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Aquaculture Practices and Knowledge Level of Fish Farmers in Purulia District of West Bengal

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HIGHLIGHTS

- The majority of fish farmers in the study area had low to medium level of knowledge about recommended aquaculture practices in the study area.
- Farmers faced critical challenges such as inadequate technical support and high input costs, limiting the effective adoption of improved fish farming methods.
- The study emphasizes the importance of technical guidance from experts, targeted need-based training and institutional backing to enhance scientific know-how regarding aquaculture.

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ABSTRACT

The study was conducted in the Purulia district of West Bengal during 2024–25, aimed to assess the state of aquaculture and the knowledge level of fish farmers. 120 fish farmers were individually interviewed to collect primary data. Most ponds were earthen (90.83%), rain-fed (68.33%), and seasonal (56.67%), with water retention for 6 to 9 months. Indian major carp were farmed by 86.67 per cent of the respondents through polyculture systems. Only 15 per cent used commercial feed, and 77.5 per cent monitored fish growth throughout the culture period. It was also revealed that 38.33 per cent had a medium level of knowledge, while 34.17 per cent had a low level of knowledge about recommended fish farming practices. It was further found that education, occupation, farming experience, mass media exposure, extension agency contacts, and economic motivation had strong relationships with the respondents' knowledge level ($p<0.01$). The majority of respondents faced constraints such as inadequate technical support for scientific fish farming (RBQ: 86.09) and high costs of input materials and skilled labour (RBQ: 85.4). A concerted educational effort with follow-up, stronger extension services, input subsidies, better water retention infrastructure, and mass media awareness is urgently needed in the area.

INTRODUCTION

Fishery and aquaculture significantly contribute to India's economy through income, nutrition, employment, and exports, evolving from traditional to commercial sectors with high potential (Mallick, 2017; India CSR, 2023; Mahanayak & Panigrahi, 2024), and act as a quick source of income for small-scale farmers, helping improve the socioeconomic conditions of rural areas (Singh et al., 2024 & Mondal et al., 2025). West Bengal is a leading fish-producing state in India, with fish production increasing significantly in recent years, with a total production of 20.45 lakh metric tons in 2022-23. If all water bodies are fully utilized, the total fish production in the state can reach approximately 33 lakh metric tons

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per year (Gazette, 2023). Purulia produces 48,928 metric tons of fish annually, contributing to the overall production in West Bengal (Purulia District Administration, 2025). Despite its contribution, Purulia ranks lower among West Bengal districts in terms of fish production because of limited water resources, and the estimated annual demand for fish is higher than its production, resulting in a deficit (Biswas et al., 2019). Purulia, a drought-prone district in West Bengal, is socioeconomically underdeveloped and largely inhabited by resource-poor communities, and poverty is prevalent in the region. (Mishra et al., 2022). The advancement of recommended aquaculture in Purulia, an economically underdeveloped district in India, faces multiple challenges related to socioeconomic conditions, terrain, and climate (Mishra et al., 2021). If the present water resources, such as ponds and tanks, are utilized properly for pisciculture, the production of fish will increase to a considerable extent, thereby increasing the scope of income and employment for rural people. Therefore, there is ample possibility of bringing more area under efficient pisciculture (Purulia District Administration, 2025).

There is significant potential to boost fish production, which relies on farmers adopting scientific practices, accessing formal financial support, receiving input from fishery departments, and improving their skills through targeted training programs (Ghosh et al., 2022; Mondal et al., 2025). Assessing fish farmers' knowledge is crucial for promoting a package of practices and effectively disseminating scientific fish culture techniques in rural conditions. This assessment serves as a foundation for designing future extension strategies (Rathore et al., 2016). Knowledge involves acquiring reliable facts and understanding how innovations work, and is an important factor in determining the success and sustainability of aquaculture practices (Kumar et al., 2018; Mutyaba et al., 2024). Biswas et al., (2019) noted that in Purulia district, most fish farmers relied on traditional, extensive aquaculture methods, with limited awareness of modern, semi-intensive techniques and scientific practices. Although some have basic literacy, their overall low knowledge hampers productivity and creates challenges in the aquaculture value chain. Considering these facts, the main objective of this study was to examine the present aquaculture practices and knowledge levels of respondents in the study area.

