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Economic Impact of Extension Interventions on Composite Carp Culture in Dhenkanal and Kandhamal, Odisha

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HIGHLIGHTS

- Scientific carp culture significantly increased fish production across all adopted ponds.
- Higher investments in feed, seed, and pond management resulted in improved profitability.
- Return on Investment (ROI) improved post-intervention, reaching up to 169 per cent in Kandhamal whereas Benefit-Cost (B:C) ratio showed notable improvement, confirming the economic feasibility of scientific practices.
- Enhanced training and awareness among farmers contributed to better adoption and success rates.

ARTICLE INFO

Keywords: Composite carp culture, Aquaculture, B:C ratio, Return on investment, Scientific carp culture technology.

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ABSTRACT

The aquaculture sector is rapidly growing, significantly contributing to the Indian and global economies by ensuring nutritional security and supporting livelihoods. Composite carp culture is one of the most extensively used technology. The study was carried out in Dhenkanal and Kandhamal districts of Odisha attempts to determine whether composite carp farming is economically viable by examining the costs and benefits of the technology. Data were collected from 220 fish farmers of both Dhenkanal and Kandhamal districts before and after adoption of Scientific carp culture technology. The total pond area was 3.6 ha in Dhenkanal and 3.7 ha in Kandhamal district. The mean fish yield was 1047.1 kg/ha/yr and rose to 2032.1 kg/ha/yr in Dhenkanal and 1247.2 kg/ha/yr to 2554.5 kg/ha/yr in Kandhamal. Rate of return on total investment (ROI) and Benefit-Cost ratio (B:C ratio) of Dhenkanal and Kandhamal ponds, after intervention was worked out as 124.7 per cent, 1.2 and 169 per cent, 1.7 respectively. Supplementary feed accounted for the largest portion of the cost of fish production, followed by pond leasing value and pond preparation costs. The study suggests that the composite carp culture method is economically viable and has a remarkable benefit-cost ratio.

INTRODUCTION

The aquaculture sector is experiencing rapid expansion globally, driven by a rising demand for fish and seafood products (Mondal et al., 2024). Fisheries and aquaculture are significant sources of food, nutrition, financial resources, and employment in India. Fish production plays a crucial role in socioeconomic status of rural population in India (Dutta et al., 2022). India is the world's third largest fish-producing country, accounting for 7.96 per cent of worldwide production, as well as the world's second-largest aquaculture producer. Odisha reported at 10.52 MMT production in 2023 (CEIC, 2023). Three significant reservoirs are located in Odisha: Rangali in Dhenkanal district (28,000 ha), Hirakud in Sambalpur (71,963 ha), and Balimela in Koraput district (19,440 ha). These diverse water bodies contribute to the state's rich fish biodiversity (Das et al., 2021). The Dhenkanal District is 4,452 square kilometers in size. The district has ponds and tank resources of 1,749.22 ha, which accounts for 1.32 per cent of the

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ponds and tank resources of Odisha. Freshwater fish production in Dhenkanal district was 10,232.46 MT in 2017-18, contributing 2.2 per cent towards total freshwater fish production of Odisha (Shasani, 2020). Kandhamal experiences sub-tropical hot and dry climate in summer. Dry and cold climate in winter. The maximum temperature recorded in the District is 45.5°C and minimum temperature is 2.0°C. Almost 66 per cent of the land area of the district is covered with dense forests and towering mountains. The important crops grown in the district during the Kharif season are paddy, maize, and niger. In irrigated areas, crops like potato, vegetables, and mustard are grown. Kandhamal is one of the most backward districts of Odisha, with 47.2 per cent of households in the BPL category as recorded in the year 2000 (District Annual Plan Document, 2013-14, Kandhamal). The district is a major producer of ginger and turmeric and has created a name for itself in India for spice cultivation. Coming to aquaculture, Limited water resources and poor water quality restrict fish production in Kandhamal, making the district reliant on Andhra Pradesh for fish supply. To address this, the administration plans to scale up local production through SHGs under the Odisha Livelihood Mission (OLM) (Sahoo et al., 2021). Aquaculture systems need to be established using sound scientific and economic evaluation (Manju Lekshmi et al., 2019). Under one DST funded project "Economic Empowerment of SC fish farmers through capacity building in two aspirational districts Dhenkanal & Kandhamal, Odisha" composite carp culture was promoted among selected beneficiaries during 2022-24. It is imperative to know how this technology is performing better as compared to traditional way of farming fish. Economic assessment of this technology is attempted in this article. Effective communication plays a vital role in advancing scientific fish farming practices by facilitating knowledge exchange, problem-solving, market awareness, and collaboration among stakeholders (Mondal et al., 2024). To ensure sustainable and profitable IMC aquaculture, it is essential to adopt an integrated approach that encompasses various aspects of pond cultivation, nutrition, and health management (Manam & Quraishi, 2024).

