A Study on Supply Chain Analysis and Marketing Margin of Catfish Seed in Mymensingh District

ABSTRACT

Aims: This study examined the supply chain and marketing margin of catfish seed in selected areas of the Mymensingh district. The objectives include analyzing supply chain management, marketing margins of catfish seed production, and identifying the challenges in production and marketing systems.

Study Design: This study used a quantitative approach with a questionnaire data collection method.

Place and Duration of Study: Samples were taken from four upazilas of Mymensingh district- Gouripur, Trishal, Mymensingh Sadar, and Muktagacha. Data was collected through face-to-face interviews between mid-September and mid-October in 2019.

Methodology: The sample size was 120 including 30 catfish seed farmers, 30 paikers, 30 wholesalers, and 30 retailers. This study employed supply chain analysis, net return and net marketing margin analysis, and descriptive statistics.

Results: The study found that retailers had the highest net marketing margin of Tk. 1664 for 10 kg spawn, while paikers earned the highest margin of Tk. 11148 for 100,000 pieces of fingerling. The annual net return per acre from spawn production in hatcheries was Tk. 9,469,097, and from fingerling production in nurseries was Tk. 455,783.

Conclusions: The research indicated that catfish seed farms with hatcheries were more profitable than those with nurseries. Hatchery owners, nursery owners, and traders faced significant problems in their operations, such as a lack of information on quality seed, higher input prices and price fluctuations, non-availability of various inputs, and poor communication systems. Based on the result, recommendations were made to support the development of catfish seed farms and traders as a promising sector in agribusiness.

Keywords: Catfish, Fish seed, Supply chain, Marketing margin, and Mymensingh

1. INTRODUCTION

The fisheries sector represents a vibrant and flourishing sector with immense possibilities for ongoing growth within Bangladesh's agricultural economy (Shamsuzzaman *et al.*, 2020). The country's fisheries sector is well-supported by its favorable geographic location and numerous aquatic species.

The inland aquaculture sector contributes more than 57.38% of the overall production, and the fisheries industry can be divided into three primary categories: inland capture fisheries, inland aquaculture, and sea fisheries (DoF, 2020). The resources from the fisheries sector are vital in shaping the socioeconomic viewpoints in Bangladesh. Bangladesh's fisheries industry has the potential to develop a number of auxiliary businesses in rural areas, creating jobopportunities and reducing emigration to metropolitan areas (Manik, 2022). More than 17 million people rely on the fisheries sector for their livelihood, including 1.4 million women who work in fishing, farming, fish handling, and processing (BFTI, 2016). In addition to marine resources, Bangladesh's huge delta, which is nourished by the Padma, Meghna, and Jamuna rivers, offers a rich environment for freshwater and brackish water capture and culture fisheries.