METHODOLOGY

The study was carried out in Purulia district, West Bengal, in the year 2024–25, which lay in the undulating red laterite zone where soil conditions were generally unsuitable for fish farming. Despite this, aquaculture emerged as an important economic activity, particularly in seasonal ponds. Two blocks, namely Baghmundi and Arsha, were purposively selected due to the notable presence of fish farmers practicing aquaculture. From each block, 60 respondents were chosen using a simple random sampling without replacement technique, making a total sample of 120 respondents. An ex-post facto research design was employed. Primary data were collected using a pre-tested semi-structured interview schedule, while secondary data were obtained from government records, websites, and research reports. The data were then tabulated and analyzed using appropriate statistical tools. Various dimensions of aquaculture practices were categorized after a pilot survey in line with the study's objectives, and responses were collected accordingly. The knowledge level of the respondents was evaluated using question statements, where a score of 1 was given for correct responses and 0 for incorrect ones, followed by a teacher-made test developed by Nagarajaiah (2002) with necessary modifications to suit the context. This knowledge test covered statements related to pre-stocking, stocking, and post-stocking practices. The total raw scores were then transformed into a knowledge index. Furthermore, respondents were classified into three categories based on the mean and standard deviation, namely: low (mean – SD/2), medium (between mean – SD/2 and mean + SD/2), and high (mean + SD/2) level of knowledge regarding fish farming.

$$\text{Knowledge index (KI)} = \frac{\text{Number of correct responses}}{\text{Total number of knowledge items}} \times 100$$

A set of constraints encountered by the respondents in the study area regarding aquaculture practices was gathered during the survey and ranked by employing the Rank-Based Quotient (RBQ) method.

$$RBQ = (\Sigma\ fi(n+1-i) / (N * n)) * 100$$

Where, fi: The frequency of respondents reporting a particular problem under the i^{th} rank. N: The total number of respondents, n: The total number of ranks (or constraints/ problems), i: The rank of the problem.

RESUTS

Present state of aquaculture practices

In Purulia, fish farming has recently gained prominence as farmers have begun to recognize its potential as a profitable livelihood. Consequently, they gradually began adopting the recommended scientific aquaculture practices, as presented in Table 1. Most of the ponds used by respondents were earthen (90.83%), and the majority were located 2 to 3 km away from their residences (56.67%). In terms of ownership, a large proportion of ponds were leased (74.17% of the total). The primary water source for these ponds was rainwater (68.33%), with long seasonal water retention (56.67%) being the most common source. The majority of respondents maintained rearing ponds (90.00%), while only a small percentage had combined nursery and rearing ponds (4.17% of respondents). The average pond depth was generally between 4 and 6 ft (56.17%). Only a few respondents practiced pond drying (5.83%), while the majority did not (94.17%). In addition, inlet and outlet systems were present in only 26.67% of the ponds. Apart from aquaculture, 76.67 per cent of the ponds were used for domestic purposes. Water quality testing was conducted daily (5.00%), weekly (14.17%), monthly (26.67%), and rarely (54.16%). Most respondents practiced polyculture or mixed farming (70.00%), with Indian major carp (*L. rohita, C. catla, C. mrigala*) and exotic carp (*H. molitrix, C. idella, C. carpio*) being the primary species stocked (86.67%). Notably, 69.17 per cent of farmers did not follow a fixed stocking density, and only a small proportion (6.67%) adopted a comprehensive input strategy involving stocking,

