



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating (2026): 4.61

VET 2026; 11(3): 60-64

© 2026 VET

www.veterinarypaper.com

Received: 02-12-2025

Accepted: 13-01-2026

PA Telvekar

College of Fishery Science,
Maharashtra Animal and Fishery
Sciences University (MAFSU),
Nagpur, Maharashtra, India

SS Relekar

College of Fishery Science,
Maharashtra Animal and Fishery
Sciences University (MAFSU),
Nagpur, Maharashtra, India

SS Gore

College of Fishery Science,
Maharashtra Animal and Fishery
Sciences University (MAFSU),
Nagpur, Maharashtra, India

RN Wanjari

College of Fishery Science,
Maharashtra Animal and Fishery
Sciences University (MAFSU),
Nagpur, Maharashtra, India

Corresponding Author:

PA Telvekar

College of Fishery Science,
Maharashtra Animal and Fishery
Sciences University (MAFSU),
Nagpur, Maharashtra, India

Portable FRP carp hatchery technology and improved culture practices: Influence on pond productivity, fish yield, and livelihood enhancement in Gadchiroli district, Maharashtra: A case study with pond size comparison

PA Telvekar, SS Relekar, SS Gore and RN Wanjari

DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i3b.3095>

Abstract

A three-phase extension-demonstration program (2019-2025) was implemented in the Gadchiroli District of Maharashtra to strengthen decentralized fish seed production, improve pond culture practices, and promote hygienic fish marketing. The intervention formed eight Fisheries Interest Groups (FIGs) across eight blocks (250 members), established five portable FRP carp hatcheries (four operational for Indian Major Carps), demonstrated scientific grow-out culture in 24 farm ponds, and deployed five mobile fish vending units. Grow-out demonstrations followed improved management, emphasizing pond preparation, stocking of quality fingerlings at $\sim 10,000 \text{ ha}^{-1}$, feed and feeding management, and routine advisory visits. District-level productivity increased consistently across blocks, from a baseline of 1,741-3,433 kg ha^{-1} (before intervention) to 4,865-6,193 kg ha^{-1} by 2024-25, supported by one-way ANOVA with Duncan's test indicating significant year-wise gains within blocks. Seed self-reliance improved through hatchery operations: Indian Major Carp spawn production increased from 80 lakhs (2022-23) to 445 lakhs (2024-25), alongside large-scale common carp spawn production during winter (e.g., 150 lakhs at Chamorshi). A pond-size economics comparison (0.5, 1.0, and 2.5 acres) indicated rising profitability and efficiency with scale, with net profits of ₹1.49 lakhs, ₹2.22 lakhs, and ₹4.58 lakhs, and benefit-cost ratios (BCR) of 1.29, 1.36, and 1.45, respectively, under comparable carp polyculture assumptions. Overall, the study demonstrates that locally available quality seeds, structured farmer collectivization, and standardized best management practices can rapidly close productivity gaps in tribal-dominated rainfed pond systems, while market-facing innovations (portable vending) improve hygiene and value capture.

Keywords: Indian major carps, FRP portable carp hatchery, pond polyculture, productivity, aquaculture economics, Gadchiroli

1. Introduction

Aquaculture plays a pivotal role in India's food security and rural economy, contributing approximately 1.1% to the national GDP and over 7.3% to the agricultural GDP, while supporting the livelihoods of more than 3 crore fishers and fish farmers (FAO, 2022; PIB, 2026) ^[3]. The sector has witnessed remarkable growth, with total fish production more than doubling from 95.79 lakh tonnes in FY 2013-14 to 197.75 lakh tonnes in FY 2024-25, driven largely by inland aquaculture, which now accounts for a significant share of the output (Department of Fisheries, 2025-26) ^[1]. India ranks as the world's second-largest fish producer and leads in shrimp production and exports, underscoring the importance of aquaculture in protein supply, employment generation, and foreign exchange earnings (FAO, 2022; FAO, 2023) ^[3, 4]. Maharashtra, endowed with vast inland water resources, including rivers, reservoirs, and farm ponds, holds substantial potential for freshwater aquaculture development (Swain *et al.*, 2020) ^[10]. The state's inland fisheries production has shown steady increases, supported by government schemes; however, regional disparities persist, particularly in underdeveloped and tribal-dominated districts (Economic Survey of Maharashtra, 2024).

