/acre/ year.

Small-scale farms (<0.2 ha) suffered from highest economic loss than medium (0.2-0.4 ha) and large-scale farms (>0.4 ha). In relative terms, this suggests small-scale farmers are more vulnerable to disease shock as percentage of income from fish production is higher among small farm holders. Small-scale farmers have very little knowledge in fish culture and they were found reluctant to use any new technologies. Consequently, their production per hectare was low and the losses were high. On the other hand, since large farmers invested more in fish culture, they tended to feed and monitor fish health more regularly.

The economic loss in Comilla district was the highest. This was due to the higher stocking density of small sized fry, inexperience of fish farmers, poor input and poor understanding of fish health management. On the other hand, Natore district had the highest production and lowest loss. This might be due to the awareness of farmers on fish culture, low stocking density, stocking of bigger sized fingerling, proper feed supply and pond management. The farmers of Natore were also more

experienced. An indication behind such a better management practices of this district was that the extension service was more developed in Natore than the other districts.

The production of fish by the farmers in Jessore district was the minimum. This may be due to the fact that the people of that district mainly involved with the production of fish seed and fry. Generally, they are not very familiar to the culture of table size fish because of limited profit in comparison to seed production. The production of Dinajpur and Comilla was quite similar. Most of the ponds in Dinajpur district were seasonal and became dry at the end of winter season. As a result, disease infection in this district was also low.

Economic loss is likely to increase as aquaculture expands and intestifies. Assessing the impact of disease in aquaculture systems is not easy, as only acute losses are recognized and quantified. Chronic mortalities and poor growth caused by disease are generally not recognized. In order to quantify disease losses, farmers should be able to identify disease as the reason for crop loss, slow growth or poor harvest[2]. Therefore, it is important to train farmers to carry out field-level diagnosis and assess the likely impact of disease.

Several indicators may be used to quantify health related losses in aquaculture. Difference between expected yield and actual yield, percentage survival and growth rate may give some indicator regarding health related chronic losses in aquaculture[14]. In the present study, the economic loss was estimated by the differences between the expected production and actual production. Such estimates may be crude, since other factors can contribute to poor survival, poor growth and production loss. However, every efforts were made here to make sure that the farmers give data on fish loss only due to disease not for other reasons. It should be mentioned that, although farmers spent quite a lot of money as a preventive measures against disease as well as during treating diseased fish, the cost of disease prevention and treatment were not considered here. Moreover, the traditional fish farmers do not keep proper records and accounts of their operations. Hence, it was very difficult to collect actual data and the authors had to relay mostly on the memory of the respondents.

Rural farmers were mostly found resource-poor with little or no knowledge of health management and have inadequate opportunities to improve management skills. Their ability to respond effectively to fish disease problem is also very limited. As a result, they suffered from financial losses due to fish disease. Such losses affected the livelihood of fish farmer, their dependent and the communities in which they occur through reduced food availability, loss of income and employment, as well as other associated social consequences.

Questionnaire interview and PRA tools were used here to collect necessary information. During PRA, respondents for questionnaire interview were selected. PRA is considered one of the popular and effective approaches to gather information in rural areas. Chambers[15] defined PRA as an approach and methods for learning about rural life and conditions from, with and by rural people. In the present study, PRA tools, mainly focus group discussion, was used to get a general overview about aquaculture strategies, fish disease problems and financial loss from disease. Rural fish farmers spontaneously took part in the discussion. During the PRA sessions, farmers mentioned a number of disease problems like EUS, red spot, gill rot and tail and fin rot. Farmers considered EUS as a major problem in fish culture. This disease was first reported in Bangladesh in 1988 and since then this disease has had a serious effect on aquaculture throughout the country. According to the farmers opinion it was found that EUS is still causing significant fish losses in Bangladesh. The disease occurs mainly at the beginning of the winter season and caused severe mortality of fish. Therefore, farmers could be suggested to take some preventive measures at the beginning of winter season which include, application of lime and salt, disinfection of equipment, addition of water etc. Other major disease related issues came out of the PRA sessions was the lack of advice from government extension services and NGOs, indication that efforts are required to increase their profile in this particular area.

In conclusion, this study demonstrated that there are substantial economic loses to fish farmers due to diseases. Therefore, the importance of prevention and control of disease risk as a measure to reduce production loss should be given proper attention. Further work is needed focused on the development of strategies for farmer-oriented primary fish health management packages. Also, there is a need to train farmers and technical personnel on simple diagnostic procedure and effective therapy, creation of awareness amongst farmers on fish health management and establishment of mobile diagnostic centers.

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