Table 1. Aquaculture practices in Purulia district

S.No.	Variable	Category	Percentage (%)
1	Pond Type	Earthen	90.83
		Concrete	9.17
2	Distance from Residence	1–2 km	22.50
		2–3 km	56.67
		3–4 km	15.83
		Above 4 km	5.00
3	Pond Ownership	Self-owned	25.83
		Leased	74.17
4	Main Water Source	Rainfed	68.33
		Canal/River	14.17
		Deep well	17.50
5	Water Retention	Short seasonal (3–6 months)	31.67
		Long seasonal (6–9 months)	56.67
		Perennial	11.66
6	Type of Pond	Nursery	-
		Rearing	90.0
		Grow-out	5.83
		Both (Nursery + Rearing)	4.17
7	Average Pond Depth	1 to 4 ft	16.17
		4 to 6 ft	56.17
		6 to 8 ft	26.16
8	Drying Ponds	Yes	5.83
		No	94.17
9	Inlet/Outlet System in pond	Yes	26.67
		No	73.33
10	Infested with Weeds	Yes	31.67
		No	68.33
11	Extent of Weed Infestation	Complete Choked	1.67
		Moderate	16.67
		Low	51.66
		Nil	30.00
12	Use of Water Body	Irrigation	13.33
		Domestic	76.67
		Both	10.00
13	Water Quality Test Frequency	Daily	5.00
		Weekly	14.17
		Monthly	26.67
		Rarely	54.16
14	Type of Culture Practice	Monoculture	4.16
		Composite	19.17
		Integrated	6.67
		Polyculture/Mix farming	70.00
15	Culture Input Level	Stocking only	13.33
		Stocking + Feeding	51.67
		Stocking + Manuring + Feeding	28.33
		Stocking + Manuring + Feeding + Liming	6.67
16	Species Stocked	Indian Major Carps (IMC), Exotic carps	86.67
		Mixed (IMC/exotic/ catfishes)	13.33
17	Stocking rate /stocking density	Fixed	30.83
		Not Fixed	69.17
18	Type of Manure Used	Organic	14.17
		Inorganic	65.83
		Both	20.00
19	Type of Feed Used	Natural	54.16
		Supplementary	30.83
		Commercial	15.00
20	Source of Fish Seed	Ramsagar Hatchery	95.0
		Naihati Hatchery	5.0
		Own	-
		Local Market	-

Table 1 contd...

S.No.	Variable	Category	Percentage (%)
21	Feeding Frequency	One time/day	22.50
		Two times/day	61.67
		Not fixed	15.83
22	Monitoring Growth	Yes	77.50
		No	22.50
23	Method of Harvesting	Partial	55.83
		Complete	9.17
		Need-based	35.00
24	Mode of Harvesting	Self	14.17
		Employing Labour	57.50
		Both	19.17
		Auction	9.16
25	Harvesting Time	Yearly 3–4 times	49.17
		Yearly 2–3 times	14.17
		Yearly 1–2 times	6.66
		Need-based	30.00
26	Mode of Disposal	Self-retailing	19.17
		Sold to Wholesaler	59.17
		Both	21.66
27	Marketing of produce	Local market	85.83
		Other areas in the district	14.17
		Export to another district	-
28	Preventive Disease Measures	Yes	75.83
29	Faced Major Disease Outbreak	Yes	65.00
30	Routine Health Management Program	Yes	76.67
31	Monitoring & Record Keeping	Yes	74.17

manuring, feeding, and liming. In terms of manure usage, most farmers relied on inorganic manure (65.83%). The feed types used included natural (54.16%), supplementary (30.83%), and commercial feed (15.00%). The primary source of fish seeds was the Ramsagar hatchery (95.00%). Feeding was typically done twice a day (61.67%), and 77.50 per cent of the respondents regularly monitored fish growth. Harvesting was mostly partial (55.83%), and the predominant method involved employing labour (57.50%). Fish were generally harvested three to four times annually (49.17%) or on a need-based schedule (30.00%). In terms of marketing, the produce was mainly sold to wholesalers (59.17%) and primarily in local markets (85.83%). Regarding health and disease management, 75.83 per cent of respondents took preventive measures, and 76.67 per cent followed a routine health management program. Finally, a good number of respondents (74.17%) maintained records and monitored their aquaculture activities.

Knowledge level

An assessment of the knowledge levels of fish farmers regarding recommended aquaculture practices categorized them into three groups: low, medium, and high. It was found that 38.33 per cent of respondents fell under the medium knowledge level, while 34.17 per cent had low knowledge level, and only 27.50 per cent exhibited a high level of understanding regarding fish farming.