METHODOLOGY

The study was carried out in eleven adopted ponds of Dhenkanal and Kandhamal district. The data was collected from the selected beneficiaries of both the districts. The profitability of composite carp culture was evaluated using the Gross Margin Analysis (GMA) method. GMA is a valuable measure for determining farm profitability. The gross margin (GM) is the difference between the fish farm's total revenue and the total variable costs required to generate the output (Firth, 2002). The whole output multiplied by the cost per unit of fish is the total income. The costs that vary according to the level of production are known as variable costs. The entire variable cost includes food, labour, shipping, fertilizers, and other input expenditures like fingerlings. The above discussion can be represented by the following equation:

Gross Margin = Total Revenue – Total Variable Cost

In order to determine the profitability of the suggested plan, the rate of return on total investment is computed as follows:

ROI = (Total Revenue / Cost of Production) * 100

B:C Ratio = Total Revenue / Cost of Production

In the above formula the term Total Variable Cost (TVC) refers to all variable cost elements, such as feed, fertilizer, lime, seed, and inputs. The whole revenue was made up of other farm income and the revenues from the sale of fish. Gross Margin is the total revenue minus all variable costs. The data was analyzed using budgeting and percentage analyses. The information gathered was from July 2022 to June 2023. The tabulated data was evaluated using appropriate statistical procedures, namely frequency and percentage. To determine profitability, a thorough economic assessment of composite carp culture technology is essential. This will make it possible for development professionals to inspire and bring in more fish farmers and young people from remote areas to use the technology. In the districts of Dhenkanal and Kandhamal, a research on input usage and net profit was conducted in adopted ponds. On a per-hectare basis, Table 2 illustrates the costs, yields, and profit from composite carp farming.

RESULTS

Comparison of pre and post intervention production of adopted ponds

Table 1 represents a comparison of fish production before and after the intervention in various adopted ponds across Dhenkanal and Kandhamal districts. The data indicate significant improvements in fish yield due to scientific carp culture practices. In Dhenkanal,

Table 1. Comparison of Pre and Post Intervention Production of adopted ponds

District	Village Name	Pond Name	Pond Area (ha)	Production before Intervention (kg/ha)	Production after Intervention (kg/ha)
Dhenkanal	Raitala	Chabaka	0.2	875	1457
Dhenkanal	Raitala	Village Pond (New)	0.6	925	1755
Dhenkanal	Raitala	Village Pond (Community)	0.6	933	1855
Dhenkanal	Raitala	Nua Pokhari	0.2	867	995
Dhenkanal	Sankulei	Sankulei Pond 1	0.4	870	1353
Dhenkanal	Sankulei	Sankulei Pond 2	0.4	1041	1925
Dhenkanal	Namichira	Namichira Pond	1.2	1285	2790
Kandhamal	Pankangaon	Pond 1	0.4	950	1953
Kandhamal	Pankangaon	Pond 2	0.2	525	765
Kandhamal	Phiringia	Pond 3	0.6	925	1800
Kandhamal	Balandapada	Pond 4	2.5	1430	2975

Table 2. Economics of composite carp culture in both the districts; Dhenkanal & Kandhamal

S.No.	Particulars	Dhenkanal		Kandhamal	
		Local Practice	Scientific Carp Culture	Local Practice	Scientific Carp Culture
1	Area (ha)	3.6	3.6	3.7	3.7
2	Lease Value (Rs)	18720.0	19500.0	17550.0	18000.0
3	Manuring (Rs)	9500.0	10000.0	12250.0	11500.0
4	Lime (Rs)	9600.0	10560.0	9723.0	10192.0
5	Seed (Rs)	25500.0	40000.0	17500.0	40000.0
6	Feed (Rs)	78000.0	183000.0	85560.0	165000.0
7	Harvest cost (Rs)	11100.0	12550.0	10200.0	11300.0
8	Cost of labour, maintenance & misc (Rs)	1000.0	1500.0	1300.0	1000.0
9	Cost of Production	153420.0	277110.0	154083.0	256992.0
10	Total Variable Cost (Rs)	134700.0	257610.0	136533.0	238992.0
11	Total Production kg/ha	1047.1	2032.1	1247.3	2554.5
12	Total Revenue	167537.8	345457.0	199567.6	434265.0
13	Gross Margin	32837.8	87847.0	63034.6	195273.0
14	Rate of return on total investment (ROI)	109.2	124.7	129.5	169.0
15	B:C Ratio	1.1	1.2	1.3	1.7

