



Journal of Indian Fisheries Association

<https://epubs.icar.org.in/index.php/IJFA/issue/view/3917>



Constraints faced by Jhora fish farmers in the Darjeeling Himalayas

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Abstract

Jhora fish farming has been instrumental in supporting income generation for the economically disadvantaged population in the Darjeeling hilly region since 1981. Nonetheless, its effectiveness in this regard has been hampered by several constraints. The primary objective of this study is to identify the constraints faced by Jhora fish farmers that hinder their profitability. A structured interview schedule was used to collect primary data from 120 respondents practicing Jhora fisheries in three types of ponds: cement, mud, and cement with mud bottom. The rank-based quotient (RBQ) method was employed to measure and quantify the technical, environmental, infrastructural, and economic constraints. Results indicated that the most important constraints faced by the Jhora fish farmers were non-availability of quality feed, hatchery, feed mills, predation, and lack of self-finances. Non-parametric Kruskal-Wallis test revealed a significant difference in the median rank scores of eight out of twenty-seven constraints faced by Jhora fish farmers using three types of ponds. Additionally, the study proposed appropriate strategies to augment fish production in the Darjeeling Himalayan hill region, with the aim of popularizing Jhora fisheries among the rural youth.

Keywords:

Jhora fishery, constraints, RBQ, Kruskal-Wallis, Darjeeling hilly region

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Received: 29 November 2022

Accepted: 31 March 2023



Introduction

Fisheries and aquaculture sector contribute significantly to food security and nutrition, especially in the world's most food-limited regions, while simultaneously supporting the livelihood of hundreds of millions of people worldwide (FAO, 2020). Cold water fisheries occupy an important place amongst the freshwater fishes of India. It deals with those fisheries activities only, where water temperature ranges from 5°C to 25°C. Such conditions in India occur in Himalayan and peninsular regions (Mahanta and Sarma, 2010).

India has significant cold water resources in the form of upland streams, rivers, lakes, reservoirs and ponds that are located at medium to high altitudes of Himalayan corridors of Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim, West Bengal and all North-Eastern States. Darjeeling Himalayan region of West Bengal, often referred to as the Queen of the Hills, is located at an elevation of 6,700 ft. (2,042.2 m), from 27° 13' N to 26° 27' N Latitude 88° 53' E to 87° 59' E Longitude, (Census of India, 2011). This region harbours numerous streams, locally named "Jhora", which usually receive rains on an average of 126 days in a year and July month records the highest rainfall. Thus, a cold temperate condition and year round water availability have enabled a culture of cold-tolerant exotic carps, popularly known as "Jhora Fishery" which is being practiced and has emerged as a means of livelihood for the locals of Darjeeling hills.

Jhora denotes 'spring water' in Nepali and 'Jharna' in Bengali. (Mukherjee *et al.*, 2013) Jhora fish culture has been reported since time immemorial and practiced more as a hobby and decorative purpose rather than for financial gains. Ever since it had helped to increase protein consumption among the economically backward people of hills, Govt. of West Bengal had initiated popularizing Jhora fisheries practices in the Darjeeling Himalayan region. Jhora fishery in the Darjeeling hilly region is the first of its kind in India. It is a traditional way of fish culture in hilly cold-water streams and is also used for irrigation (Sarma *et al.*, 2015). This clean water, rich in dissolved oxygen from the Jhora is stored in ponds for fish culture mainly in three types of ponds, viz., cement pond, cement with mud bottom pond, and mud pond. But culturing fish without proper scientific management protocols had resulted in poor production providing meagre gains to Jhora fish farmers which may be due to the constraints faced by them (Foning, 1987). These constraints are adversely affecting farmers in obtaining expected fish yields and income (Dewan and Pandey, 2015). Thus, the study was undertaken to find out the constraints faced by Jhora fish farmers in Darjeeling hilly region, so that fish production can be enhanced for their sustainable livelihood and income generation.