To understand the influence of demographic characteristics on the knowledge level of fish farmers, chi-square tests and Cramer's V value estimation were done. The results are summarized in Table 2. Significant associations were found between some of demographic variables and the knowledge level of respondents in the study area (N = 120), as indicated by Pearson's χ^2 value. The variables age (χ^2 = 149.005*), education (χ^2 = 160.112*), farming area (χ^2 = 151.825*), occupation (χ^2 = 94.765*), social participation (χ^2 = 121.163*), annual income (χ^2 = 177.089*), farming experience (χ^2 = 199.751*), mass media exposure (χ^2 = 145.832*), extension agency contact (χ^2 = 162.137*), economic motivation (χ^2 =

Table 2. Relationship between demographic variables and knowledge level of the respondents

S.No.	Variables	Pearson Value Chi-square (χ^2)	Cramer's V value
1	Age	149.005*	0.761
2	Caste	101.205NS	—
3	Education	160.112*	0.817
4	Family Size	92.761**	0.675
5	Type of House	101.852**	0.693
6	Farming Area	151.825NS	—
7	Occupation	94.765*	0.889
8	Social Participation	121.163*	0.715
9	Annual Income	177.089*	0.657
10	Farming Experience	199.751*	0.912
11	Mass Media Exposure	145.832*	0.858
12	Extension agency Contact	162.137*	0.935
13	Economic Motivation	186.595*	0.832
14	Risk Orientation	176.708*	0.857

*Significant at 0.01 level of probability; **Significant at 0.05 level of probability; NS = Non-Significant

Table 3. Major constraints encountered by the respondents for fish farming

S.No.	Statement	RBQ value	Rank	Constraints category
1	Inadequate technical support for scientific farming	86.09	I	Technical
2	High cost of input materials and labour	85.4	II	Economic
3	Getting less selling price for the produce	84.98	III	Marketing
4	Lack of access to market channels and involvement of middlemen	83.94	IV	Marketing
5	Lack of access to quality inputs	83.17	V	Technical
6	Inadequate infrastructure and resources	79.4	VI	Technical
7	Financial burden and high-interest rate of the local moneylender	78.73	VII	Economic
8	Lack of support from the government	72.49	VIII	Economic
9	Lack of adequate extension support, like a need-based training program	67.89	IX	Extension service
10	Water scarcity in the area	64.68	X	Environmental

186.595*), risk orientation (χ^2 = 176.708*) showed significant associations at a probability level of 0.01. Family size (χ^2 = 92.761**) and type of house (χ^2 = 101.852**) showed significant associations at a probability level of 0.05. While also estimation of Cramer's V value in chi-statistics (Lee, 2016), it is also pointed out that education, occupation, farming experience, mass media exposure, extension agency contact, source of information, economic motivation, risk orientation all these variables have the very strong (Cramer's V 0.80–1.00) relationship with knowledge level of respondents.

Constraints encountered by the respondents

Several constraints were encountered by the respondents in the study area in various dimensions related to profitable farming, among those some important constraints were ranked and listed as per the responses and presented in Table 3. The most critical constraint faced by fish farmers was the inadequate technical support for scientific farming (RBQ: 86.09), followed by the high cost of input materials and labour (RBQ: 85.40), getting less selling price for the produce (RBQ: 84.98), lack of access to market channels and the involvement of middlemen (RBQ: 83.94), lack of access to quality inputs ranked high among the challenges (RBQ: 83.17).