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Nevertheless, the fisheries industry is still underdeveloped when compared to other businesses, despite the nation's abundant water bodies and lengthy coastline. Although the productivity per hectare of water area in inland fisheries has increased over time, it has not yet reached its optimum level. To enhance the production in inland fisheries, various eco-friendly initiatives are being launched, including replenishing endangered species with fingerling stocking, initiating beel nursery projects, community-led fishery management, creating and sustaining fish sanctuaries, and introducing cage and pen cultivation in aquatic areas (Hasan *et al.*, 2021). Numerous private hatcheries have been established throughout the nation as a result of the high demand for high-quality fish seeds, an essential component of fish farming. 102 government and 1068 private hatcheries in Bangladesh produced 987834 kg of 4-5-day-old fry in 2017 (DoF, 2020). For good aquaculture practices (GAP), utilizing high-quality seeds in fish farming is crucial for achieving increased production and favorable returns (Debnath *et al.*, 2020). Recently, the development of artificial spawning methods has empowered farmers to breed high-value fish commercially in controlled environments (Zamri *et al.*, 2022). The private sector has seen a significant increase in carp seed hatcheries, especially in places with greater resources. To reduce negative selection and inbreeding in hatcheries, more focus has recently been placed on genetic management and selecting breeders based on sperm quality (Mataveli *et al.*, 2015). The Government of Bangladesh established public sector hatcheries around the nation as a result of the success of fish seed production using artificial breeding techniques. These hatcheries act as hubs for technology transfer and educate business owners and seed growers on managing brood stock. Maximizing the advantages of this essential sector for the country's sustainable development would require continued support and breakthroughs in aquaculture practices (DoF, 2020). Fish is a key contributor to the sustenance and well-being of a substantial segment of the global population. Fish is the main source of animal protein for the population (Akter *et al.*, 2022). Hence, fish seed production is essential to the development of fish farming and aquaculture in Bangladesh. The development of aquaculture is significantly influenced by the availability of high-quality fish seed. Historically, fish farmers relied extensively on wild fish seeds gathered from rivers, but this source of supply created a number of problems, including the introduction of predator fish seeds and seeds that were contaminated or of low quality. Fish Seed Multiplication Farms (FSMFs) were founded in the 1960s with the goal of providing high-quality seeds to fish farmers, mostly by raising wild fish seeds gathered from rivers. However, fish hatcheries were established, and induced breeding technology was made available to the private sector as a result of a decline in the supply of wild carp seeds and an increase in demand from fish farmers. As a result, Bangladesh is now self-sufficient in the manufacturing of carp seeds, even if there are still few high-quality fish seeds available. A reliable system that can ensure adequate fish seed is necessary to satisfy the rising domestic demand, better-quality catfish seed must be accessible (Jha *et al.*, 2019). A big problem impeding the nation's production growth is the lack of catfish seeds. According to the study, there are three main places to get catfish seed: public fish farms, private fish farms, and natural spawning sites in bodies of water. Fish producers currently obtain catfish seeds from public or private fish seed farms due to habitat damage and rising demand (DoF, 2020). There are inefficiencies in the sale of fish seeds in Bangladesh, which are primarily handled by private dealers that act as numerous middlemen between seed producers and farmers and lower revenues for seed producers. Despite catfish's economic significance for Bangladesh, little supply chain and agribusiness research has been done on the cultivation of catfish seeds. The goal of this study is to give a thorough agribusiness analysis of catfish seed in various parts of the Mymensingh district, including supply chain management, as opposed to earlier studies that concentrated on general production or marketing issues. So, the study mainly focused on supply chain management and marketing margin of catfish seed and to identify problems and constraints of catfish seed production and marketing.

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2. MATERIALS AND METHODS

2.1 Study Area and Data Collection

To carry out the study Gouripur, Trishal, Mymensingh Sadar, and Muktagacha upazilas of Mymensingh district were selected. The study area was selected purposefully because this region is renowned for its wide distribution of catfish seeds throughout the country. Additionally, easy accessibility and good communication in the study areas were considered for selection. Notably, there have been no recent

studies that specifically emphasized the agribusiness perspective of catfish seed in this area. The study period for data collection was from September to October 2019. Primary data was gathered through face-to-face interviews with fish seed producers and traders, using a structured survey schedule.

2.2 Selection of Samples and Sampling Techniques

A total of 120 samples were selected from the population of the study areas, which included hatcheries, nurseries, paikers, wholesalers, and retailers. Shing and Pabda catfish species were chosen for the study. Specifically, 15 hatcheries and 15 nurseries were selected from the selected upazilas. In addition, 30 paikers (15 for spawn and 15 for fingerlings), 30 wholesalers (15 for spawn and 15 for fingerlings), and 30 retailers (15 for spawn and 15 for fingerlings) were chosen to represent the spawn and fingerlings marketing functions in the selected areas (Table 1).

Table 1. Number of respondents

Respondents		Number
Hatcheries		15
Nurseries		15
Retailer	Spawn	15
	Fingerling	15
Wholesaler	Spawn	15
	Fingerling	15
Paiker	Spawn	15
	Fingerling	15

2.3 Analytical Technique

2.3.1 Supply Chain Analysis

Supply chain management is a comprehensive approach to handling the strategic management of materials, goods, and information through an organization's marketing channels. It involves a network of suppliers needed to create specific products for a company, with each link connected in a specific order. This concept is useful for analyzing interdependent supply chains in various sectors. Descriptive analysis was used in the study areas to achieve this objective.

