



Adoption Behaviour of Fish Farmers towards Better Management Practices (BMPs) of Seabass Farming

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HIGHLIGHTS

- Most seabass farmers have a medium level of adoption of Better Management Practices (BMPs), influenced by factors such as age, education, income, farming experience, training, and extension contact.
- Following the water exchange in the culture system, using formulated feed and soil probiotics, and introducing check-trays to observe feed intake were adopted at its lowest level.
- The study emphasized the importance of extension services and training programs in enhancing BMP adoption, recommending phase-specific demonstrations, entrepreneurship development, and the use of experienced farmers as trainers to foster better farming practices.

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ABSTRACT

This study sought to assess the adoption behaviour of Better Management Practices (BMPs) in seabass farming among fish farmers in the Purba Medinipur district of West Bengal, India, in 2023 by constituting a randomly selected sample size of ninety from three purposefully chosen blocks in the district. It was found that a significant number of respondents were middle-aged (46.67%), had attained middle school education (46.67%), and had been farming for 6 to 10 years (60%). Most respondents (84.44%) reported seabass farming as their primary occupation and practiced it semi-intensively (77.78%). Adoption of Better Management Practices (BMPs) was moderate, with 61.11 per cent of respondents showing a medium adoption level. Key practices, which were fully adopted by most of the respondents, included using lime to maintain water quality (90%), collecting seeds from reputable hatcheries or reliable wild seed collectors (85.6%), acclimatizing seeds before release (82.2%), maintaining size variation of seeds for polyculture to prevent cannibalism (81.1%). Eight variables, namely, age, education, annual income, farming area, experience, operation intensity, training attendance, and extension agency contact, were significantly correlated ($p < 0.01$) with BMP adoption.

INTRODUCTION

The *Lates calcarifer*, commonly known as the giant sea perch, seabass, or barramundi, is a significant species in the coastal, estuarine, and freshwater environments of the Indo-Pacific region. It has a rapid growth rate, can reach large sizes, and is capable of breeding in captivity, making it highly suitable for aquaculture.

Seabasses can be cultured in brackish ponds, freshwater ponds (Ghosh, 2019), and fixed or floating net cages in coastal waters (Philipose et al., 2013; Liyanage & Pushpalatha, 2018; Wijayanto et al., 2020). There are two primary systems employed in pond culture of seabass: monoculture, where only seabass is produced, and polyculture, where seabass is cultured alongside one or more other species of wild fish, sometimes integrated with mangrove

ecosystems (Venkatachalam et al., 2018) or with species such as tilapia, milkfish, and groupers (Monwar et al., 2013). The feed for cultured Asian seabass consists of trash fish or industrial feed. Asian seabass has emerged as an ideal species for diversifying India's brackish aquaculture sector because of its good domestic market potential (CIBA, 2014). The species is gradually becoming familiar to Indian farmers, with production increasing from 278 tons in 2009–2010 to 474 tons in 2012–2013 (MPEDA, 2010, 2012, 2013). According to Future Market Insights (FMI), Asian seabass sales have grown at a compounded annual growth rate (CAGR) of 4.1 per cent between 2016 and 2020 (ASM, 2021).

Better Management Practices (BMPs) in fish culture are structured approaches designed to increase the efficiency, sustainability, and profitability of aquaculture operations, while minimizing environmental impacts. These practices address various aspects of fish farming, from hatchery to harvest, ensuring that the operations are economically viable and ecologically responsible (Pashudhan Praharee, 2020). BMPs in fish culture include compatible species selection, appropriate site selection, proper stocking and stock management, pond management, feed management, and disease prevention implemented in a scientific manner (Sivaraman et al., 2019). The process of embracing new ideas and technologies is dynamic and interactive, with the goal of fulfilling farmers' needs and invigorating the national economy (Goswami et al., 2010). Multiple investigations have found that adopting BMPs can yield better profits in various cultures, such as tilapia, rainbow trout, channel catfish, and shrimp, resulting in environmentally efficient aquaculture systems (Engle et al., 2005; Henriksson et al., 2015) and social welfare.

Currently, West Bengal produces 17.15 lakh metric tons of fish annually, which accounts for 16.75 per cent of the nation's total production (Department of Fisheries, 2020). From 2005 to 2020, the annual per capita fish consumption increased by 81.43 per cent, highlighting the growing demand for fish in the country, even individuals who now eat fish (Padiyar et al., 2024). One of the key elements in raising fish production is farmers' acceptance of advised scientific fish farming techniques. Linkages with formal financial institutions, subsidized input support from the fishery department, and investment in the human resource development of farmers might be some points of intervention to boost fish culture in the coastal zone of West Bengal, India (Ghosh et al., 2022).