DISCUSSION

Education plays a key role in improving farm decision-making, yet most respondents possess only up to 8th standard education, highlighting the need to motivate the younger generation (Biswas et al., 2019; Unnikrishnan & Dinesh, 2020). As most respondents were marginal, diversifying income sources is essential (Majhi, 2018). Low training exposure further limits scientific knowledge transfer, leading farmers to rely on traditional practices (Mondal et al., 2025), emphasizing the urgent need for targeted motivation and mentorship. Despite challenging conditions, fish farming is growing, but most farmers still rely on traditional, unscientific methods, limiting productivity, consistent with findings by Biswas et al., (2019). Scientific aquaculture promotes practices like pond drying, proper stocking density, organic manure use, balanced feeding, fish health, and water quality monitoring (Kumar et al., 2018; CMFRI, 2020). However, the study shows major gaps, least percentage practiced pond drying (Biswas et al., 2019). The majority of respondents did not follow proper stocking ratio rather optimal stocking densities to ensure uniform growth and efficient feed conversion (Fatima et al., 2020). Only few adopted comprehensive input strategies that combine stocking, manuring, feeding, and liming, despite this being a foundational element of semi-intensive aquaculture systems (Kalidoss, 2024). Given the widespread presence of animal husbandry in the region (ARD, Purulia, 2022), promoting the use of organic or mixed manure is essential, as most respondents still rely solely on inorganic inputs, reducing their net profit. Additionally, regular fish health monitoring should be a universal practice, yet it remains neglected in the area, highlighting the need to strongly encourage its adoption. Water quality management is weak, as over half the respondents rarely test their pond water. Scientific guidelines suggest monthly checks for dissolved oxygen, pH, and ammonia (Kumar et al., 2018; Moses, 2023). Without regular monitoring, farmers often detect issues only after fish health declines. Ragasa et al., (2022) reported that connecting farmers with multiple certified hatcheries enhances seed quality and reduces over-dependence. Therefore, addressing this issue is crucial for improving aquaculture production in the region. Most of the respondents in the area had low to medium knowledge regarding recommended aquaculture practices. There was a clear gap in both understanding and application, mainly due to limited access to technical training, extension services, and hands-on demonstrations (Biswas et al., 2019). The study finds that extension agency contact has the strongest relationship with knowledge level, reinforcing earlier findings by Jarh et al., (2024) & Sarkar et al., (2021) that targeted extension can significantly influence adoption of best management practices (BMPs). The study identifies several key constraints limiting profitable aquaculture in Purulia. To address these, strategic actions are needed—primarily, enhancing field-level extension services through regular farm visits, on-site demonstrations, and community-based aquaculture advisors to tackle the major issue of inadequate technical support (RBQ: 86.09) (Biswas et al., 2019; Kappen, 2018). Promoting local production of feed and encouraging group purchases, can help overcome challenges related to input quality and middlemen. Additionally, ensuring the timely availability of quality seed, feed, and fertilizers (RBQ: 83.17) by linking farmers with certified suppliers, along with promoting financial literacy, is essential for strengthening input access and resource planning (Dutta et al., 2022). To bridge the practice gap, a concerted educational effort is needed to promote standardized practices, deliver hands-on training, and provide farmers with access to quality inputs and market linkages (Mondal et al., 2025; Olaganathan & Kar, 2017). Without this support, the potential of aquaculture to transform rural livelihoods in Purulia will remain underrealized, despite its growing relevance in the region.

CONCLUSION

This study establishes that aquaculture in Purulia holds significant potential but is hindered by limited knowledge and suboptimal adoption of scientific practices among farmers. Most fish farmers operate seasonal, rain-fed ponds and rely heavily on traditional methods due to insufficient training, weak extension services, and high input costs. The strong correlation between knowledge level and factors like education, extension contact, and farming experience confirms that targeted support mechanisms are essential. These findings highlight the urgency of implementing structured training, localized extension systems, and input accessibility to enable farmers to improve productivity and sustainability. The results confirm the hypothesis that knowledge gaps, if addressed strategically, can unlock aquaculture's potential as a reliable livelihood in this underdeveloped region. Policymakers should prioritize inclusive, farmer-centric programs to support the adoption of best practices, empower marginal communities, and ensure long-term development of the sector.

Data availability statement: The corresponding author has access to the study's raw data.

Author's contribution: Conceptualization and designing of the research work (N.R.; A.H.M., S.S.D.); Execution of field/lab experiments and data collection (N.R.; A.H.M.); Analysis of data and interpretation (N.R.; A.H.M., R.K.); Preparation of manuscript (A.A.; D.R.; A.H.M., M.R.S.).

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