2.3.2 Net Return Analysis

Net return of hatchery,

$\pi = TR - TC$

$= P_S . S - (TVC+TFC)$, for spawn

Net return of nursery,

$\pi = TR - TC$

$= P_f.F - (TVC+TFC)$, for fingerlings

Where,

π = Profit per hatcher y or nursery.

TR = Total Revenue

TC = Total Cost

P_s = Per unit price (Tk.) of spawns

P_f = Per unit price (Tk.) of fingerlings

S = Total quantity of spawns produced per farm per year

F = Total number of fingerlings produced per farm per year.

TVC = Total variable costs of hatcheries or nurseries

TFC = Total fixed costs of hatcheries or nurseries

Interpretation and discussion of the findings were presented in simple terms, such as average, percentage, etc.

2.3.3 Net Marketing Margin Analysis

Gross marketing margin = Sale Price-Purchase Price

Net marketing margin = Gross marketing margin -Marketing Costs
Return over total investment = (Net margin/Total investment) *100
Total investment = Purchase Price + Marketing costs

3. RESULT AND DISCUSSION

3.1 Supply Chain Management of Catfish Seed

The catfish seed supply chain starts with brood fish management, where hatchery owners collect brood fish from pond fish producers. Hatcheries produce spawn, which is then sold to traders and nursery owners. The nursery owners raise fingerlings and supply them to fish farmers. Brood fish management is crucial for the success of channel catfish culture, ensuring a reliable source of quality fingerlings. Farm managers play a vital role in managing hatcheries and nurseries. Training centers offer practical training to enhance their technical knowledge and improve their capability in hatchery and farm management. The training covers various aspects of breeding, hatchery management, and seed production techniques.
Feed, Fertilizer, Chemicals, Poison, and Hormone Supply to Hatchery and Nursery.
Different types of artificial feed, fertilizers, chemicals, poisons, and hormones are used in managing brood fish and fingerlings. These inputs are purchased from nearby dealers and suppliers.
Spawn trading involves several intermediaries, including paikers, wholesalers, and retailers. They procure catfish seed from hatcheries and sell them to nursery owners and fish farmers (Figure 1). Similarly, fingerlings are traded among paikers, wholesalers, retailers, and fish farmers.
The final destination for the fingerlings is the pond fish farmers. They purchase fingerlings from the intermediaries or directly from nursery owners for fish cultivation in their ponds (Figure 1).

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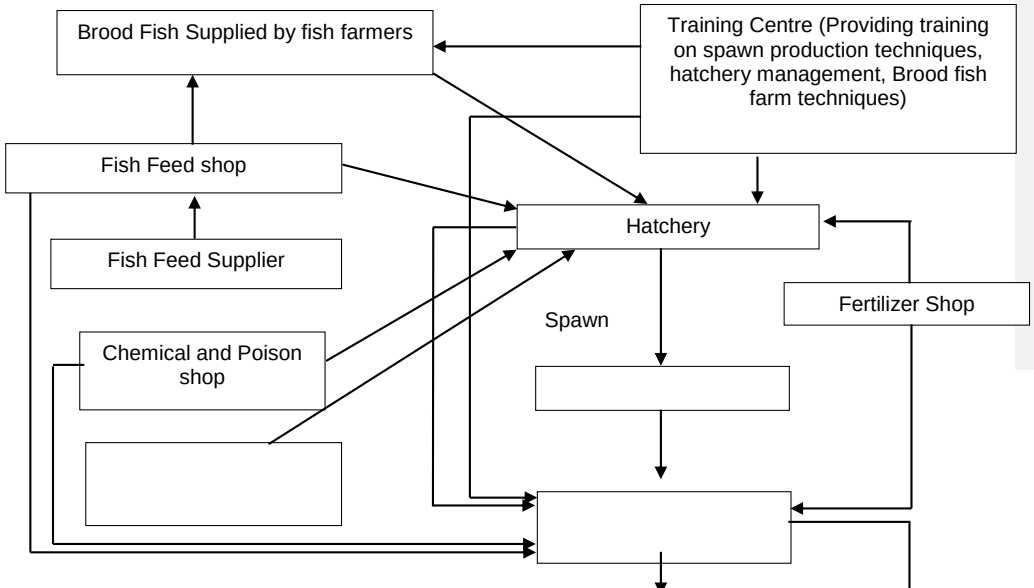