Districts such as Gadchiroli in eastern Maharashtra face unique challenges, including limited access to quality fish seeds, low adoption of scientific farming practices, inadequate marketing infrastructure, and dependency on external (often mixed-quality) seed supplies from neighboring regions (Telvekar *et al.*, 2022; STRC, 2025) ^[11]. Gadchiroli, a predominantly tribal area with abundant rain-fed ponds, seasonal water bodies, and reservoirs, relies heavily on traditional fish farming methods that yield suboptimal production owing to poor pond management, nutrient limitations, and lack of organized seed production (Sonone *et al.*, 2020; Telvekar *et al.*, 2022) ^[9, 11]. These constraints are exacerbated by socioeconomic factors such as remoteness, limited technical knowledge among tribal farmers, and minimal infrastructure for post-harvest handling (Telvekar *et al.*, 2022) ^[11].

Government initiatives, such as the Pradhan Mantri Matsya Sampada Yojana (PMMSY), have aimed to address such gaps by promoting seed production, pond development, and livelihood diversification in tribal regions, including Maharashtra; however, implementation in remote areas, such as Gadchiroli, requires targeted extension efforts (Department of Fisheries, 2024-25; PIB, 2025). This study draws from a project titled "Development of Organized Fish Seed Production, Culture and Marketing to Ensure Sustainable Livelihood Opportunities in Aquaculture in Gadchiroli District," funded by the Science & Technology Resource Center (STRC) and implemented by the Maharashtra Animal & Fishery Sciences University (MAFSU), Nagpur, from August 2019 to March 2025 ^[7]. The study objectives included forming Fisheries Interest Groups (FIGs), demonstrating scientific culture practices, establishing portable carp hatcheries, and promoting value-added marketing. By bridging knowledge gaps and delivering technical support, this initiative sought to boost productivity, seed availability, and income in tribal communities. This study documents a district-scale case study of improved pond culture practices, farmer collectivization through FIGs, decentralized seed production using FRP portable hatcheries, and market innovation (portable fish vending). We further compared the economics of carp culture across three pond sizes (0.5, 1.0, and 2.5 acres) to inform scaling strategies.

2. Materials and Methods

2.1 Study area and project period

The program was implemented in the Gadchiroli District, Maharashtra, India, from August 14, 2019, to March 31, 2025, through the College of Fishery Science, MAFSU, Nagpur, in collaboration with the STRC, Gondwana University, Gadchiroli.

2.2 Institutional and farmer mobilization (FIG formation)

Eight Fisheries Interest Groups (FIGs) were established across eight blocks (Armori, Kurkheda, Korchi, Dhanora, Aheri, Etapalli, Chamorshi and Mulchera) totaling 250 members. FIGs serve as platforms for collective input procurement, technical advisory, and marketing discussions.

2.3 Training, demonstrations, and advisory delivery

A total of 62 extension events were conducted under the project, through which 1,141 participants were trained and engaged. These activities included workshops on scientific fish culture, on-farm demonstrations in 24 ponds, training programs on induced breeding, focus group discussions, a

buyer-seller meeting, and repeated advisory farm visits. The demonstrations focused on scientific pond preparation, basic water and soil quality management, appropriate species selection and stocking, and stocking of fingerlings at approximately 10,000 ha⁻¹ in the demonstration ponds. Farmers were also guided on feed rationing and feeding management, fish health management, harvesting practices and marketing advisories.