Methodology

Primary data was collected from 120 Jhora fish farmers of the Darjeeling Himalayan hilly region using a pre-tested interview schedule from October 2019 to December 2019. These respondents practiced Jhora fisheries in three types of ponds: cement pond, mud pond and cement with a mud bottom pond. From each of these ponds, 40 respondents (Jhora fish farmers) were randomly selected for the study. Constraints faced by Jhora fish farmers were identified from those farmers who were practicing the same and confirmed by the government officials and experts of Department of Fisheries, West Bengal. All together 27 constraints were identified and were categorised into four subheads namely technical, environmental, infrastructural and economic constraints.

Rank-Based Quotient given by Sabarathnam (1988) was used to quantify the data collected through preferential ranking technique for each parameter. The formula used for RBQ is given as under:

$$RBQ = \frac{\sum f_i(n+1-i)}{(N \cdot n)} * 100$$

Where f_i = Number of Jhora fish farmers reporting a particular problem with i^{th} rank, N = number of Jhora fish farmers and n = number of problems identified.

Respondents were asked to rank the identified constraints in each subheads, according to their severity from '1 to n' in such a way that rank '1' represents major constraint and rank 'n' represents minor constraint. Data obtained for RBQ was analysed in MS Excel.

Once all the constraints for the three types of ponds; cement, mud, and cement with a mud bottom were ranked under the above-mentioned subheads, a rank-based non-parametric Kruskal-Wallis test was used to check the potential differences in the median rank score across two or more groups (Rajendran *et al.*, 2009; Tixier *et al.*, 2014; Hwang *et al.*, 2018) with the following null hypothesis:

H0: The median rank scores of the constraints across the three types of Jhora fish ponds are equal.

Against the alternative hypothesis;

H1: At least one of the median rank score is different from the others.

Data was analysed using statistical software SPSS, version 22.0 with following test-statistics

$$H = \frac{12}{n(n+1)} \sum_{j=1}^k \frac{R_j^2}{n_j} - 3(n+1)$$

Where n = the total sample size, j = type of pond to which it belongs, k = total number of ponds, n_j = the sample size of pond j , and R_j = the sum of ranks of pond j .

Results and discussion

Technical constraints

Technical constraints faced by Jhora fish farmers in Darjeeling Himalayan hilly region are listed in Table 1. Results indicated that non-availability of quality feed and less availability of quality seed as the major constraints, ranked I and II with an RBQ score of 84.91 and 79.44 respectively by all the selected respondents. This may be due to the unavailability of floating feed locally and farmers were compelled to buy from neighbouring Jalpaiguri district of West Bengal which is approximately 400 km far away. Also, seed from the vendors were reported to be of low quality which gave a sluggish growth rate. A similar finding was reported by Maity *et al.*, (2019), citing lack of seed production and non-availability of quality seed as important constraints in Purba Medinipur district of West Bengal. Third major constraint was less knowledge of modern and scientific fish farming with an overall RBQ score of 60.65. Whereas, Mohanthy *et al.*, (2011) reported lack of awareness and technical knowledge as the most important constraint (RBQ score-100) faced in aquaculture practices in Odisha. The fourth major constraint was seepage of water with an overall RBQ score of 58.33. To a greater extent, fish farmers with cement ponds faced this problem, which they could reduce by using poly-lining. Maintenance of water line was ranked fifth with an overall RBQ score of 48.61, as the farmers had to spend hours in fixing water line, if there were any interruptions in the water supply. However, transportation of feed/seed and mortality rate were reported as constraints with lower RBQ scores by Jhora fish farmers. As most of the farmers mainly depended on the Department of Fisheries (DoF) for feed and seed with better transportation