production increased from 875 kg/ha to 1,457 kg/ha in Chabaka pond, while the Namichira pond recorded a substantial rise from 1,285 kg/ha to 2,790 kg/ha. Similarly, in Kandhamal, Pankangaon Pond 1 experienced an increase from 950 kg/ha to 1,953 kg/ha, and Balandapada Pond 4 saw an increase from 1,430 kg/ha to 2,975 kg/ha. These improvements indicate that scientific practices significantly enhanced production efficiency across all ponds. Similarly Debnath (2024) reported in Tripura's Dhalai district the composite fish culture intervention significantly boosted aquaculture increasing fish yields from 305-380 kg/ha to 934-1577 kg/ha in three years, a 206-315% rise enhancing farmers' profits.

Economic analysis of composite carp culture

Table 2 provides a detailed economic analysis of composite carp culture in Dhenkanal and Kandhamal districts. The cost of production increased post-intervention due to additional investments in quality inputs such as feed, seed, and pond preparation. In Dhenkanal, production costs rose from Rs. 1,53,420 to Rs. 2,77,110, while in Kandhamal, they increased from Rs. 1,54,083 to Rs. 2,56,992. However, this increase in investment resulted in higher yields, leading to greater profitability. The total production per hectare increased from 1,047.1 kg to 2,032.1 kg in Dhenkanal and from 1,247.3 kg to 2,554.5 kg in Kandhamal. As a result, the gross margin rose from Rs. 32,837.80 to Rs. 87,847.00 in Dhenkanal and from Rs. 63,034.60 to Rs. 1,95,273 in Kandhamal. Return on Investment (ROI) improved from 109.2 per cent to 124.7 per cent in Dhenkanal and from 129.5 per cent to 169.0 per cent in Kandhamal. Similarly, the Benefit-Cost (B:C) ratio increased from 1.1 to 1.2 in Dhenkanal and from 1.3 to 1.7 in Kandhamal. These figures confirm that the adoption of scientific carp culture resulted in significantly higher productivity and profitability. De et al., (2022) also reported that commercial feed-based systems yield higher profits compared to extensive farming methods without feed, thereby justifying the increased investment costs.

DISCUSSION

The significant rise in fish production and economic gains can be attributed to the adoption of scientific carp culture techniques. As shown in Table 1, the increase in yield across all ponds was driven by improved pond management, optimized feeding practices, and higher stocking densities. The use of high-quality supplementary feed and increased stocking rates played a crucial role in accelerating fish growth, ultimately leading to greater production. Furthermore, proper pond preparation, including appropriate liming and manuring, enhanced water quality and contributed to higher fish survival rates. Differences in production levels among ponds were influenced by factors such as pond size, efficiency in water management, and the degree of adherence to recommended scientific practices. Ponds with better management and larger areas demonstrated superior performance. This highlights the importance of targeted training and awareness programs to promote the consistent adoption of best practices among fish farmers.

