



ISSN Print: 2664-9926
ISSN Online: 2664-9934
NAAS Rating (2026): 4.82
IJBS 2026; 8(8): 80-84
www.biologyjournal.net
Received: 03-06-2026
Accepted: 07-07-2026

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The adoption gap of scientific fish farming practice among fish farmers of Malwa Madhya Pradesh

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DOI: <https://www.doi.org/10.33545/26649926.2026.v8.i8a.981>

Abstract

Fish farming is a way to improve fish production and help people make a living in India.. Many fish farmers in Madhya Pradesh are not using the best scientific methods to farm fish. This is especially true for Indian Major Carps. We did a study in the Malwa region of Madhya Pradesh to see how many fish farmers are using these methods and what is stopping them from doing so. We talked to 240 fish farmers from Indore, Ujjain and Dhar. We asked them about how they prepare their ponds, stock fish feed them manage water quality, control disease and harvest fish. What we found out is that 58% of the fish farmers are using these scientific methods. This means that 42% are not. The main reasons for this are that fish farmers do not have the training they do not have enough money and they are used to doing things the traditional way. They also do not have access to quality fish and food for the fish. The fish farmers think that if they get training, good quality fish and food and help from the government they can do a better job. We think that if we can help the fish farmers learn more about scientific fish farming and get them the support they need they can produce fish and make a better living.

Keywords: Adoption gap, Indian major carps, scientific fish farming, aquaculture, extension services, Madhya Pradesh, IMC culture

1. Introduction

Fish farming is an industry all over the world and it helps people have enough food to eat. In India many people make a living from fishing. Indian Major Carps are very popular are grown in many ponds and lakes. Madhya Pradesh has a lot of water is one of the biggest producers of fish in India according to Gupta (2015) ^[3, 8]. The Malwa region is a place to grow fish using scientific methods. Even with the help of the government many fish farmers are still using old methods. Scientific fish farming is a way to grow fish. It involves preparing the pond in a way putting the right number of fish in the pond feeding them the right food keeping the water clean and preventing disease. If fish farmers use these methods they can grow fish and make more money. There are many reasons why they do not use these methods. We need to understand why fish farmers are not using these methods so we can help them. That is why we did this study. We wanted to see how many fish farmers are using methods and what is stopping them from doing so Kumar (2024) ^[6, 7] and Laxmi, Gupta *et al.*, (2015) ^[3, 8]. We also wanted to suggest ways to help them use these methods.

2. Materials and Methods

2.1 Study Area

The study took place in the Malwa region of Madhya Pradesh, India. This region includes the districts of Indore, Ujjain, Dewas, Ratlam and Dhar. These districts are important for fish production and for growing Indian Major Carps. The Malwa region has ponds, reservoirs and irrigation tanks that are good for freshwater aquaculture.

2.2 Experimental setup

In this study, authors analysed the how many fish farmers use scientific fish farming practices this design known as ex-post facto. The reason of selection of this design was what types of fish farming perform by fish farmers according to Debbarma *et al.*, (2024) ^[1].

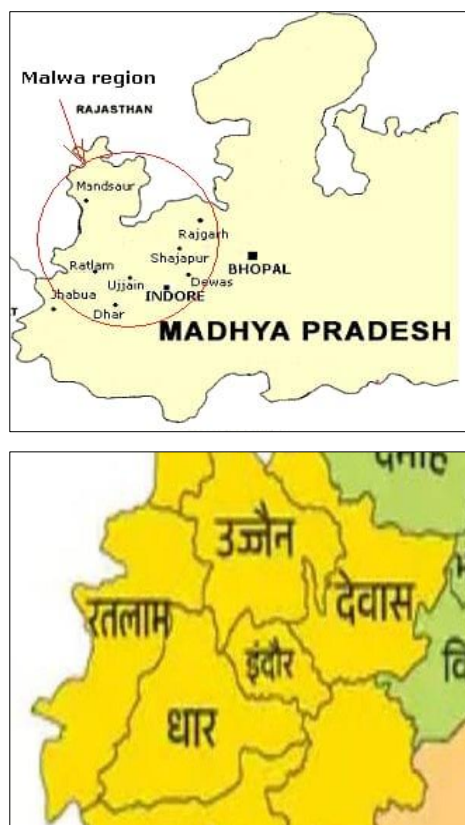


Fig 1: Malwa region of Madhya Pradesh

2.3 Sampling Procedure

A multistage purposive and random sampling technique was employed to select the study respondents. In the first stage, three prominent fish-producing districts of Madhya Pradesh, Indore, Ujjain, and Dhar were purposively selected based on their high volume of aquaculture production. In the second stage, key development blocks and corresponding villages actively engaged in the cultivation of Indian Major Carps (IMCs) were selected. Finally, a sample of 240 fish farmers, comprising medium-scale and large-scale IMC practitioners, was drawn using a simple random sampling method, Dutta *et al.*, (2020) ^[9] and Mondal *et al.*, (2021) ^[10].

