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Fish farmer livelihood in Hisar, Haryana: Understanding constraints and charting a sustainable future

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Abstract

The study conducted in Hisar, Haryana, from September 15 to March 30, 2022, aimed to assess the livelihood status of fishermen in the region. Demographic analysis revealed that the majority of fishermen were aged between 36 to 50 years, predominantly from the general caste, and had completed secondary or senior secondary education. The sample primarily consisted of males, with a small representation of females. Regarding aquaculture experience, most respondents had been engaged in the practice for 5–10 years. Farm documentation was reported by about a third of respondents, with varying land sizes among them. The study identified and ranked constraints faced by fishery enterprises, with irregular water supply emerging as the foremost challenge, followed by fin diseases, marketing issues, un favorable fish prices, and transportation limitations. These findings underscore the critical hurdles hindering the development of fishery enterprises in the region. Addressing these challenges necessitates improvements in water supply infrastructure, effective disease management strategies, enhanced marketing approaches, pricing mechanisms, and transportation facilities. Addressing tarese constraints is vital for the sustainable growth and prosperity of the fisheries sector in Hisar, Haryana.

Keywords: Aquaculture, fishermen, livelihood status, education, fin diseases and constrains

Introduction

Aquaculture is now one of the fastest-growing divisions of the animal production industry. Fishing and aquaculture provide significant sources of food, nutrition, revenue, and livelihood for millions of people throughout the world. Fish are the most important aquatic animal for supplementing protein supplies for human consumption. Carp culture is the basis of the Indian freshwater aquaculture sector. Indian major carps IMC, such as Catla (*Catla catla*), Rohu (*Labeo rohita*), and Mrigal (*Cirrhinus mrigala*) account for 80 to 85 percent of total freshwater fish production, while silver carp, grass carp, common carp, and other catfish species account for the remaining 25 to 30 percent (FAO, 2022) [4]. India is the world's second-largest fish producer, behind only China, while Indonesia is the world's third-largest aquaculture producer. In India, this industry accounts for about 5% of worldwide fish output and 3% of global fish commerce. In 2020, catch fisheries and aquaculture produced around 178 million metric tonnes of fish globally, 157 million metric tonnes of which were used as food. Haryana has been an agriculturist state since its creation in 1966, with agriculture and allied industries employing a large section of the population. An allied industry of agriculture known as the 'fisheries sector' has recently gained traction across India, including Haryana, and is recognised as an important source of income and employment.

The Fisheries Department, Haryana, shows that fish farmers in Haryana are earning a good amount of 3.20 lakh as net profit per hectare per annum from fish farming on their water-logged land. Further, the State has achieved its goals with great success in fish breeding; therefore, the National Bureau of Fish Genetic Resources has declared Haryana a 'fish disease-free state' (Sarin, 2017) [20]. Haryana has developed progressive economic initiatives over the years. The state's vast water resources include rivers, canals, drains, natural and man-made lakes, reservoirs, micro-water, sheds, and village ponds, which allow for the promotion of fishing. In terms of average yearly fish production per unit area, Haryana ranks second in the country. The average yearly fish production per acre in the state is 7000 kg, compared to the national average of 2900 kg. The state has also achieved self-sufficiency in the production of Indian Major Carp and Common Carp seed. When the state was created in November 1966, the total water area under fish farming was 58 hectares, and it is expected to increase to 18207.60 hectares by the end of March 2021. Similarly, fish seed stocks have expanded from 1.5 lakh to 2925.31 lakh. The livelihood of fishermen in Hisar, a landlocked district

located in the state of Haryana, has long been intricately tied to the region's water bodies. Despite its geographical constraints, Hisar boasts a rich diversity of lakes, ponds, and reservoirs, which have historically served as a source of sustenance for the local fishing community. However, the challenges faced by these fishermen in recent years have threatened their way of life and called for a concerted effort to ensure a sustainable future.

Community-based aquaculture represents a distinct subset of rural aquaculture, where governance and management are cantered around community institutions. This system is characterised by locally based small-scale farming, extensive technology, and operating without direct government involvement. Despite its potential benefits, there is limited knowledge and understanding of this farming system, including its management practises, implications, and economic viability. Thus, there is a pressing need to document and update the status of community-based aquaculture at a national level, enabling its integration into mainstream aquaculture practises and advocating for scientific fish culture in these water bodies. To address this gap in knowledge, the present study focuses on the randomly selected typical community fishponds in one representative district of Hisar. The study aims to record fish production, economic profitability, and various aspects of management practises, particularly in relation to the lease period. By gathering comprehensive information from these investigations, policymakers, planners, researchers, and aqua culturists can gain valuable insights for utilising community water resources effectively and promoting both horizontal and vertical aquaculture extension. The findings of this study have significant implications for multiple stakeholders. Policymakers can utilise the information to develop policies and regulations that support and encourage community-based aquaculture. Planners can incorporate these findings into their strategies for sustainable resource management and rural development. Researchers can build upon this knowledge base to conduct further studies and explore innovative approaches for enhancing the productivity and profitability of community fishponds. Additionally, aqua culturists can learn from the experiences documented in this study to implement best practises and improve their own operations. The potential benefits of community-based aquaculture extend beyond economic considerations. By utilising local water resources, rural communities can increase household food security, enhance nutritional security, and generate self-employment opportunities within the village. Moreover, adopting socially, culturally, environmentally, and economically sustainable practises ensures a holistic approach to aquaculture development.