Figure 1. Supply Chain Map of Selected Catfish Seed (Spawn and Fingerlings)
Source: Field Survey, 2019

3.1.1 Actors Involved in Catfish Seed Supply Chain

The catfish seed supply chain involves several key actors, each playing a distinct role in the process. These main actors are as follows:
Hatchery Owners: They are the central players in the supply chain, responsible for breeding brood fish and producing spawns. Their production cycle lasts for six months.
Nursery Owners: The second key actor, who receives spawns from hatchery owners and rears fingerlings. The production cycle for nurseries is around 7-8 months.
Training Centers: Institutes like the Department of Fisheries, Department of Youth Development, and Fisheries Research Institute provide technical training to hatchery and nursery personnel to improve their management skills.
Farm Laborers: Involved in fish seed farms, mainly hatcheries and nurseries. Local laborers are preferred for employment.
Traders: Vital actors in catfish seed production, engaged in spawn and fingerling trading. They include paikers, wholesalers, and retailers, serving as intermediaries between hatcheries, nurseries, and fish farmers.

3.1.2 Marketing Channel for Catfish Seed

The marketing channel or channel of distribution is a path trace in the direct or indirect transfer of ownership to a product as it moves from a producer to ultimate consumer or industrial users. In the study areas, fish seed moved from the hatchery owners to the fish farmers through some market participants such as nursery owners, fingerling producers, paikers, wholesalers, retailers, and fish farmers (Figure 2 and Figure 3). The most common channels of marketing catfish seed from hatchery owners to fish farmers were as follows:

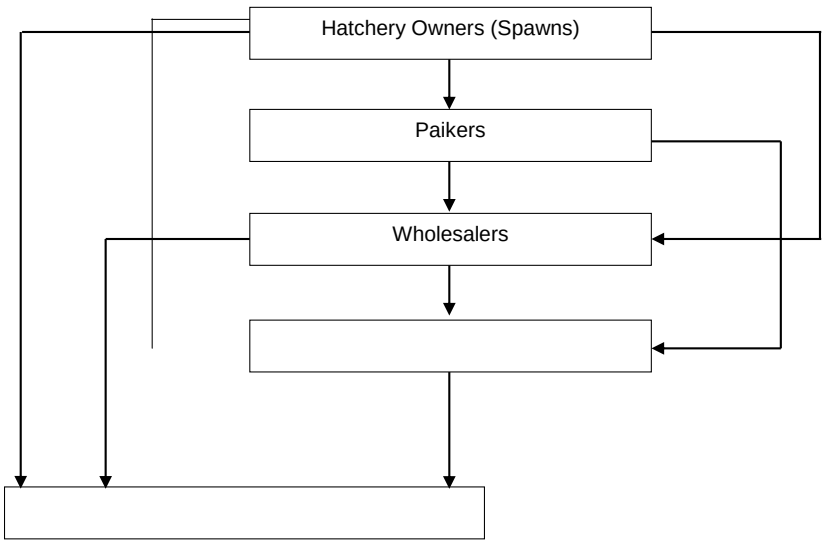

Figure 2. Marketing channels of catfish seed (spawn)

Channel 1: Hatchery Owners→Nursery owners
Channel 2: Hatchery Owners→Retailers →Nursery Owners
Channel 3: Hatchery Owners →Paikers→Wholesalers→Retailers→Nursery Owners
Channel 4: Hatchery Owners→Wholesalers →Retailers → Nursery owners
Chapter 5: Hatchery Owners→ Wholesalers →Nursery owners
Chapter 6: Hatchery Owners→ Paikers →Wholesalers → Nursery owner