2.4 FRP portable carp hatcheries and seed production monitoring

Five FRP portable carp hatcheries were procured; four became operational for IMC seed production during the project period at Kurkheda, Korchi, Chamorshi, and Mulchera. Hatchery operators were trained in broodstock management, induced breeding protocols, hatchery operations, and nursery rearing. FRP hatchery technology is recognized for its portability and on-farm seed production advantages. Seed production outputs (spawn and fingerlings) were compiled annually (2022-23 to 2024-25). Common carp seed production was conducted during the winter months.

2.5 Grow-out productivity assessment in demonstration ponds

Twenty-four farmer ponds were monitored across the blocks. Fish production was recorded as total harvest (kg) and standardized to productivity (kg ha⁻¹) using pond area data, generating year-wise productivity for the baseline (before intervention), 2022-23, 2023-24, and 2024-25.

2.6 Statistical analysis

Block-wise year-wise fish production (kg ha⁻¹) was analyzed using one-way ANOVA followed by Duncan's multiple range test (as reported in the project dataset) to assess the differences across years within blocks.

2.7 Economics comparison across pond sizes

A comparative cost-return analysis for carp culture under a 1-year cycle was presented for three pond sizes (0.5, 1.0, and 2.5 acres) using the provided fixed capital, working capital, production assumptions, and sale price. The net profit and BCR were computed as follows

- Net Profit = Gross revenue – Working capital
- BCR = Gross revenue / Fixed capital cost

3. Results and Discussion

3.1 FIG formation and capacity building outcomes

The establishment of eight FIGs (250 members) enabled repeated engagement and the diffusion of technical practices. FIG-based interactions supported collective learning and improved access to inputs (seeds and feed ingredients) and market information. Such collectivization aligns with the policy emphasis on strengthening fisheries value chains and producer aggregation under PMMSY-linked approaches.

3.2 Decentralized seed production through FRP portable hatcheries

Indian Major Carp (IMC) spawn production increased substantially as FRP portable hatcheries became operationally stabilized over time (Table 1). Production increased from 80 lakhs in 2022-23 to 335 lakhs in 2023-24, and further to 445 lakhs in 2024-25, indicating the success of decentralized hatchery-based seed production in the Gadchiroli district.

Table 1: Year-wise IMC spawn production through FRP portable hatcheries in the Gadchiroli district

Year	IMC spawn production (lakh)
2022-23	80
2023-24	335
2024-25	445

The Chamorshi hatchery emerged as a major seed hub (300 lakh IMC spawn in 2024-25). In addition, common carp winter breeding produces substantial spawn (*e.g.*, 150 lakhs at Chamorshi and 20 lakhs at Kurkheda), supporting species diversification for local farmers. The performance is consistent with the intended advantages of FRP portable hatcheries—localized, farmer-field seed production with reduced transport dependency and simpler installation.

3.3 Improvements in pond productivity under scientific culture demonstrations: Across the observed ponds, productivity rose steadily from baseline farmer practices to third-year outcomes. The block-wise mean productivity (kg ha^{-1}) recorded a substantial improvement by 2024-25 (Table 2). Among the selected blocks, productivity increased from 2,366 to 5,333 kg ha^{-1} in Kurkheda, 2,283 to 5,340 kg ha^{-1} in Mulchera, 1,875 to 4,936 kg ha^{-1} in Korchi, 1,766 to 4,865 kg ha^{-1} in Aheri, and 3,433 to 6,193 kg ha^{-1} in Chamorshi.