Methodology

The study was conducted in nine blocks (Aampur, Agroha Barwala, Hisar-I, Hisar-II, Hansi-I, Hansi-II, Narnaund, and Uklana) in Hisar District with an area of 3,983 km2 for obtaining detailed information about pond fishery resources and the livelihood status of fish farmers. Hisar district, a part of the Indo-Gangetic alluvial plain, is situated between 28°53'45" and 29°49'15" N latitudes and 75°13'15" and 76°18'15" E longitudes, geographically at Hisar, District of Haryana (India). Data was collected from 45 randomly chosen village community ponds.

In your study, data were collected through personal interviews with fish farmers. The specific aspect of the fish farmers' socioeconomic status was assessed using a questionnaire designed for the survey. The questionnaire was carefully constructed and tested prior to the interviews to ensure its effectiveness in gathering relevant information. A total of 45 fish farmers participated in the interviews and provided their responses to the questionnaire. This methodology aimed to obtain accurate and standardized data on the socioeconomic status of the fish farmers in your study.

Farmers were selected randomly, and they were interviewed at their pond sites to collect first-hand information with a pre-tested structural questionnaire. Following factors, *viz*., the number of aquaculture farms in Hisar regions, Selection of farmer (Number of aquaculture farms: small farmer (5 acres), medium farmer (5–10 acres), and large farmer (10 acres) Location of farms and aquaculture units, Evaluation and documentation of aquaculture units, History of aquaculture units or ponds, Management of farm seed, stocking density, feed, water quality, health, average weight at harvesting, marketing or processing, market price variations, etc. Cluster farming, NGOs, and Associations involvement in the fisheries sector of Haryana Financial assistance/subsidy. Contact of farmers with research institutes and experts, industry, and other farmers of different coastal and non-coastal states of India Number of crops per year from the same site. Types of aquaculture practises and systems (Extensive, semi-intensive, Intensive, and Integrated farming) Fish productivity, Net profit analysis, and constraints.

All statistical analysis was performed using Statistical analysis OPSTAT. Bar diagrams and graphs were made in Microsoft Excel 2007. Statistical analysis will be carried out using frequencies, percentages, averages, and chi-square. Probability levels of 0.05 were used to find out the significance in all cases.

Results

Demographic and farm characteristics of fish farmers

To gain a comprehensive understanding of the study on the participants, it is crucial to gather background information about the respondents. In our research, the questionnaire included various parameters to get general information about the 45 fish farmers who were part this study. These parameters encompassed details such as age, education level, caste, documentation of aquaculture units, subsidiary occupation, income, mode of selection of farmers, and extension contact. By collecting this information, we aimed to establish a contextual background of the respondents and gain insights into their socioeconomic profiles, education, occupational diversification, income levels, and engagement with agricultural extension services. This comprehensive approach provides a foundation for understanding the characteristics and circumstances of the fish farmers involved in our study.

The study involved collecting data through personal interviews with 45 fish farmers. The respondents represented a diverse range of age groups, with 8 (17.78%) classified as young (up to 35 years), 30 (66.67%) as middle-aged (36 to 50 years), and 7 (15.56%) as old (above 50

years). In terms of education, the respondents had varying levels of formal education. The highest percentage was 22 (48.89%) who had completed secondary and senior secondary education, followed by 14 (31.11%) who had graduated or obtained higher qualifications. There were also 7 (15.56%) respondents with up to a middle school education, while 2 (4.44%) were illiterate. The caste distribution among the respondents revealed that 19 (42.22%) belonged to the scheduled caste, 4 (8.89%) identified as backward class (A/B), and 22 (48.89%) fell under the general caste category. Out of the 45 respondents, only 1 (2.22%) was female, while the majority, 44 (97.78%), were male. Regarding the history of aquaculture ponds, 6 (13.33%) respondents had been engaged in fish farming for less than 5 years, 30 (66.67%) for 5-10 years, and 9 (20.00%) for more than 10 years. In terms of farm documentation, 31 (68.89%) respondents reported having their farms documented, while 14 (31.11%) did not have any formal documentation. The selection of farmers varied in terms of landholding. 10 (22.22%) were classified as small farmers (5 acres), 24 (53.33%) as medium farmers (5-10 acres), and 11 (24.44%) as large farmers (more than 10 acres).