Table 1. Technical constraints faced by Jhora fish farmers

Types of ponds	Cement pond (n=40)		Cement-mud bottom pond (n=40)		Mud pond (n=40)		Over all (n=120)	
Constraints	RBQ score	Rank	RBQ score	Rank	RBQ score	Rank	RBQ score	Rank
Non availability of quality feed	83.89	I	85.00	I	85.83	I	84.91	I
Less availability of quality seed	79.44	II	82.22	II	76.67	II	79.44	II
Less knowledge on modern & scientific fish farming	59.72	IV	62.78	III	59.44	III	60.65	III
Water seepage	62.22	III	55.00	IV	57.78	IV	58.33	IV
Maintenance of water line	44.72	VIII	50.83	V	50.28	VI	48.61	V
Difficulties in transportation of feed	47.22	VII	41.94	VII	54.72	V	47.96	VI
High rate of mortality	49.17	VI	48.61	VI	35.46	IX	44.44	VII
Difficulties in transportation of seed	49.44	V	39.44	VIII	40.28	VII	43.06	VIII
Less technical guidance	26.39	IX	37.78	IX	39.44	VIII	34.54	IX

facilities, and the fingerlings provided by DoF had better survival rate. They had also received timely advices from the Fisheries Extension Officers; hence lack of technical guidance was reported as lowest constraint with RBQ score of 34.54.

Environmental constraints

Environmental constraints faced by Jhora fish farmers in Darjeeling Himalayan hilly region are listed in Table 2. Results indicated predation as the most important environmental constraint with rank I with an overall RBQ score of 71.46, since birds eat fish when they are small in size which can be controlled by using leaf netting over the ponds. Respondent farmers had also reported to be affected by snakes, animals, and crabs which can be controlled by using small mesh fencing. Natural disaster was ranked II with an overall RBQ score of 67.71, as frequent landslides during monsoon resulted in breakage of water pipes and also hindered transportation. Third constraint was reported as pollution in Jhora with an overall RBQ score of 56.66 due to dumping of waste in the nearby Jhora. To control this, farmers had to get fresh water from different source for fish culture. Disease outbreak was

reported as the lowest faced environmental constraint with an overall RBQ score of 55.41, as majority of farmers get fresh water, although few of them also had reported fungal diseases, while a study conducted by Abraham *et al.* (2010) reported disease outbreak as the most important constraint faced by 82% of the fish farmers in different parts of West Bengal.

Infrastructural constraints

Infrastructural constraints faced by Jhora fish farmers in Darjeeling Himalayan hilly region are listed in Table 3. Results indicated non-availability of hatchery as the major infrastructural constraint with rank I and an overall RBQ score of 83.2. This was mainly due to the existence of only one hatchery (Reyang Hatchery) in the hilly region which was not even operational since long and farmers had to buy fish seeds from the neighbouring Jalpaiguri district. Similar findings were reported by Das (2018) and Niangti *et al.* (2020) stating that non-availability of quality seed as the top infrastructural constraint in the North-Eastern Hills and West Garo Hills of Meghalaya. Second major constraint reported was non-availability of feed mills with an overall RBQ score of 82.74, as no feed

Table 2. Environmental constraints faced by Jhora fish farmers

Types of ponds	Cement pond (n=40)		Cement-mud bottom pond (n=40)		Mud pond (n=40)		Overall (n=120)	
Constraints	RBQ score	Rank	RBQ score	Rank	RBQ score	Rank	RBQ score	Rank
Predation	71.25	I	74.38	I	68.75	II	71.46	I
Natural disaster	58.13	IV	72.5	II	72.50	I	67.71	II
Pollution in Jhora	61.25	II	50.63	IV	58.13	III	56.66	III
Disease outbreak	58.75	III	56.25	III	51.25	IV	55.41	IV