METHODOLOGY

The current study was conducted in the meticulously selected Medinipur district of West Bengal in 2023 utilizing an ex-post facto research design. The district was chosen on purpose because of its abundant and varied brackish and inland water fisheries, which are perfect for scientific fish rearing. Tamluk, Haldia, Egra, and Contai are the four subdivisions of the Purba Medinipur District. This district contains 25 blocks, of which 16 are brackish water blocks. From 16 brackish water blocks, three blocks were selected, namely Contai-I, Deshopran (contai-II), and Ramnagar-II, as there was the highest concentration of seabass farmers as reported by block fishery officers in the year of 2023. Thirty farmers are selected from each block. Thus, 90 farmers constituted the respondents to the study by simple random sampling without replacement.

Primary data were acquired with the help of a structured interview schedule created specifically for the study and direct observation methods. Secondary data were obtained from the official records of the government, sectors, and gram panchayats. Better management practices (BMPs) for seabass consist of standardized management practices to culture them properly in a scientific way. In this study, a total of eighteen standard BMPs were recorded from various studies and expert opinions. The dependent variable, adoption behaviour of the respondents towards Better Management Practices (BMPs) of seabass fish culture, was employed using the approach outlined by Sinha and Kolta (1974), followed by Goswami et al., (2010), with necessary modifications. Scores of 2, 1, and 0 were assigned to full, partial, and non-adoption, respectively. Adoption quotients were calculated from raw scores to gauge the overall adoption level. In this study, the adoption quotient by Sengupta (1967) was applied using the following formula to determine the general adoption level:

$$\text{Adoption quotient} = \frac{\text{Adoption score of the respondents}}{\text{Maximum adoption score one could get}} \times 100$$

Thus, after computing the individual adoption quotient scores, the respondents were categorized into three groups with a mean and standard deviation as a measure of check. The relationship between two categorical variables of such independent variables and adoption behaviour was checked by implementing a non-parametric test of chi-square value estimation to draw a conclusion.

RESULTS

Demographic profile of the respondents

The study examining various factors related to seabass farming, several variables were analyzed across different categories. Regarding age distribution, 46.67 per cent of respondents fell within the middle age category. Education levels varied, with the highest proportion having completed middle school (46.67%). Notably, a significant portion had a moderate annual income ranging from 1 to 3 lakhs (51.1%). Primary occupational status in seabass culture was predominant at 84.44 per cent. Ownership of farming areas was divided among those who owned their land (55.56%). Farming experience varied, with the majority having moderate experience (60%). Semi-intensive farming operations were most prevalent (77.78%). Extension agency contacts were diverse, with private company consultants/input dealers being the most frequent (41.11%). The number of trainings attended on seabass farming varied, with 36.67 per cent attending only one. In the case of scientific orientation, 46.67 per cent of respondents possessed medium level of orientation.

Adoption level of BMPs of seabass farming

Respondents' adoption levels of Best Management Practices (BMPs) in seabass farming varied across three categories, presented in Figure 1. The majority fell within the medium adoption level range, comprising 61.11 per cent of the respondents. Following this, 18.89 per cent of respondents demonstrated a high level of adoption, while 20 per cent exhibited a low adoption level.

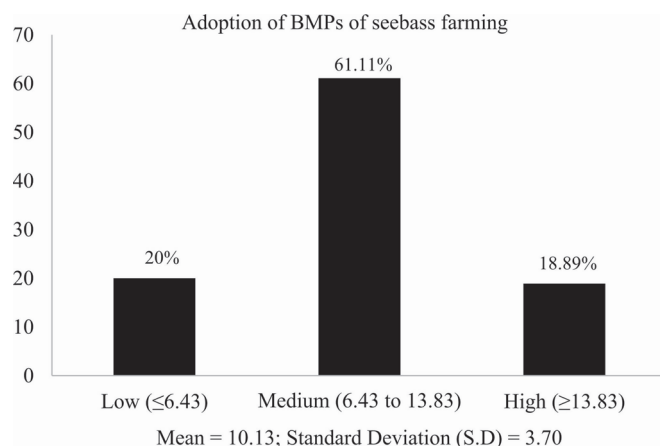


Figure 1. Distribution of respondents according to adoption level of BMPs of seabass farming