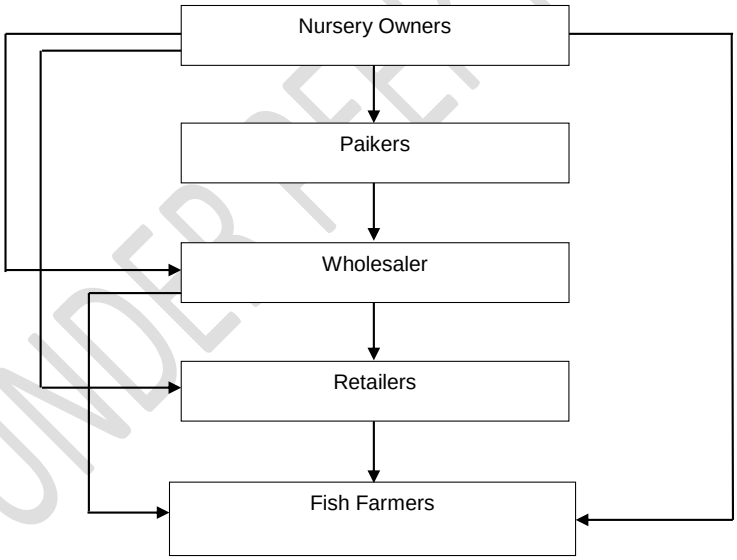

Figure 3. Marketing channels of catfish seed (fingerling)

Channel 1: Nursery Owners→Fish Farmers
Channel 2: Nursery Owners→Retailers→Fish Farmers
Channel 3: Nursery Owners→Paikers →Wholesalers→Retailers →Fish Farmers
Channel 4: Nursery Owners →Wholesalers →Retailers →Fish Farmers
Chapter 5: Nursery Owners →Wholesalers→ Fish Farmers

3.2 Marketing costs and margins of all intermediaries for spawn and fingerling

Table 2. Total average marketing costs of all intermediaries for Tk./10 Kg. spawn and for Tk./100000 pieces of fingerlings

Cost Items	Paiker (10 kg spawn)	Wholesaler (10 kg spawn)	Retailer (10 kg spawn)	Total Cost (10 kg spawn)	Percentage (10 kg spawn)	Paiker (100k Pieces fingerlings)	Wholesaler (100k Pieces fingerlings)	Retailer (100k Pieces fingerlings)	Total Cost (100k Pieces fingerlings)	Percentage (100k Pieces fingerlings)
Electricity Bill		155		155	4.18%		72		72	1.66%
Security		3		3	0.08%		1		1	0.02%
House rent		379		379	10.23%		176		176	4.07%
Telephone Bill	259	109	173	541	14.61%	75	80	345	500	11.56%
Transportation	530	354	142	1026	27.70%	721	710	575	2006	46.36%
Loading and Unloading	63	103	24	190	5.13%	113	201	108	422	9.75%
Packaging	50	67	79	196	5.29%	29	42	111	182	4.21%
Storage		17		17	0.46%		78		78	1.80%
Personal Expenses	304	117	127	548	14.79%	73	79	380	532	12.29%
Wages and Salaries	98	461		559	15.09%	77	175		252	5.82%
Fish Feeding		53		53	1.43%		87		87	2.01%
Tips and Donation	25	11	1	37	1.00%	4	10	5	19	0.44%
Total	**1329**	**1829**	**546**	**3704**	**100.00%**	**1092**	**1711**	**1524**	**4327**	**100.00%**

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The total marketing cost of catfish seed included all costs incurred by different types of intermediaries like paikers, wholesalers, and retailers. The total marketing cost incurred by intermediaries was calculated at Tk. 3704 per 10 Kg. spawns and Tk. 4327 per 100,000 pieces fingerlings. Among the cost items transportation was the highest cost item for both spawn and fingerling which were Tk. 1026 (27.70% of total costs), and Tk. 2006 (46.36% of total costs) respectively. Similarly, the lowest cost item was for security and it was 0.08% and 0.02% of total cost for spawn and fingerling (Table 2). The average marketing cost was Tk. 3704 for 10 Kg. spawn and Tk. 4327 for 100,000 pieces of fingerlings (Table 2). Again, the gross margin (average profit) was Tk. 6998 and Tk. 35493 earned by all intermediaries. Total net marketing margin per 10 Kg. spawn was 3294 and Tk 31165 for 100k pieces fingerlings (Table 3). Among all three intermediaries, the net marketing margin of the retailer was highest in the case of spawn. On the contrary, the net marketing margin of paiker was seen highest for the fingerling.