Table 1: Fish Disease Awareness and Adoption of mitigation strategies

	Diseases	Control / treatment	Awareness	Percentages	Adoption	Percentages
1.	Tail and fin rot	50 mg $CuSO_4$ in water or 60 mg chloromycetin in1L^{-1} water	33	73.33	21	46.67
2.	Ulcer disease	Wash the wounds of fish with mercuric chloride and $KMNO_4$	40	88.89	31	68.89
3.	Dropsy	Add 5g tetracycline kg^{-1} feed day^{-1}	39	86.67	12	26.67
4.	Kidney disease	Isolate the affected fish and add 100 mg erythromycin in feed for 21 days	3	6.67	1	2.22
5.	Fungal attack	Allow the fish for 90 min in 1 g $KMNO_4$, in 100L^{-1} of water Continue for 3 days	42	93.33	32	71.11

As sown in table no.1 the adoption rate was 46.67%, while 73.33% of people were aware of tail and fin rot. Similarly, 6.67% of respondents with Ulcer disease and 88.89% of respondents with renal illness were aware of these conditions. The production of it is influenced by a variety of circumstances. As a result, all farmers embraced practises involving the use of cheap, safe chemicals after becoming aware of the issue.

From results highlights that there was substantial gap between awareness and adoption for several diseases. While there is relatively high awareness for fungal attack (93.33%), the adoption rate is slightly lower at 71.11%, indicating some reluctance or challenges in implementing the suggested treatment. Ulcer disease and dropsy show higher adoption rates (68.89% and 26.67%, respectively) compared to awareness, suggesting that farmers are more inclined to apply these specific treatments. Conversely, kidney disease exhibits low awareness (6.67%) and adoption (2.22%) rates, indicating a significant knowledge gap or potential lack of effective treatment options. The findings emphasize the need for targeted educational campaigns to bridge the awareness-adoption gap and enhance overall disease management practices among fish farmers. Similarly indicated by Kumar *et al.*, 2018 [11].

Table 2: Pond Fish Farming: Knowledge, Skills, and Actual Practices Analysis

S. No.	Knowledge and skill	Full Knowledge (3)	Partial Knowledge (2)	No Knowledge (1)	WMC	Mean score	Rank
1.	Knowledge about Eradication /Control of weed fishes	20(4.44)	22(48.89)	3(6.67)	107	2.37	IV
2.	Knowledge about fish seed stocking	26(57.78)	18(40.00)	1(2.22)	116	2.57	III
3.	Knowledge about pond Management	3(6.67)	30(66.67)	4(8.89)	73	1.62	VII
4.	Knowledge about manuring & fertilization	25(55.56)	29(42.22)	1(2.22)	135	3.00	I
5.	Knowledge about New technologies for fish farming	6(13.33)	25(55.56)	14(31.11)	82	1.82	VI
6.	Knowledge about feeding management	10(22.22)	21(46.67)	14(31.11)	86	1.91	V
7.	Knowledge about harvesting & marketing	27(60.00)	17(37.78)	1(2.22)	117	2.60	II

The analysis observed that 48.89% of respondents had partial knowledge about the eradication and control of weed fish. It was observed that more than 55.56% of respondents had full knowledge and 42.22% had partial knowledge about manuring and fertilisation. The investigation done for the respondent's knowledge about harvesting and marketing revealed that nearly one-third of the respondents (60.00%) had full knowledge. According to the analysis of the knowledge of fish seed stocking, 57.78% of respondents had Full knowledge. More than half of the respondents (66.67%) had partial knowledge about pond management. In terms of knowledge about new technologies for fish farming, more than one-fifth of the respondents (55.56%) had partial knowledge. Most of the respondents (46.67%) had partial knowledge about feeding management.

It is shown in Fig.1 that nearly three-fifths of the respondents (40.00%) had a medium knowledge level, followed by 37.8% with a high level and 22.22% with a low level of knowledge regarding fish farmers.

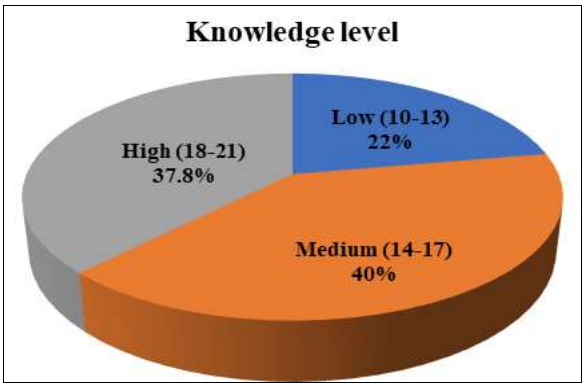

Fig 1: Knowledge level among fish farmers

The results revealed that knowledge about manure and fertilizer stands out with the highest mean score of 3.00, indicating a strong understanding among farmers. This was crucial for optimizing pond productivity. Following closely were knowledge about harvesting and marketing, where farmers show significant awareness (mean score of 2.60), suggesting a well-rounded understanding of the post-cultivation phases. Fish seed stocking also demonstrates a robust level of awareness (mean score of 2.57), contributing to effective fish population management. Conversely, knowledge about pond management receives a lower mean score of 1.62, indicating potential areas for improvement in practices related to pond maintenance. The variation in scores highlights the diverse levels of proficiency among farmers in different aspects of aquaculture. To enhance overall farm management, targeted educational interventions can address specific areas with lower knowledge levels, ensuring a more comprehensive skill set among fish farmers.