2.4 Data Collection

Primary data were collected through face-to-face personal interviews with the selected fish farmers using a pre-tested, structured interview schedule. The field survey was executed between October and December 2025. The primary tool captured comprehensive data regarding the respondents' socio-economic profiles, their levels of knowledge and adoption regarding scientific aquaculture practices, and the critical constraints encountered in fish farming management. To supplement the field insights, secondary data were gathered from the Department of Fisheries, Government of Madhya Pradesh, alongside relevant published literature and official reports.

2.5 Measurement of Adoption

To quantify the extent to which fish farmers implement scientific management practices for Indian Major Carp (IMC) cultivation, an Adoption Index (AI) was developed. The assessment focused on eight core dimensions of scientific aquaculture according to Ojha (2014) ^[12]; Pounraj and Rathakrishnan (2022) ^[14].

1. Pond Preparation and Liming

2. Stocking Density and Species Composition
3. Fingerling Quality Assurance
4. Feed Management
5. Water Quality Management
6. Biosecurity and Disease Management
7. Harvesting Protocols
8. Record Keeping

Scoring Matrix and Index Calculation

For each respondent, individual practices were evaluated using a standardized 4-point Like-type scale to reflect the degree of implementation:

0 (Non-adoption): The practice is entirely absent.

1. (Low adoption): The practice is implemented superficially or inconsistently.

2. (Moderate adoption): The practice is implemented partially, meeting baseline criteria.

3. (Full adoption): The practice is executed completely in strict accordance with scientific recommendations.

The cumulative adoption behavior of each farmer was mathematically operationalized through the Adoption Index (AI), calculated using the following formula:

$$AI = \frac{\text{Adoption Score}}{\text{Maximum Score}} \times 100$$

2.6 Statistical Analysis

The quantitative data collected from the field survey were coded, tabulated, and analyzed using statistical software to derive meaningful inferences. The analytical framework comprised both descriptive and inferential statistical methods to evaluate the adoption behaviour of fish farmers.

3. Results and Discussion

3.1 Adoption Level of Scientific Fish Farming Practices

We found that most fish farmers are using practices at a moderate level. 60% of the farmers are using the practices moderately 25% are using them a lot and 15% are not using them much. The overall adoption index is 58%. This means that the fish farmers are not using about half of the recommended practices. The adoption gap is 42%. The fish farmers are using some practices like getting the pond ready and managing the food for the fish. However they are not using some practices like keeping the water clean preventing diseases and keeping records. This is because they do not have technical knowledge and they do not get enough support. Our findings suggest that even though the fish farmers know about aquaculture they are not using all the practices. This is because of some socio- institutional problems. Our results are similar to studies that have looked at the adoption of scientific fish farming practices, in India.

3.2 Factors Influencing the Adoption Gap in Indian Major Carp Culture

The study found out that there are reasons why Indian Major Carp farmers in the Malwa region of Madhya Pradesh are not using the best farming methods. These reasons are related to the farmers' social and economic situation the techniques they use and the support they get from institutions. The main reason for this is that the farmers do not have knowledge about the best farming methods they do not get enough help from experts they do not have enough money and they cannot get good quality materials.

A lot of farmers 68% said that they did not get enough

guidance on how to farm fish using the best methods. This is because they do not get to talk to the people who can help them with farming so they are not confident about using methods. Financial problems are also an issue. 62% of farmers said that it is too expensive to buy the things they need to farm fish and they cannot get help from banks or other institutions. The price of quality fish, food for the fish, medicine and other things they need to take care of the fish is too high so farmers are not willing to spend money on the best farming methods. Some farmers still use methods because they are used to them and think they are safer. 57%

of farmers said they do this. They are also afraid to try things because they might lose money.

The study also found out that farmers do not have access to quality materials and they do not know enough about the best farming methods. Farmers who did not have education did not have much experience and did not get to attend training programs were less likely to use the best Indian Major Carp farming methods. If the people who are supposed to help the farmers do not do a job it makes it even harder for the farmers to use the best methods.