Table 3. Infrastructural constraints faced by Jhora fish farmers

Types of ponds	Cement pond (n=40)		Cement-mud bottom pond (n=40)		Mud pond (n=40)		Over all (n=120)	
Constraints	RBQ score	Rank	RBQ score	Rank	RBQ score	Rank	RBQ score	Rank
Non availability of hatchery	86.43	I	85.00	I	78.21	II	83.21	I
Non availability of feed mills	81.43	II	81.79	II	85.00	I	82.74	II
Poor development of roads & transport facility	64.64	IV	71.07	IV	77.50	III	71.07	III
Inadequate marketing facility	71.79	III	73.21	III	65.36	IV	70.12	IV
Poor communication facility	49.64	V	39.29	V	35.00	VI	41.31	V
Irregular power Supply	27.50	VI	33.57	VI	40.36	V	33.81	VI
Shortage of drinking water & daily needs	18.57	VII	16.07	VII	18.57	VII	17.74	VII

manufacturing facility was available in the hilly regions and floating feed was brought from Jalpaiguri district. Poor development of road and transportation was reported as the third constraint, with an overall RBQ score of 71.07. It was observed that proper roads were yet to be developed and most of the farmers had to walk a long way from their dwellings. Inadequate marketing facility was reported as the fourth constraint with overall RBQ score of 70.12, as the region doesn't have proper hygienic fish market for local fish produce. However, poor communication facility, irregular power supply, shortage of drinking water and daily needs were reported with lower RBQ scores of 41.31, 33.81, and 17.74, respectively by the respondent farmers. Whereas in other hilly regions like Kashmir, less availability of drinking water and power cuts were the commonly faced infrastructural constraints (Bhat and Sharma, 2021)

Economic constraints

Economic constraints faced by Jhora fish farmers in Darjeeling Himalayan hilly region are listed in Table 4.

Results indicated that most of the farmers with cement ponds and cement-mud bottom ponds had ranked lack of self-finance and high initial investment as the two major economic constraints with rank I and II with an overall RBQ score of 79.17 and 71.07 respectively. Initial fixed investments in these two types of ponds are relatively higher, i.e., ₹32,033.16 /500 sq ft. and ₹24,469.57 /500 sq ft., respectively as compared to mud pond (₹8,821.27 /500 sq ft.) (Thapa, 2020). Whereas, high price of feeds was the major economic constraint faced by farmers having mud bottom ponds. Lack of financial support in the form of subsidy was reported as the third major constraint, with an overall RBQ score of 68.10. Since subsidies were mainly provided under Tribal Sub-plan and could be availed by the Scheduled Tribe category farmers only, therefore, other farmers were deprived of subsidies. The fourth constraint reported was the high price of feed, with an overall RBQ score of 67.38. Since feed was brought from Jalpaiguri district, its cost had increased from ₹35/Kg to almost ₹50/Kg due to additional transportation costs. Similar finding was reported by

Table 4. Economic constraints faced by Jhora fish farmers

Types of ponds	Cement pond (n=40)		Cement-mud bottom pond (n=40)		Mud pond (n=40)		Over all (n=120)	
Constraints	RBQ score	Rank	RBQ score	Rank	RBQ score	Rank	RBQ score	Rank
Lack of self-finance	86.43	I	81.07	I	70.00	III	79.17	I
High initial investment	73.21	II	74.29	II	65.71	IV	71.07	II
Lack of financial support / subsidies	61.43	IV	68.93	III	73.93	II	68.10	III
High price of feeds	65.36	III	62.50	IV	74.29	I	67.38	IV
Availability of credits	53.21	V	56.07	V	50.00	V	53.09	V
Problem of theft	30.71	VI	28.57	VI	32.50	VI	30.59	VI
High price of seeds	28.93	VII	28.21	VII	31.79	VII	29.64	VII

Mishra *et al.* (2022) citing that cost of supplementary feed was one of the major constraints of the resource-poor farmers in Purulia district of West Bengal. Non-availability of credits, problem of theft, and high price of seeds were the constraints reported by respondents with lower RBQ scores. Whereas, Rahaman *et al.* (2013) and Das *et al.* (2018) had reported theft/poaching as the most important constraint of fish production in West Bengal and Assam.