Table 3: Extension Contact Frequency and Mean Scores by Stakeholder Group in Pond Fish Farming

Sr. No.	Extension Contact	Monthly (3)	Half yearly (2)	Yearly (1)	WMC	Mean score	Rank
1.	Dept. of Fisheries	3(6.67)	14(31.11)	28(62.22)	65	1.44	VII
2.	Fisheries Co- Operatives	6(13.33)	11(24.44)	28(62.22)	68	1.51	VI
3.	District fisheries officer/ fisheries officer (DFO/FO)	7(15.56)	19(42.22)	19(42.22)	79	1.75	IV
4.	Input supplier	25(25.56)	18(40.00)	2(4.44)	115	2.55	II
5.	Marketing agent	37(82.22)	7(15.56)	1(2.22)	126	2.80	I
6.	SAUs/College of fisheries science	7(15.56)	15(33.33)	23(53.11)	74	1.64	V
7.	Progressive fish farmers	13(28.89)	19(42.22)	13(28.89)	90	2.00	III

The data in above table represents the extension contact made by the respondents with fish farmers. Overall rank was given based on a weighted mean score. According to the analysis, marketing agents were ranked first, followed by input suppliers (II), Progressive fish farmers (III), DFO/FO (IV), SAUS/College of Fisheries Science (V), etc., with a weighted mean score of 2.80, 2.55, 2.00, 1.75, and 1.64. It is shown that in Fig.2, nearly three-fifths of the respondents (40.00%) had low extension contact, 35.56% had medium contact, and 24.44% had high extension contact regarding fish farmers.

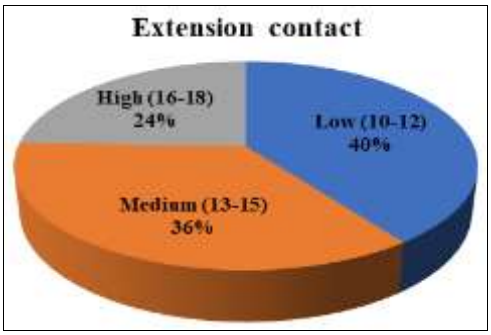

Fig 2: Extension contact among fish farmers

Table 4: Farmer's awareness about new governmental schemes and training programs

S. No	Awareness of farmer's	Full Awareness (3)	Partial Awareness (2)	No Awareness (1)	WMC	Mean score	Rank
1.	Do knows about the Pradhan Mantri Matsya Sampada Yojana (PMMSY)	25(55.56)	19(42.22)	1(2.22)	114	2.53	II
2.	Do knows about the Fisheries and Aquaculture Infrastructure Development Fund (FTDF)	4(8.89)	12(26.67)	29(64.44)	65	1.45	VI
3.	Do knows about the Kisan Credit Card (KCC)	28(62.22)	14(31.11)	3(6.67)	115	2.55	I
4.	Do knows about the Aquaculture Research and Training Institute, (ARTI) HISAR	9(20.00)	28(62.22)	8(17.78)	91	2.02	V
5.	Do knows about the College of Fisheries in Haryana	13(28.89)	22(48.89)	10(22.22)	93	2.06	IV
6.	Do knows about the Krishi Vigyan (KVK) HISAR	21(46.67)	19(42.22)	5(11.11)	106	2.35	III

The values present in table no.4 analysis revealed that about more than half of the respondents (55.56%) had full awareness regarding the Pradhan Mantri Matsya Sampada Yojana (PMMSY). Similarly, about the Fisheries and Aquaculture Infrastructure Development Fund (FIDF), more than half of the respondents (64.44%) also had no awareness of new schemes. Whereas, more than one-fifth of the respondents (62.22%) had full awareness of the Kisan Credit Card (KCC). For the Aquaculture Research and Training Institute (ARTI) in Hisar, an overwhelming majority of the respondents (62.22%) had partial awareness. Regarding the College of Fisheries in Haryana, more than two-fifths of the respondents (48.89%) had partial awareness. The analysis revealed that about Krishi Vigyan Kendra (KVK), less than half of the respondents (46.67%) had full awareness.

As shown in Fig.3 that 44.44% of respondents had a medium awareness level, followed by 31.11% and 24.44%, who had a high and low level of awareness of new schemes and training programmes, respectively.