Table 1: Quality Parameters of experiential site

S. No	Parameter	Optimum Range	Indore/Dewas	Dhar	Ujjain/Ratlam
1.	Temperature (°C)	20-30	15.3-35.6	22-34	Suitable variation
2.	pH	6.5-9.0	6.8-8.9	7.2-8.6	Often >7
3.	DO mg/L	>4	4.5-12.4	5.2-10.8	Adequate in ponds
4.	Free CO ₂ mg/l	>10	0-19	1-12	Variable
5.	Total Hardness (mg/L)	100-600	200	150-500	Elevated some areas

Table 2: Fisheries Profile of Selected Districts of Madhya Pradesh

S. No	Questions	Response	Indore	Ujjain	Dhar	Dewas	Ratlam
1.	Numbers of Cooperative society	-	47	32	103	56	842
2.	Age group of farmers	>16 16-28 29-40 41-57 >58	25-50	20-65	29-57	16-58	20-55
3.	Marital status	Married & Unmarried	All Married	All Married	Both Married & Unmarried	Both Married & Unmarried	Both Married & Unmarried
4.	Education status	Junior Primary/higher Secondary Graduate/ Masters literate	Primary	Primary	Primary	Primary to Higher secondary	Primary to Higher secondary
5.	Fishing Mode	Capture and Culture	Culture and Capture	Culture and Capture	Culture and Capture	Culture and Capture	Culture and Capture
6.	Which IMC carps species high consuming	Catla Rohu Mrigal	Catla & Rohu	Catla, Rohu, mrigal, Naren	Catla & Rohu	Rohu	Rohu
7.	Which technology use in fisheries adaptation	Pond RAS Bio-floc	Pond & biofloc	Pond & Biofloc	Pond & biofloc	RAS	Bio-Floc
8.	Feed use	Artificial Natural	Artificial	Artificial Natural	Artificial	Artificial Natural	Artificial
9.	How much seeds are required	Spawn/Fry/Fingerlings	5000 Kg	208.60 lakh	163 lakh	110 Lakh	80 lakh
10.	How much annual fish production	Kg/Quinton/Ton	2000 MT	9406 ton	23715 MT	1406MT	1152 MT
11.	Other income source in off season.		Agriculture/ Dairy/ Shop etc	Agriculture	Agriculture	Labour, Agriculture	Agriculture, Water chestnut
12.	Total water area	Hc.	5500.2 hc.	4110.031 hc.	13400 hc.	1998.69 hac.	3085 hc.
13.	Total Numbers of ponds	No.	472	503	1375	60	175

Institutional and Demographic Profile of Fish Farmers

The institutional framework and demographic characteristics varied significantly across the surveyed districts. Cooperative Infrastructure: Ratlam demonstrated an exceptionally high institutional density with 842 cooperative societies, followed by Dewas (103) and Ujjain (47). Dhar possessed 32 societies, while data for Indore was unavailable. The age profile of the fish farmers spanned across a wide productive spectrum. Dewas exhibited the widest age distribution (16–58 years), capturing younger participants. The remaining districts predominantly engaged middle-aged cohorts, with age brackets ranging from 25–50

years in Indore, 20–65 years in Ujjain, 29–57 years in Dhar, and 20–55 years in Ratlam. The participant demographic was entirely married in Ujjain and Dhar, whereas Indore Dewas, and Ratlam reported a mix of both married and unmarried individuals. Education levels were relatively basic; farmers in Indore, Ujjain, and Dhar had attained primary school education, while those in Dewas and Ratlam showed slightly higher educational attainment, ranging from primary to higher secondary levels. Due to the seasonal nature of fisheries, diversification was highly prevalent. Agriculture served as the primary off-season livelihood across all five districts. Additionally, farmers in Indore

diversified into dairy and retail shops, those in Dewas engaged in casual labor, and farmers in Ratlam utilized waterlogged resources for water chestnut (*Trapa natans*) cultivation. The technical parameters and management strategies reflect a mix of conventional and intensive aquaculture systems. All five districts relied on a dual approach to fish sourcing, combining capture fisheries (harvesting wild stocks from open waters) and culture fisheries (controlled rearing in managed environments). Among Indian Major Carps (IMC), preferences differed by locality. *Labeo catla* and *Labeo rohita* were highly preferred in Indore and Dhar. Ujjain demonstrated the most diverse consumption pattern, incorporating Catla, Rohu, *Cirrhinus mrigala* (Mrigal), and Naren. Conversely, consumer preference in Dewas and Ratlam was highly skewed toward Rohu alone. Traditional pond aquaculture remains the baseline, but intensive technologies have emerged. Indore, Ujjain, and Dhar have adopted a combination of traditional ponds and Biofloc technology (a waste-recycling system utilizing beneficial microbial clusters). Dewas uniquely shifted focus toward Recirculating Aquaculture Systems (RAS) for water-efficient rearing, while Ratlam exclusively deployed Biofloc systems. Supplemental feeding strategies varied. Indore, Dhar, and Ratlam relied solely on artificial commercial feeds. In contrast, farmers in Ujjain and Dewas utilized a combination of natural food organisms (plankton) stimulated within the ecosystem and external artificial feeds.