Table 3. Average total marketing margin per 10 Kg. spawn and per 100,000 pieces of fingerling

Intermediaries	Average Marketing Costs (10 Kg. Spawn) (Tk.)	Gross Margin (10 Kg. Spawn) (Tk.)	Net Marketing Margin (10 Kg. Spawn) (Tk.)	Average Marketing Costs (100k Pieces fingerlings) (Tk.)	Gross Margin (100k Pieces fingerlings) (Tk.)	Net Marketing Margin (100k Pieces fingerlings) (Tk.)
Paiker	1329	2335	1006	1092	12240	11148

Wholesaler	1829	2453	624	1711	11105	9394
Retailer	546	2210	1664	1524	12147	10623
Total	3704	6998	3294	4327	35493	31165

3.2.1 Cost and Returns of Catfish Seed Production

Table 4. Yearly total costs and net earnings of catfish seed hatcheries and nurseries

Item of Costs	**Hatchery (Tk.)**	**Nursery (Tk.)**
Variable costs		
Feed costs	640285	125550
Brood fish costs/Procurement cost of spawn	422713	251575
Human labor costs	264381	328376
Fertilizer costs	10192	14744
Hormone costs, Chemical, and poison costs	428109	34996
Fuel costs	36677	32203
Electricity cost	65563	27675
Plastic Cost	31116	26500
Dewatering cost	11154	15105
Re excavation cost	111313	151375
Telephone bill cost	15606	16275
Other costs	11857	7469
Interest on operating capital	61469	36114
A. Total Variable Costs	2110433	1067957
Fixed Costs		
Land use cost of pond and hatchery/office area	294375	181875
Tools and equipment costs	49086	55033
Cost farm building and other structure	23159	4940
B. Total Fixed Costs	366620	241848
C. Total Costs	2477053	1309805
D. Gross Return	5288191	2973129
E. Gross Margin	3177758	1905172

F. Net Return		
	2811138	1663324

The study reveals that the per farm yearly total costs of hatcheries was Tk. 2477053 and it was for nurseries Tk. 2475729 (Table 4). Moreover, the yearly net return from spawn production in the hatchery was Tk. 2811138 and the net return from fingerling production in the nursery each year was Tk. 1663324 (Table 4).

Table 5. Annual total return from hatchery andnursery

Species	Average Quantity (Kg)	Unit Price (Tk./Kg - Hatchery)	Total Return (Hatchery) (Tk.)	Quantity (100k Pieces - Nursery)	Unit Price (Tk./Kg - Nursery)	Total Return (Nursery) (Tk.)
Shing	405.5	4187.5	1698031	19.29375	51875	1000863
Pabda	512.88	7000	3590160	28.05	70312.5	1972266
Total	918.38		5288191	47.34375		2973129

In hatchery enterprise spawn is the main item in the gross return. The yearly total production of spawn was found to be 918.38 Kg per farm and yearly total return from spawn production per year was Tk.5288191 (Table 5). Similarly, in nursery enterprise fingerling is the main item in the gross return. The yearly total production of fingerlings was found to be 47.34 Lakh pieces per farm and the yearly total return from fingerling production per year was Tk. 2973129 (Table 5).

3.3 Constraints of Catfish Seed Production and Marketing

Good seed quality is pivotal for the growth of fisheries; however, many farmers don't have this essential information, leading to poor seed distribution. The study found out that 43.75% of hatchery owners felt uninformed, and among nursery owners, 31% shared this sentiment (Table 6). For catfish production, maintaining seed stock quality is vital, yet the country lacks methods to monitor this before stocking. Around 50% of hatchery owners and 56% of nursery owners recognized this issue (Table 6). There's also a noticeable gap in information from the government about broodstock quality, which is essential for fish seed production. As pond fish culture increases, so does the demand for spawn and fingerlings. Yet, some farms neglect quality due to inadequate monitoring and certification. About half of the hatchery and 63% of nursery owners expressed concerns about this. The mating of closely related fish, known as in-breeding, is seen as a problem by 37.25% of hatcheries and 56% of nursery owners. Input availability and rising prices, especially for fertilizers, are other concerns in the industry, with over half of both hatchery and nursery owners agreeing. Though hatchery farming requires significant investment, 31.25% of hatchery owners didn't see this as an issue (Table 6). Lastly, while extension services could benefit catfish seed production, they are currently weak in Bangladesh, a concern shared by both hatchery and nursery owners.