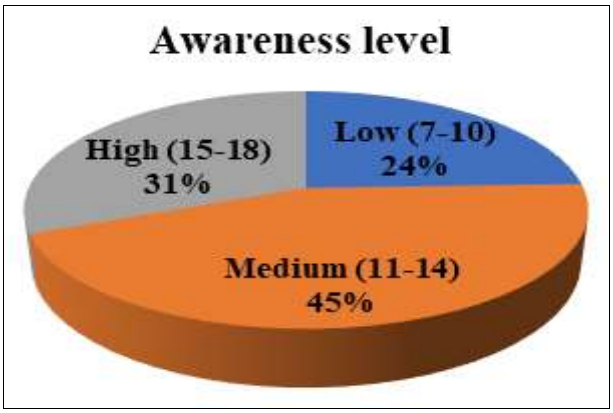

Fig 3: Awareness about new schemes

Aquaculture fish farming, productivity and Net profit of farmers

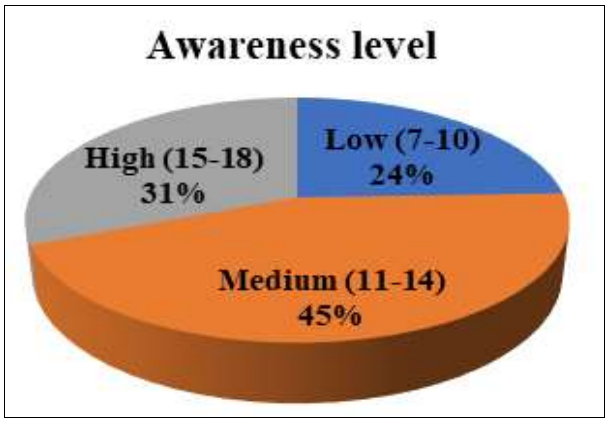

Fig 4: Maximum 42.22% of farmers engaged in semi-intensive culture practises, followed by Intensive culture practises (28.89%), extensive culture practises (17.78%), and 11.11% engaged in IFF

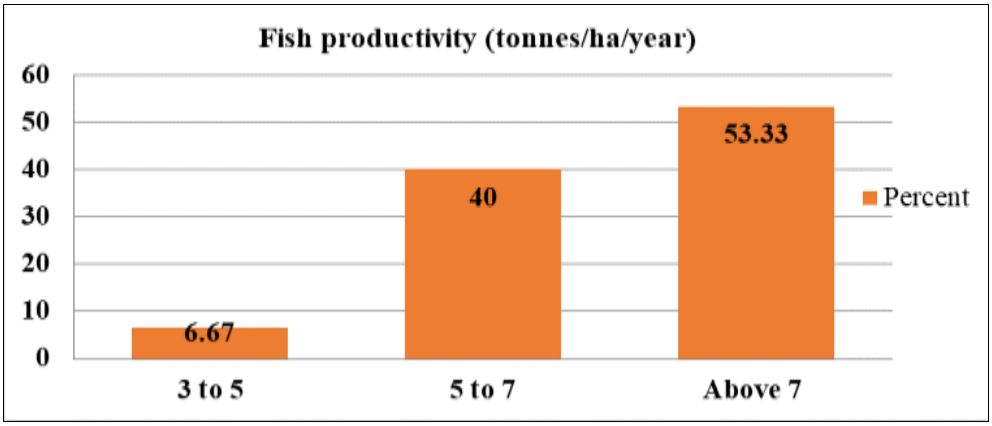

Fig 5: shows 53.33% of farmers having productivity greater than 7 tonnes/ha/yr, followed by 40% of farmers having productivity between 5-7 tonnes/ha/yr, and a minimum of 6.67% of farmers having productivity between 3-5 tonnes/ha/yr

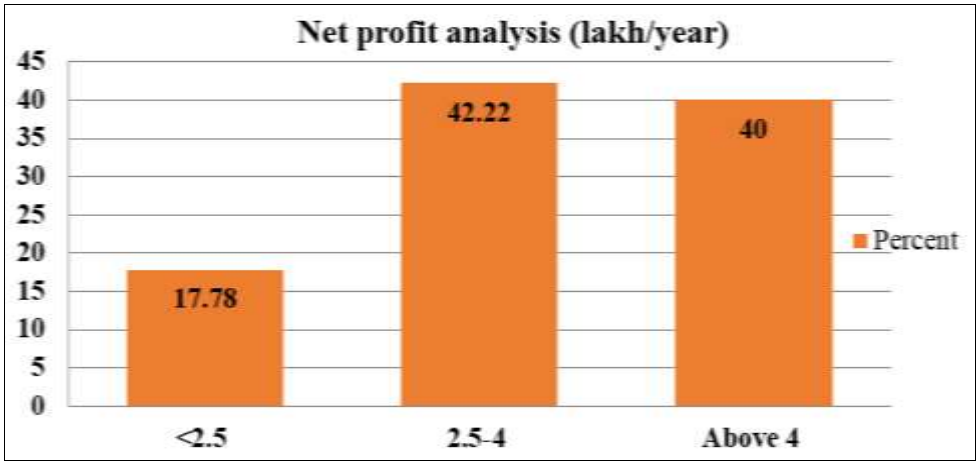

Fig 6: 42.22% of farmers have a net profit between 2.5 and 4 lakh/yr, 40% secure above 4 lakh income annually, and 17.78% have an income less than 2.5 lakh/yr