Table 2: Block-wise improvement in pond productivity under scientific culture demonstrations in the Gadchiroli district

Block	Baseline productivity (kg ha^{-1})	Productivity in 2024-25 (kg ha^{-1})	Increase (kg ha^{-1})
Kurkheda	2,366	5,333	2,967
Mulchera	2,283	5,340	3,057
Korchi	1,875	4,936	3,061
Aheri	1,766	4,865	3,099
Chamorshi	3,433	6,193	2,760

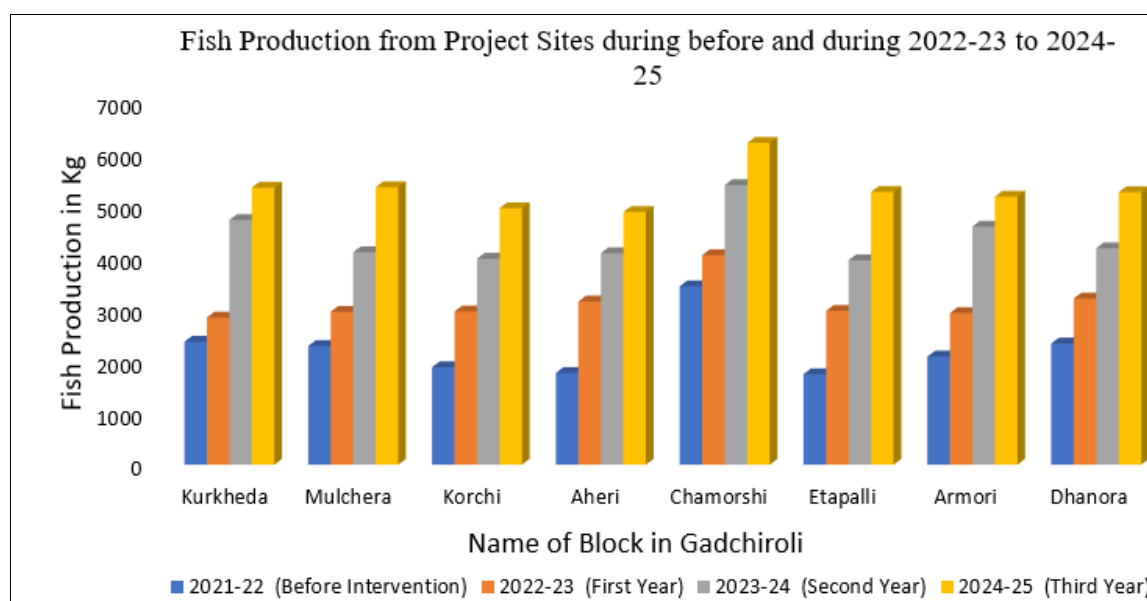
To further validate the year-wise trend in productivity improvement, block-wise fish productivity data were analyzed using one-way ANOVA, followed by Duncan's multiple range test. The results revealed statistically

significant increases in fish productivity from the pre-intervention period to subsequent years in most blocks (Table 3; Figure 1).

Table 3: Block-wise year-wise fish productivity (kg ha^{-1}) before and after intervention in Gadchiroli district

Name of Block	Before intervention	2022-23 (First year)	2023-24 (Second year)	2024-25 (Third year)
Kurkheda	2366 $\pm$ 450.52 ^a	2833 $\pm$ 381.68 ^a	4710 $\pm$ 422.25 ^b	5333 $\pm$ 305.50 ^b
Mulchera	2283 $\pm$ 256.58 ^a	2943 $\pm$ 265.76 ^b	4090 $\pm$ 528.48 ^c	5340 $\pm$ 121.65 ^d
Korchi	1875 $\pm$ 326.90 ^a	2950 $\pm$ 278.38 ^b	3966 $\pm$ 642.91 ^c	4936 $\pm$ 281.12 ^d
Aheri	1766 $\pm$ 152.75 ^a	3141 $\pm$ 414.21 ^b	4073 $\pm$ 556.44 ^c	4865 $\pm$ 305.50 ^c
Chamorshi	3433 $\pm$ 404.10 ^a	4033 $\pm$ 450.92 ^a	5383 $\pm$ 175.59 ^b	6193 $\pm$ 378.72 ^c
Etapalli	1741 $\pm$ 448.84 ^a	2962 $\pm$ 341.43 ^b	3936 $\pm$ 413.56 ^c	5250 $\pm$ 412.18 ^d
Armori	2083 $\pm$ 301.38 ^a	2918 $\pm$ 453.12 ^a	4583 $\pm$ 599.12 ^b	5158 $\pm$ 586.47 ^b
Dhanora	2333 $\pm$ 404.14 ^a	3199 $\pm$ 381.68 ^a	4166 $\pm$ 381.89 ^b	5246 $\pm$ 217.33 ^c

Note: Values with different superscripts within a row differ significantly at $p < 0.05$, according to Duncan's multiple range test.