Table 1 represents the level of adoption of various BMPs by the seabass farmers. It was seen that several practices were fully adopted by most of the respondents, like using lime to maintain water quality (90%), collecting seeds from reputable hatcheries or reliable wild seed collectors (85.6%), acclimatizing seeds before release (82.2%), maintaining size variation of seeds for polyculture to prevent cannibalism (81.1%), using trash fish feed for proper diet feeding (74.74%), maintaining the stocking density (72.2%), treating seeds with KMnO_4 before stocking (70%), and being aware of various diseases and consulting with fellow farmers and fishery experts (67.8%). The highest percentage of partial adoption of several BMPs were seen, like uses

of medicines in specific doses and using only CAA-approved medicine (47.8%), maintaining the proper depth of water (45.6%), using basic chemicals like zeolite and iodine compounds for proper pond management (37.8%), and conducting routine pond maintenance activities (36.6%). Some BMPs are still not adopted by the respondents, like following the water exchange in the culture system (51.1%), using formulated feed and soil probiotics (26.8%), and introducing check-trays to observe feed intake (23.3%).

Significant associations were found between demographic variables and the adoption behaviour towards Better Management Practices (BMPs) of seabass farming among the respondents ($N=90$), as indicated by Pearson's χ^2 values, are presented in Table 2. The variables age ($\chi^2 = 128.945^*$), education ($\chi^2 = 119.581^*$), farming area ($\chi^2 = 105.811^*$), annual income ($\chi^2 = 101.522^*$), farming experience ($\chi^2 = 92.952^*$), intensity of operation of farming ($\chi^2 = 92.773^*$), number of trainings attended ($\chi^2 = 151.715^*$), and extension agency contact ($\chi^2 = 133.101^*$) showed significant associations at a probability level of 0.01. While also estimation of Cramer's V value in Chi-statistics (Lee, 2016), it is also pointed out that all these variables have the strong (Cramer's V 0.60 – 0.80) to very strong (Cramer's V 0.80 – 1.00) relationship with adoption behaviour.

DISCUSSION

The distribution of respondents' adoption levels of Better Management Practices (BMPs) in seabass farming, as depicted in Figure 1, revealed that the majority of respondents fell within the medium adoption level range, comprising 61.11 per cent (Goswami et al., 2010; Goswami et al., 2012; Dana et al., 2018; Shil et al., 2022), indicating a moderate uptake of BMPs in seabass farming practices. However, 18.89 per cent of respondents demonstrated a

Table 1. Adoption of BMPs of seabass farming by the respondents

S.No.	Statement	Full adoption (%)	Partial adoption (%)	Non-adoption (%)
1	Collect the seeds from reputable hatchery/reliable wild seed collector	85.6	14.4	-
2	Follow the practice of selecting seeds of uniform size and colour which are actively able to swim against water current	65.6	24.4	10
3	Maintain the criteria of acclimatization before release the seed	82.2	17.8	-
4	Treat seeds with potassium permanganate (KMnO_4) before stocking	70	26.6	3.4
5	Conduct routine pond maintenance activities such as vegetation control, bank stabilization, and infrastructure repairs to ensure optimal pond conditions	46.7	36.6	16.7
6	Maintain the depth of at least 80 cm at the shallowest part of the pond and overall, 1.5 m water depth	32.2	45.6	22.2
7	Maintain the stocking density: Fry (1.0-1.5 cm) @ 40-50 nos./m ² : Advanced fingerlings (80-100 g) @ 25-30 nos./m ³	72.2	24.5	3.3
8	Maintain the size variation of seeds for polyculture to stop cannibalism	81.1	18.9	-
9	Regularly monitor water quality parameters such as pH, salinity, D.O, ammonia level	70	23.3	6.7
10	Use of trash fish feed for proper diet feeding	74.4	20	5.6
11	Introducing check-trays after one week of stocking to observe feed intake	26.7	50	23.3
12	Use formulated feed and soil probiotics	38.8	34.4	26.8
13	Follow water exchange in culture system	23.3	25.6	51.1
14	Follow the practice of regular health check-up and keep the expired seeds away from pond	65.6	34.4	-
15	Using lime to maintains the water quality	90	10	-
16	Using the basic chemicals like zeolite, iodine compounds for proper pond management	62.2	37.8	-
17	Aware about uses of medicines in a particular given dose and use CAA approved medicine only	26.7	47.8	25.5
18	Aware about various diseases and consult with fellow farmers and fishery expert person	67.8	25.5	6.7

Table 2. Association between demographic profile and adoption of BMPs of seabass (*Lates calcarifer*) farming