Table 5(A): Association between Socio-economic Profiles and Knowledge/Skill Levels of Fish Farmers in Fisheries

Socio-economic variables	Level of awareness of farmers			
	Low	Medium	High	Total
Age				
Young (up to 35 Years)	1(12.5)	7(87.5)	-	8(17.78)
Middle (36 to 50 Years)	10(33.33)	9(30.00)	11(36.66)	30(66.67)
Old (above 50 Years)	1(14.28)	4(57.14)	2(28.57)	7(15.56)
Total	11(24.44)	20(44.44)	14(31.11)	45
χ^2=9.423*				
Education				
Illiterate	1(50.00)	1(50.00)	-	2(4.44)
Up to middle	5(71.42)	2(28.57)	-	7(15.56)
Secondary and sr. sec.	4(18.18)	12(54.54)	6(27.27)	22(48.89)
Graduate and above	1(7.14)	5(35.71)	8(57.14)	14(31.11)
χ^2 = 14.862*				
Caste				
Scheduled caste	6(31.57)	8(42.10)	5(26.31)	19(42.22)
Backward class (A/B)	1(25.00)	2(50.00)	1(25.00)	4(8.89)
General caste	4(18.18)	10(45.45)	8(36.36)	22(48.89)
χ^2 =1.188				
History of aquaculture unit or pond History				
<5 year	2(33.33)	-	4(66.66)	6(13.33)
5-10 year	8(26.66)	13(43.33)	9(30.00)	30(66.67)
Above 10 years	1(11.11)	7(77.77)	1(11.11)	9(20.00)
χ^2 =9.441*				
Selection of farmer				
Small farmer (5 acre)	3(30.00)	7(70.00)	-	10(22.22)
Medium farmer (5-10 acre)	8(33.33)	8(33.33)	8(33.33)	24(53.33)
Large farmer (>10 acre)	-	5(45.45)	6(54.54)	11(24.44)
χ^2=10.820*				
Extension contacts				
Low (0-3)	8(44.44)	5(27.77)	5(27.77)	18(40.00)
Medium (4-8)	2(12.5)	11(68.75)	3(18.75)	16(35.56)
High (9-12)	1(9.09)	4(36.36)	6(54.54)	11(24.44)
χ^2=11.145*				

Figures in the parenthesis denote percentage.
*Significant at 5 per cent level of significance, **Highly significant at 1 per cent level of significance

Table 5(B)

Knowledge and skill	Level of Knowledge and skill of farmers			
	Low	Medium	High	Total
Age				
Young (up to 35 Years)	5(62.5)	2(25.00)	1(12.5)	8(17.78)
Middle (36 to 50 Years)	5(16.66)	15(50.00)	10(33.33)	30(66.67)
Old (above 50 Years)	-	1(14.28)	6(85.71)	7(15.56)
Total	10(22.22)	18(40.00)	17(37.77)	45
χ^2=15.938**				
Education				
Illiterate	2(100)	-	-	2(4.44)
Up to middle	4(57.14)	2(28.57)	1(14.28)	7(15.56)
Secondary and sr. sec.	1(4.54)	13(59.09)	8(36.36)	22(48.89)
Graduate and above	3(21.42)	3(21.42)	8(57.14)	14(31.11)
χ^2 =12.803*				
Caste				
Scheduled caste	7(36.84)	8(42.10)	4(21.05)	19(42.22)
Backward class (A/B)	1(25.00)	2(50.00)	1(25.00)	4(8.89)
General caste	2(9.09)	8(36.36)	12(54.54)	22(48.89)
χ^2 =6.945				
History of aquaculture unit or ponds				
<5 year	1(16.66)	2(33.33)	3(50.00)	6(13.33)
5-10 year	6(20.00)	12(40.00)	12(40.00)	30(66.67)
Above 10year	3(33.33)	4(44.44)	2(22.22)	9(20.00)
χ^2 =1.614				
Selection of farmer				
Small farmer (5 acre)	5(50.00)	4(40.00)	1(10.00)	10(22.22)

Medium farmer (5-10 acre)	4(16.66)	12(50.00)	8(33.33)	24(53.33)
Large farmer (>10 acre)	1(9.09)	2(18.18)	8(72.72)	11(24.44)
χ^2=12.293**				
Taking suggestion with research institute and experts				
Low (0-3)	6(33.33)	8(44.44)	4(22.22)	18(40.00)
Medium (4-8)	3(18.75)	7(43.75)	6(37.50)	16(35.56)
High (9-12)	1(9.09)	3(27.27)	7(63.63)	11(24.44)
χ^2=5.631				

Figures in the parenthesis denote percentage.
*Significant at 5 per cent level of significance
**Highly significant at 1 per cent level of significance