Dickson et al., (2016) emphasized that best management practice training was initially designed to enhance overall farm efficiency, which in turn was expected to provide environmental benefits through improved feed utilization. This aligns with the findings of the present study, where effective training and implementation of scientific practices have played a crucial role in increasing fish production and economic returns. The economic impact, as outlined in Table 2, reinforces the profitability and viability of scientific carp culture. Although production costs increased, the resulting rise in revenue and net profits justified the investment. The higher expenditure on quality inputs such as feed and seed played a critical role in maximizing productivity. The enhanced Return on Investment (ROI) and Benefit-Cost (B:C) ratio in both districts demonstrate the economic viability of adopting scientific carp culture. Notably, Kandhamal exhibited significant improvements, with ROI rising from 129.5 per cent to 169.0 per cent and the B:C ratio increasing from 1.3 to 1.7. Similarly, De et al. reported that ROI for adopters and non-adopters was 85.84 per cent and 63.03 per cent, respectively, while the B:C ratio was calculated at 1.86 for adopters and 1.63 for non-adopters. These findings indicate that factors such as better market access, favorable environmental conditions, and efficient management played a crucial role in achieving superior results. Singh (2019) reported that fish harvests increased by up to 164 per cent following the adoption of Composite Fish Farming (CFC). Comparative studies between CFC and traditional methods demonstrated higher gross and net profits, with benefit-cost ratios of 2.36 and 1.83, respectively. Research by Singh (2007); Ananth et al., (2014) & Chouhan (2015) has shown that farmers with a profit-maximization approach are more likely to adopt CFC systems. Additionally, Singh (2006) highlighted a positive correlation between fish farming income and overall family earnings. Studies by Ali et al., (2008); Paik et al., (2010); Gupta & Dey (2015) have suggested that increasing fish production can help reduce income inequality, as productivity is influenced not only by environmental factors but also by socio-economic and management practices. Olasunkanmi (2012) found that fish farming, with a benefit-cost ratio of 1.65 and a profit-cost ratio of 0.65, was a profitable venture, recommending greater investment in essential inputs like feed, lime, and fingerlings while minimizing labor and fertilizer costs.

CONCLUSION

Carp fry survival and growth are mostly dependent on appropriate supplementary feeding with nutritionally balanced diets, which significantly boosts Indian major carp output in ponds. Diets should include 30-40 per cent protein, 6-8 per cent lipids, and necessary vitamins and minerals. Feeding multiple times, a day, using appropriate pellet sizes, and ensuring even distribution improve feed intake and growth. Regular water quality monitoring, aeration, and water exchange maintain optimal living conditions. Incorporating probiotics and maintaining hygiene prevent disease. These practices lead to higher survival rates, faster growth, and increased production yields, making aquaculture operations more successful and profitable. The B:C ratio of fish farmers increased dramatically on adopting scientific carp culture technology compared to control farmers. This empirical study found that carp culture is profitable, with adopters of scientific technology having a gross margin more than twice that of non-adopters. This indicates that improved fish farming methods can help farmers improve their socioeconomic status.

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REFERENCES

Ali, M. H., Hossain, M. D., Hasan, A. N. G. M., & Bashar, M. A. (2008). Assessment of livelihood status ofthe fish farmers in some selected areas of Baghmara Upazilla under Rajshahi district. *Bangladesh Agricultural University, 6*(2), 367-374.

Ananth, P. N., Sahoo, P. R., Dash, A. K., Pati, B. K., Jayashankar, P. & Singh, S. R. K. (2014). A study on community based aquaculture promoted by KVK-Khordha, Odisha, India. *Current World Environment*, *9*(3), 947-951. http://dx.doi.org/10.12944/CWE.9.3.47

Anonymous (2023). About Dhenkanal District. Available at: https://dhenkanal.odisha.gov.in/about-district/about-us. Accessed on: 21 December 2023.

Biswas, A., Acharjee, S. K., & Haque, M. A. (1991). Adoption of composite fish culture in the context of some psychological orientation. *Environment and Ecology*, *9*(3), 661-663.

CEICdata.com. “India Fish Production: Odisha.” CEICdata.com, 2024, https://www.ceicdata.com/en/india/fish-production/fish-production-odisha Accessed 5 Aug. 2024.

Chouhan, P. (2015). Comparative study of fish production and earning from fish culture in two years in Barwani district, MP, India. *Research Journal of Animal, Veterinary and Fishery Sciences*, *3*(7), 5-8.

Das, B. K., Sahu, S. K., & Parida, P. K. (2021). GIS mapping of inland water bodies of Odisha, *ICAR-Central Inland Fisheries Research Institute, Barrackpore*, Sailee Press Pvt. Ltd. Kolkata pp. 256.

Debnath, C. (2024). Composite fish culture enhances fish productivity in rural Tripura, Northeast India. *Indian Farming, 74*(6), 24-27. https://epubs.icar.org.in/index.php/IndFarm/article/view/147080/55191

De, H. K., Shasani, S., Das, M. K., & Saha, G. S. (2020). An economic appraisal of composite carp culture in West Bengal. *Journal of Extension Education*, *32*(2), 6492-6499. https://doi.org/10.26725/JEE.2020.2.32.6492-6499.