Table 6. Production related problems for hatchery and nursery owners

Name of the problems	Strongly Agree (%)		Agree (%)		Probably Agree (%)		Probably Disagree (%)		Not sure (%)	
	H	N	H	N	H	N	H	N	H	N
Lack of information about good quality seed	25	31	25	19	43.75	31	6.25	19	0	0
Lack of practical methods to monitor quality of fish seed before stocking	0	0	50	56	31.25	31	12.5	13	6.25	0
Lack of information from government to farmers on brood stock quality and management	18.75	19	25	25	43.75	44	12.5	13	0	0

Lack of monitoring and certification from government side on quality of seed produced by private hatchery	12.5	0	50	63	31.25	38	0	0	6.25	0
In breeding problem	12.5	0	25	6	37.5	56	12.5	25	12.5	13
Non availability of various inputs	6.25	0	12.5	0	31.25	38	50	63	0	0
Higher price of various inputs	12.5	13	62.5	56	12.5	31	0	0	12.5	0
Lack of financial capital	6.25	0	25	44	25	19	31.25	31	12.5	6
Lack of extension services	18.75	31	25	56	31.25	6	25	6	0	0

**H= Hatchery owner, *N= Nursery owner*

Intermediaries in the Mymensingh district who are involved in catfish seed marketing are also exposed to different kinds of constraints. It was revealed that almost all the intermediaries faced price fluctuation problems. 93% of paikers (spawn) faced price influence problems and 80% of paikers (fingerlings) faced price influence problems. In addition, 100% of wholesalers (spawn), 93% of wholesalers (fingerlings), 93% of retailers (spawn), and 100% of retailers (fingerlings) also faced this problem (Table 7).

Table 7. Marketing related problems for catfish seed trader spawn and fingerling

Name of the problems	Paiker (%)		Wholesaler (%)		Retailer (%)	
	S	F	S	F	S	F
Lack of hatchery units	40	40	0	0	7	0
Lack of development of ancillary units	7	20	33	40	27	7
Lack of transportation facilities	53	53	47	33	40	60
Mortality During Transportation	40	63	73	87	40	53
lack of fish seed market	80	73	40	47	47	60
Lack of institutional finance	47	53	60	67	53	67
Lack of training and extension network	47	47	53	33	47	40
Lack of methods for testing the quality of seed during transportation	47	67	47	47	40	47
Price fluctuations	93	80	100	93	93	100
Unexpected marketing competition	53	60	80	67	67	87
Poor Communication system	53	47	20	27	40	53

**S means spawn trader, and *F means fingerling trader*

4. CONCLUSION

The study reveals that catfish seed farms with hatchery were more profitable than catfish seed farms with nursery. One way to bring expected profits to the nursery could be reducing operating costs as much as possible. This can be achieved through biological and technological mechanisms like labor costs, reducing seed costs and other operating costs, and employing the most efficient methods of production taking into account ecological and environmental factors. In addition, different training programs should be arranged for the hatchery operators, traders, fish seed producers, and all the other actors who have a

direct or indirect role to play in this sector. Facilities such as clean water during transportation should be available to traders. Hatchery operators should be trained on appropriate technologies concerning selective breeding, broodstock management, etc. Proper methods of testing seed quality with traders during transportation are inevitable. In addition, primary markets should be free from the control of paiker to make the market competitive so that hatchery owner could receive a fair price to increase their sales revenue. Last but not least, the ultimate success of such ventures depends upon the government, which determines the policies and provides incentives for the development of catfish seed farms. That will encourage the expansion of catfish seed farming and thereby will contribute to increasing catfish seed production in the study area and the country as a whole.

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