It can be seen from the table no.5 (A) & 5(B), age was found to be significant with the level of awareness having a chi-square value of 9.423. An overwhelming majority of the respondents (87.50%) who were young had a medium level of awareness of new schemes and training programmes related to fisheries. Education was found to be significantly associated with the level of awareness at a chi-square value of 14.862. Nearly three-fourths of the respondents (71.42%) who had education up to middle grade had a low level of awareness towards new schemes and training programmes related to fisheries. No significant association was found between caste and level of awareness. Half of the respondents (50%) who belonged to backward castes had a medium level of awareness of new schemes and training programmes related to fisheries. The history of aquaculture was found significant, with the level of awareness at a chi-square value of 9.441. More than three-fourths of the respondents who had experience of more than 10 years had a medium level of awareness towards new schemes and training programmes related to fisheries. A significant association is found between level of awareness and farmer selection at a chi-square value of 10.820. Seventy percent of the respondents who were small farmers had a medium level of awareness of new schemes and training programmes related to fisheries. Extension contacts were found to be significant, with the level of awareness having a chi-square value of 11.145. Sixty-Eight percent of the respondents who had medium-level extension contacts had a medium level of awareness of new schemes and training programmes related to fisheries.

The study highlighted that farmers demonstrate a predominantly medium to high level of awareness, while middle-aged farmers exhibit a more balanced distribution across all awareness levels. Older farmers tend to have a medium level of awareness. Education plays a crucial role, with illiterate and up-to-middle-educated farmers primarily falling into the low awareness category, and graduate and above-educated farmers showing a propensity towards high awareness. Caste-wise, scheduled caste farmers show variability, while backward class and general caste farmers lean towards medium to high levels of awareness. The history of aquaculture units or ponds is significantly associated with awareness levels, with farmers engaged for 5-10 years demonstrating a balanced distribution. The selection of a farmer and extension contacts also exhibit significant associations, highlighting the importance of tailoring extension strategies based on the farmer's profile. Similarly, reported by Gautam *et al.,* 2017 [17]. With a chi-square value of 15.938, age and degree of expertise were shown to be highly significant. A large percentage of the older respondents (85.71) had a high level of knowledge and skill when analysing fish farmers' understanding of fisheries. The amount of knowledge and competence was shown to be significantly correlated with education, with a chi-square value of 12.803. A low level of knowledge and skill was found in the respondents' (100%) analyses of fish farmers' knowledge of fisheries. There was no discernible correlation between caste and knowledge or skill level. 54.54 percent of respondents who belonged to the General caste had a high degree of knowledge and skill analysis of fish farmers with reference to fisheries, which is more than half of all respondents. There was no correlation between aquaculture's history and knowledge and skill levels. Fish farmers' knowledge and skills were highly rated by the respondents, who made up 50% of those with less than five years' experience. At a chi-square value of 12.293, a highly significant correlation between knowledge and skill level and farmer choice is discovered. The respondents who were larger farmers (72.72%) had a high level of knowledge and skill when analysing fish farmers' knowledge of fisheries. Extension interactions did not appear to be significantly correlated with knowledge and expertise. The knowledge and skill analysis of fish farmers with reference to fisheries was at a high level for 63% of the respondents who reported having a high level of extension contacts.

The analysis of socio-economic factors and farmers' knowledge and skill levels reveals distinct patterns. Young farmers predominantly possess low knowledge and skill, likely due to limited experience. Middle-aged farmers show a balanced distribution, benefitting from a combination of practical experience and exposure to evolving techniques. Older farmers exhibit a higher proportion with high knowledge and skill, reflecting years of hands-on expertise. Education significantly influences knowledge, with illiterate farmers facing challenges in accessing new information, while graduates excel in adopting modern agricultural practices. Caste-wise variations suggest diverse challenges for scheduled caste farmers and relatively better access to resources and education for backward class and general caste farmers. The duration of involvement in aquaculture units alone does not dictate knowledge and skill levels, emphasizing the importance of factors like adaptability. Varied knowledge and skill levels among different farm sizes may stem from resource disparities. Interaction with research institutes positively correlates with higher knowledge and skill, underscoring the crucial role of extension services in promoting innovation and learning among farmers. Tailored interventions considering these factors are essential for effectively enhancing farmers' knowledge and skill across diverse socio-economic background. Similarly reported by Remya Surendran, 2023.