**Fig 1:** Block-wise year-wise fish productivity (kg ha^{-1}) before and after intervention in Gadchiroli district

The reported ANOVA with Duncan's test indicates statistically significant year-wise increases within blocks (letters differ across years in the data set). These outcomes are

credible in light of the known yield gaps in carp systems and the strong response of yields to improved feed and pond management. Notably, Chamorshi started from a higher

baseline and still achieved the district's highest final productivity, suggesting that progressive farmers and better local input access (including hatchery seeds) accelerate yield improvements.

3.4 Interpretation against published yield benchmarks

Farmer-managed carp ponds in India frequently report yields below the technically achievable levels. Strengthening feeding, fertilization, and husbandry practices can substantially close this gap. The project's third-year outcomes ($\sim 4.9\text{--}6.2\text{ t ha}^{-1}$ in several blocks) aligned with semi-intensive carp polyculture performance under improved practices, while remaining realistic for smallholder pond systems. The intervention's stocking density ($\sim 10,000$ fingerlings ha^{-1}) is within the range tested in carp polyculture studies and demonstration contexts. However, the observed differences among blocks indicate that seed quality, farmer experience, water permanence, and market incentives likely moderated the realized yields.

3.5 Market innovations: portable fish vending units and hygiene/value capture

Five portable fish vending units were deployed at the selected market nodes. The study rationale addresses a common

challenge in informal fish markets: open display without icing increases spoilage risk and reduces consumer confidence in the product. Hygienic vending (and live fish marketing where feasible) can improve value capture at the producer/vendor level and align with broader value chain modernization goals highlighted in PMMSY. The buyer-seller meeting (January 2025) clarified a key constraint for outward market expansion: without cold chain and storage, distant wholesalers face high marketing costs, limiting farmgate price improvements. This supports the study recommendation for cold storage and small processing infrastructure in higher-producing blocks (e.g., Chamorshi and Mulchera).

3.6 Pond-size comparison: economics of carp culture (0.5, 1.0, 2.5 acre)

Using the provided budgets and production assumptions for a one-year culture cycle at a sale price of ₹150 kg^{-1} , profitability improved with increasing pond size (Table 4). The gross revenue increased from ₹2,55,000 in 0.5 acre ponds to ₹8,92,500 in 2.5 acre ponds. Similarly, net profit increased from ₹1,48,810 to ₹4,58,450, whereas the benefit-cost ratio improved from 1.29 to 1.45, indicating better economic efficiency at larger pond sizes.

Table 4: Comparative economics of carp culture in different pond sizes

Pond size (acre)	Gross revenue (₹)	Net profit (₹)	Benefit-cost ratio (BCR)
0.5	2,55,000	1,48,810	1.29
1.0	4,78,050	2,22,350	1.36
2.5	8,92,500	4,58,450	1.45

This pattern reflects economies of scale: fixed costs (sluices, implements, pump sets, and basic infrastructure) are spread across higher output, and operational efficiencies (feeding, labor, and harvesting logistics) improve as pond size increases. Importantly, the project's field results suggest that smaller ponds can achieve high productivity if seed quality and management are improved. Therefore, scale-up should be coupled with strong extension and local seed systems, rather than pond expansion alone.