Discussion

The study shows that Indian Major Carp farmers will only use the farming methods if they know about them if they have enough money if they get help from institutions and if they can get the materials they need. Farmers who talk to the people who can help them and attend training programs are more likely to use the methods. So it is very important to make the support system stronger to make it easier for farmers to get quality materials to teach farmers more about the best methods and to give them access to affordable loans Pandey *et al.*, (2014) ^[13]; Singh *et al.*, (2017) ^[16]. This will help reduce the gap, between the farmers who use the methods and those who do not and it will help increase the production of fish in the Malwa region of Madhya Pradesh. Indian Major Carp farmers need all this help to do their job well. The active participation of the middle-to-mature age cohort (20–65 years) across the studied districts aligns with the national trends documented by Ekka *et al.* (2012) ^[2], who reported that inland capture and culture fisheries in Central India are heavily dominated by the 36–55 age bracket due to the physically demanding nature of harvesting operations. The mixed marital status observed in Indore, Dewas, and Ratlam, contrasted against the exclusively married baseline in Dhar and Ujjain, supports the assertions of Reza *et al.* (2015) ^[15] that family stability acts as an informal social insurance system in rural aquaculture setups. However, the lower educational attainment (restricted primarily to higher secondary levels) remains a critical bottleneck. As highlighted in regional reviews, low literacy rates heavily constrain a farmer's capacity to interpret complex technical instructions regarding water quality parameters, dosage formulations, and disease diagnoses. "The structural density of 842 cooperative societies in Ratlam points to an advanced model of community-based natural resource management.

According to institutional reports on Aquaculture Development in Madhya Pradesh, cluster-based institutional approaches and strong cooperative frameworks significantly lower the transactional barriers for smallholders looking to adopt modern technologies. This institutional backup explains why Ratlam has successfully transitioned exclusively toward modern intensive setups like Biofloc. Concurrently, the adoption of Recirculating Aquaculture Systems (RAS) in Dewas and Biofloc configurations in Indore, Ujjain, and Dhar indicates a progressive paradigm shift from traditional extensive culture to high-density, horizontal space-saving aquaculture. This technological transition matches findings by Khuman and Singh (2022) ^[5], who observe that sub-surface water vulnerabilities and unpredictable weather conditions increasingly push progressive inland farmers to opt for controlled-environment systems like RAS and Biofloc over traditional open earthen ponds. Furthermore, the universal reliance on off-season occupational diversification across all districts highlights the vulnerability of relying solely on seasonal fisheries. The deployment of alternative strategies—ranging from traditional crop cultivation and dairy farming to casual labor and niche agro-ventures like water chestnut farming in Ratlam—confirms the multi-layered livelihood frameworks outlined by Nianti *et al.* (2020) ^[11]. Cultivating water chestnuts (*Trapa natans*) in the off-season is a highly effective dual-use strategy for local water bodies, allowing fish farmers to generate continuous returns even when primary aquaculture activities are paused due to seasonal fry shortages or winter growth delays.

Conclusion

This study underlines the varying socio-economic dynamics, technological choices, and production metrics across the five key aquaculture districts of Madhya Pradesh. While traditional pond aquaculture remains the baseline, a significant transition toward modern, high-density systems like Biofloc and Recirculating Aquaculture Systems (RAS) is evident, particularly in Ratlam and Dewas. Dhar functions as the regional production hub due to its vast water footprint, whereas Ujjain demonstrates a highly intensive stocking strategy. The institutional strength observed through Ratlam's massive cooperative network highlights the value of community-driven infrastructure in accelerating tech adoption. Furthermore, the universal reliance on off-season activities like agriculture and water chestnut farming stresses the importance of livelihood diversification for seasonal security. Ultimately, targeted interventions focusing on technical training, standardized stocking protocols, and cooperative development are essential to maximize aquaculture efficiency across these districts.

Funding Information

The study was funded by Department of Aquaculture, School of School, Sanjeev Agrawal Global Educational (SAGE) University Bhopal, India.

Competing Interests

The authors have no relevant financial or nonfinancial interests to disclose.

Acknowledgements

The authors gratefully acknowledge the Department of

Aquaculture, School of School, Sanjeev Agrawal Global Educational (SAGE) University Bhopal, India for providing the necessary facilities for conducting this research.

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