Table 5 clearly indicates that there was a significant difference in the median rank scores across the three types of ponds; cement, mud, and cement with a mud bottom used for Jhora fishery in Darjeeling Himalayan hilly region for only eight constraints under four different sub-heads (as $p < 0.05$). These constraints were difficulties in transportation of feed and high rate of mortality under technical head; natural disaster and disease outbreak under environmental head; non-availability of hatchery, poor communication facility and irregular power supply under infrastructural head while lack of self-finance under economic head. However, other constraints had not shown any significant difference in their median rank scores across the three types of ponds; cement, mud, and cement with a mud bottom used for Jhora fishery in Darjeeling Himalayan hilly region.

Conclusion

The study highlights the four types of constraints faced by Jhora fish farmers, namely technical, environmental, infrastructural, and economic. It was observed that non-availability of quality feed and less availability of quality seed were the most important constraints under technical category, predation was under environmental, non-availability of hatchery was under infrastructure and lack of self-finance was under economic categories. A non-parametric Kruskal-Wallis test revealed that there was a significant difference in the median rank scores of eight constraints out of twenty-seven constraints faced by Jhora fish farmers using three types of ponds; cement, mud, and cement with a mud bottom in Darjeeling Himalayan hilly region. With the support of Department of Fisheries, West Bengal and Gorkhaland Territorial Administration (GTA), quality feed and seed can be made available locally at a reasonable price, along with proper marketing infrastructure. This can encourage more farmers to be involved in Jhora fisheries, leading to better food security and income generation in Darjeeling Himalayan hilly region. Construction of feed mills, private hatcheries, hi-tech aquaculture techniques like raceways, etc. should be promoted for farmers' benefit through different Pradhan Mantri Matsya Sampada Yojana (PMMSY) schemes. In collaboration, GTA and Department of Fisheries, West Bengal can initiate issuing an angling license to integrate fisheries with tourism for earning extra revenue, so that Jhora fisheries gets popularized among rural youth of Darjeeling Himalayan hilly region.

Significance of the constraints faced

Results of Kruskal-Wallis test for the four sub-heads namely technical, environmental, infrastructural and economic constraints making comparison across the three types of ponds are presented in the following table 5.

Table 5. Kruskal-Wallis test for the constraints faced by Jhora fish farmers

Constraints	Kruskal-Wallis test (p-value)	
Technical constraints		
Non availability of quality feed	0.758	0.685
Less availability of quality Seed	3.007	0.222
Less knowledge on modern & scientific fish farming	0.431	0.806
Water seepage	0.418	0.811
Maintenance of water line	2.432	0.296
Difficulties in transportation of feed	7.014	0.030**
High rate of mortality	11.302	0.004**
Difficulties in transportation of seed	2.817	0.245
Less technical guidance	5.921	0.052
Environmental constraints		
Predation	4.578	0.101
Natural disaster	8.179	0.017**
Pollution in Jhora	3.454	0.178
Disease outbreak	18.467	0.000**
Infrastructural constraints		
Non availability of hatchery	10.331	0.006**
Non availability of feed mills	1.469	0.480
Poor development of roads & transport facility	4.480	0.106
Inadequate marketing facility	2.268	0.322
Poor communication facility	24.530	0.000**
Irregular power supply	23.642	0.000**
Shortage of drinking water & daily needs	3.173	0.205
Economic constraints		
Lack of self-finance	7.524	0.023**
High initial investment	0.605	0.739
Lack of financial support / subsidies	1.739	0.419
High price of feeds	2.297	0.317
Availability of credits	1.669	0.434
Problem of theft	1.021	0.600
High price of seeds	0.958	0.620

Acknowledgements

Authors are thankful to Director/Vice-Chancellor, ICAR-CIFE, Mumbai for providing necessary support and facilities for conducting this research work during Master's degree programme. Financial support during the period in the form of Junior Research Fellowship provided by ICAR is also gratefully acknowledged.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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