3.7 Seed enterprise economics (FRP hatchery at Chamorshi)

The supplied hatchery enterprise budget indicates a capital investment of ₹5.95 lakhs, annual operating cost of ₹2.60 lakhs, gross revenue of ₹9.45 lakhs, net profit of ₹0.90 lakhs, and BCR of 1.59. While the dataset's "break-even < 1 year" statement may depend on accounting treatment (e.g., whether capital costs are depreciated rather than fully charged in year 1), the enterprise clearly demonstrates positive annual operating margins and strong extension value by enabling local seed availability, consistent with FRP hatchery technology claims and prior documentation.

4. Conclusion

The Gadchiroli district study demonstrated that structured farmer collectivization (FIGs), reliable local seed supply via portable FRP hatcheries, and standardized scientific pond management can substantially increase carp pond productivity within three culture cycles. Block-level productivity increased from baseline ranges of $\sim 1.7\text{--}3.4\text{ t ha}^{-1}$ to $\sim 4.9\text{--}6.2\text{ t ha}^{-1}$ by 2024-25, supported by ANOVA/Duncan's test results in the project dataset. Seed self-reliance improved markedly (IMC spawn up to 445 lakhs in 2024-25), reducing dependence on distant and mixed-quality seed sources. The pond-size

economics comparison indicates that profitability increases with scale (BCR 1.29 $\rightarrow$ 1.45 from 0.5 to 2.5 acres), but the project evidence suggests that management and seed quality are the dominant levers even for small ponds. For sustained gains and market expansion beyond local demand, cold-chain infrastructure and small-scale processing/value addition in high-production clusters (Chamorshi, Mulchera) are the next priority steps.

References

1. Department of Fisheries. Annual report 2025-26. New Delhi: Ministry of Fisheries, Animal Husbandry and Dairying, Government of India; 2026.
2. Directorate of Economics and Statistics. Economic survey of Maharashtra 2023-24. Mumbai: Planning Department, Government of Maharashtra; 2024.
3. FAO. The state of world fisheries and aquaculture 2022: towards blue transformation. Rome: Food and Agriculture Organization of the United Nations; 2022.
4. FAO. Fishery and aquaculture country profiles: India. Rome: Food and Agriculture Organization of the United Nations; 2023.
5. Press Information Bureau. Strengthening marine resources and livelihoods: India celebrates World Fisheries Day 2025. New Delhi: Government of India; 2025 Nov 20.
6. Press Information Bureau. Fish production has increased to 197.75 lakh tonnes in FY 2024-25 from 95.79 lakh tonnes in FY 2013-14. New Delhi: Government of India; 2026 Jan 12.
7. Science and Technology Resource Centre. From streams to livelihoods: aquaculture opportunities in Gadchiroli's water-rich landscapes. Gadchiroli: Gondwana University; 2025.

8. Jaiswal S, *et al.* A study of the social and economic status of fishermen in Gadchiroli district. *ShodhKosh: Journal of Visual and Performing Arts*. 2024;5(7):1-10.
9. Sonone A, Belsare SS, Joshi SA. Freshwater aquaculture of Maharashtra - a review of Vidarbha perspective. *Rashtriya Krishi*. 2020;15(1):95-101.
10. Swain SK, *et al.* The status and prospectus of fisheries and aquaculture in Maharashtra, India. *Indian Journal of Marine Sciences*. 2020;49(4):567-575.
11. Telvekar PA, Relekar SS, Gore SB, Rathod RH, Belsare SS. Livelihood opportunities for tribal farmers through fish culture practices in seasonal ponds in Gadchiroli district of Maharashtra. *Journal of Indian Fisheries Association*. 2022;49(1):1-7.

How to Cite This Article

PA Telvekar, SS Relekar, SS Gore and RN Wanjari. Portable FRP Carp hatchery technology and improved culture practices: Influence on pond productivity, Fish Yield, and Livelihood Enhancement in Gadchiroli District, Maharashtra: A case study with Pond size comparison. *International Journal of Veterinary Sciences and Animal Husbandry*. 2026;11(3):60-64.

Creative Commons (CC) License

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.