Table 7: Constraints Faced by Farmers in the Fisheries Sector in Haryana: Severity Analysis

Sr. No.	Constraints	Very serious (3)	Serious (2)	Not so serious (1)	WMC	Mean score	Rank
1.	Lack of funds	2(4,44)	3(6.67)	40(88.89)	52	1.15	VIII
2.	Irregular water supply	11(24.11)	23(51.11)	11(24.44)	90	2.0	I
3.	Unavailability of fingerlings	3(6.67)	4(8.89)	38(84.44)	55	1.25	VII
4.	Lack of transport	4(8.89)	15(33.33)	26(57.78)	68	1.51	V
5.	Fin disease	3(6.67)	25(55.56)	17(37.78)	76	1.68	II
6.	Increased cost of feed	2(4.44)	20(44.44)	23(51.11)	67	1.48	VI
7.	Marketing problems	2(4.44)	28(62.22)	15(33.33)	75	1.66	III
8.	No Skilled worker	1(2.22)	5(11.11)	39(86.67)	50	1.11	IX
9.	Unfavorable price of fish	5(11.11)	19(42.22)	21(46.67)	74	1.64	IV

The table 7, represents the constraints faced by farmers in the fisheries sector in Haryana, along with their severity levels (ranked as very serious, serious, and not so serious). The mean score and rank are also provided, indicating the overall impact of each constraint on the farmers' aquaculture operations. Depicted the difficulties that the respondents, who were fish farmers, experienced. Based on the weighted mean score, an overall ranking was determined. With a weighted mean score of 2.0, 1.68, 1.66, 1.48, 1.51, etc., irregular water supply was ranked first, followed by fin disease (II), marketing issues (III), unfavourable fish prices (IV), lack of transport (V), etc.

These findings highlight the key constraints that farmers face in the fisheries sector in Haryana. Irregular water supply and fin disease are identified as the most serious challenges, followed by marketing problems and the unfavourable price of fish. Addressing these constraints is crucial for improving the productivity and profitability of aquaculture operations and enhancing the livelihoods of farmers in the region.

1.	**Age**	**Frequency**	**Percent**
	Young (up to 35 Years)	8	17.78
	Middle (36 to 50 Years)	30	66.67
	Old (above 50 Years)	7	15.56
2.	**Education**		
	Illiterate	2	4.44
	Up to middle	7	15.56
	Secondary and Sr. Secondary	22	48.89
	Graduation and above	14	31.11
3.	**Caste**		
	Scheduled caste	19	42.22
	Backward Class (A / B)	4	8.89
	General caste	22	48.89
4.	**Gender**		
	Female	1	2.22
	Male	44	97.78
5.	**History of aquaculture ponds**		
	<5 year	6	13.33
	5-10 year	30	66.67
	Above 10 year	9	20.00
6.	**Documentation of farm**		
	Yes	31	31.11
	No	14	68.89
7.	**Selection of farmer**		
	Small farmer (5 acre)	10	22.22
	Medium farmer (5-10 acre)	24	53.33
	Large farmer (>10 acre)	11	24.44
8.	**Stocking density**		
	8000- 10000	4	8.89
	10000- 12000	22	48.89
	>12000	19	42.22
9.	**Feed**		
	Natural	27	60.00
	Artificial	18	40.00
10.	**Regular water quality monitoring**		
	Yes	23	48.89
	No	22	51.11
11.	**Regular health monitoring**		
	Yes	16	35.56
	No	29	64.44
1.	**Effect of Chemical use**	Number of farmers	**Percent**

	Stock loss	8	17.78
	Stock survival	37	82.22
2.	**Average weight at harvesting (g)**		
	<500	13	28.89
	500- 1000	30	66.67
	>1000	2	4.44
3.	**Marketing/processing**		
	Marketing	45	100
	Processing	-	-
4.	**Market price variations**		
	0-8	22	48.89
	8-16	15	33.33
	16-24	8	17.78
5.	**Cluster farming**		
	Yes	11	24.44
	No	34	75.56
6.	**NGO's and association with involvement in fisheries sector of Haryana**		
	Yes	2	4.44
	No	43	95.56
7.	**Financial**		
	Financial assistance / loan	16	35.56
	Subsidy	29	64.44
8.	**Number of crops per year from same site**		
	One crops per year	45	100
	More than one crops per year	-	-

Conclusion

Analysis revealed that more than two-thirds of the respondents (67%) hailed from the age group 36–50 years, followed by the above-50 years' age group (15.56%) and up to the 35 years' age group (17.78%). Among the respondents, 89 percent belonged to general castes, 8.89% belonged to backward castes, and 42.22% belonged to the scheduled caste. More than two-thirds (66.67%) of farmers had a culture history between 5 and 10 years, with 20% having more than 10 years of farming experience and 13.33% having below 5 years of farming experience. 8% of fish farmers had registered farms and proper documentation with the fisheries department of Haryana. *L. rohita* and *C. catla* were being cultured by all farmers due to their suitability to local weather conditions, better growth rate, good resistance to disease, and good market prices. The majority of the respondents (33%) had medium-sized ponds, 24.44% had large ponds, and 22.22% had small ponds. It was observed that 44% of farmers had received subsidies from the government, while 35.56% had received assistance in the form of loans or Kisan credit cards from banks. The 40.00% respondents had a medium knowledge level, followed by 37.8 percent and 22.22 percent, who had a high and low level of knowledge regarding fish farmers, respectively. Different constraints showed that Irregular water supply was ranked first, Fin disease was ranked second, and marketing problems were 3rd, unfavourable price 4th, Lack of transport 5th.

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