De, H. K., Shasani, S., Das, M. K., Das, S., Gudipudi, S., Mahapatra, A. S., & Saha G. S. (2022). Composite carp culture in Andhra Pradesh and Odisha: A comparative study. *Indian Journal of Fisheries*, *69*(3), 36-42. https://doi.org/10.21077/ijf.2022.69.3.110946-05.

Dickson, M., Nasr-Allah, A., Kenawy, D., & Kruijssen, F. (2016). Increasing fish farm profitability through aquaculture best management practice training in Egypt. *Aquacultur*e, *465*, 172–178.

Dutta, M. P., Kalita, B., Hussain, S. M., & Bhagawati, K. (2022). Constraints in adoption of scientific fish farming in Nagaon District, Assam. *Indian Journal of Extension Education*, *58*(3), 190–192. https://doi.org/10.48165/ijee.2022.58339

Firth, C. (2002). The use of gross and net margins in the economic analysis of organic farms. In: Proceedings of the UK Organic Research 2002 Conference. *Organic Centre Wales, Institute of Rural Studies*, University of Wales Aberystwyth, pp. 285–288.

Gupta, T., & Dey, M. (2015). Socioeconomic and cultural profile of fish farmers: a study in and around the Lumding town, Nagaon district Assam. *Indian Journal of Environmental Sciences, 19*(1&2): 71-78.

Manam, V. K., & Quraishi, M. A. (2024). Comprehensive review on Indian major carps: An integrated approach to pond cultivation, nutrition, and health management for sustainable aquaculture. *International Journal of Fisheries and Aquatic Studies*, *12*(1), 1-12. http://dx.doi.org/10.22271/fish.2024.v12.i1a.2884

Mondal, A. H., Dana, S. S., & Ray, M. (2024). Management orientation of members of fish farmers producer organizations (FFPOs). *Indian Journal of Extension Education*, *60*(3), 110–113. https://doi.org/10.48165/ijee.2024.603rn05

Mondal, A., Dana, S. S., Ray, M., Kumari, N., & Karjee, R. (2024). Communication behavior of fish farmers with regard to scientific fish farming: a study from Purba Medinipur District of West Bengal. *Indian Journal of Extension Education*, *60*(2), 11-16. https://doi.org/10.48165/IJEE.2024.60202

Olasunkanmi, J. B. (2012). Economic analysis of fish farming in Osun state, south-western Nigeria. *In IIFET 2012 Tanzania*

Proceedings, Department of Fisheries and Wildlife Management, College of Agriculture, Ejigbo Osun State University, Osogbo. Nigeria.

Paik, T. K., Acharya, S. K., Chakraborty, S. K., Biswas, S., & Haque, A. (2010). Assessment of the productivity of fishery in lentic aqua system from a score of Bio-social and Techno managerial factors. *Journal of Inland Fisheries Society of India*, *42*(1), 23-32. https://doi.org/10.47780/jifsi.42.1.2010.121469

Manju Lekshmi, N., Praveen, K. V., Sreekanth, G. B., Pratap Singh, N., Vennila, A., Ratheesh Kumar, R., & Pandey, P. K. (2019). Economic Evaluation of Different Aquaculture Systems in Coastal waters of Goa, Southwest Coast of India. *Fishery Technology*, *56*, 231-241. https://epubs.icar.org.in/index.php/FT/article/view/92248

Sahoo, B., Panigrahi, A., Behera, S., & Das, S. (2021). Freshwater aquaculture in Kandhamal district prospects and potentials. *Journal of Aquaculture,* 29-36 https://doi.org/10.61885/joa.v29.2021.267.

Shasani, S., & De, H. K. (2020). Constraints to adoption of composite carp culture technology in Dhenkanal district of Odisha. *Journal of the Inland Fisheries Society of India*, *52*(1), 100-105. https://doi.org/10.47780/jifsi.52.1.2020.106550

Singh, K., (2006). Relative and marginal effects of fish production on family income inequality in Tripura: Decomposition of Gini by income sources. *Agricultural Economics Research Review, 19*, 353-366. https://doi.org/10.22004/ag.econ.57769

Singh, K. (2007). Economics and determinants of fish production and its effects on family income inequality in West Tripura District of Tripura. *Indian Journal of Agricultural Economics*, *62*(1), 113-125. https://doi.org/10.22004/ag.econ.204508

Singh, P. K. (2019). Comparative study of composite fish culture and local practices of fish culture in Surguja district of Chhattisgarh. *Journal of Krishi Vigyan*, *7*(2), 36. https://doi.org/10.5958/2349-4433.2019.00007.2.