Variable	Category	Adoption Behaviour towards BMPs of seabass farming			Pearson χ^2 value (Chi square value)
		Low (%)	Medium (%)	High (%)	
Age	Young (18-35 years.)	3.6	11	3.4	128.945* Cramer's V value = .85
	Middle (>35-60years)	8.4	25.7	7.9	
	Old (>60 years)	6	18.3	5.7	
Education	Up to Primary (Up to 4th standard)	2.6	7.9	2.5	119.581* Cramer's V value = .81
	Middle school (Up to 8th standard)	8.4	25.7	7.9	
	Secondary level (Up to 10th standard)	4.8	14.7	4.5	
	Higher Secondary level (Up to 12th standard)	2.2	6.7	2.1	
Farming area	Marginal (Up to 4 Bigha)	4.2	12	4.0	105.811* Cramer's V value = .77
	Small (4 to 6 Bigha)	7.2	22.0	6.8	
	Large (More than 6 Bigha)	6.6	20.2	6.2	
Annual income	Low annual income (Rs. <1 lakh)	2.6	7.9	2.5	101.522* Cramer's V value = .75
	Medium annual income (Rs. 1 lakh to 3 lakhs)	9.6	29.3	9.1	
	High annual income (Rs. >3 lakhs)	5.8	17.7	5.5	
Farming experience	Short term experience (Up to 5 years)	5.4	16.5	5.1	92.952* Cramer's V value = .72
	Moderate experience (Between 6 to 10 years)	10.8	33.0	10.2	
	Long term experience (Above 10 years)	1.8	5.5	1.7	
Intensity of operation of farming	Traditional	2.8	8.6	2.6	92.773* Cramer's V value = .83
	Semi-intensive	14.0	42.8	13.2	
	Intensive	1.2	3.7	1.1	
Number of trainings attended	No training attended	4.4	13.4	4.2	151.715* Cramer's V value = .92
	Only one training attended	6.6	20.2	6.2	
	Only two training attended	3.8	11.6	3.6	
	Only three training attended	2.0	6.1	1.9	
	Four or more training attended	1.2	3.7	5.5	
Extension agency contact (Most often contact)	Government officials/Fishery Extension Officer	3.2	9.8	3.0	133.101* Cramer's V value = .86
	Private company consultant/Input dealers	7.2	22.0	6.8	
	KVK (Subject matter specialist)	1.0	3.1	0.9	
	Fisheries institute	1.8	5.5	1.7	
	NGOs	4.8	14.7	4.5	

*Significant at 0.01 level of probability

high level of adoption, while 20 per cent exhibited a low adoption level. The availability of extension services and support from government agencies, private experts, and non-governmental organizations (NGOs) might influence farmers' adoption decisions. Socioeconomic factors such as age, education, farming experience, and income level could also shape farmers' attitudes towards BMP adoption. Research and targeted interventions aimed at addressing the specific needs and constraints of seabass farmers can help promote greater adoption of BMPs, ultimately contributing to the sustainability and productivity of seabass farming practices. The high adoption rates of BMPs, such as using lime to maintain water quality and collecting seeds from reputable hatcheries, may be influenced by the availability of resources and support systems (Uttej et al., 2023). Farmers are likely to adopt practices that are easily accessible, cost-effective, and supported by extension services or government initiatives (Ogunremi and Oladele, 2012). The lower adoption rates of certain BMPs, such as using formulated feed (Singas & Manus, 2014) and soil probiotics or adhering to specific medication guidelines (Uttej et al., 2023), due to barriers such as limited awareness, inadequate training, or perceived costs and

benefits. Adoption behaviour may also be influenced by social and cultural variables (Adesehinwa & Bolorunduro, 2007). The availability of technical support and guidance from extension agencies, private consultants, or peer networks influences farmers' decisions to adopt certain BMPs. The varying adoption levels of BMPs among seabass farmers underscore the importance of addressing the diverse needs and constraints of farmers through targeted extension programs, capacity-building initiatives, and policy interventions (Uttej et al., 2023). By addressing the fundamental roots of the adoption behaviour, stakeholders can promote the uptake of sustainable farming practices and enhance the productivity and resilience of seabass farming systems (Saha et al., 2016). The chi-square test indicated that various factors had a significant association with different levels of adoption of Better Management Practices. According to the estimation of Cramer's V value in Chi-statistics, it is revealed that, among all the variables, the number of trainings attended, extension agency contact, age of the respondents and education had strong to very strong relationship with adoption behaviour (Talukdar & Sontaki, 2005; Goswami et al., 2012; Borah et al., 2019). By addressing these

factors, stakeholders can facilitate the transition towards more sustainable and efficient farming practices, ultimately contributing to the long-term viability and resilience of the seabass farming sector.

CONCLUSION

The study on seabass farming in Purba Medinipur district highlights the current state of farming practices. It reveals that most seabass farmers have a medium level of adoption of Better Management Practices (BMPs), influenced by factors such as age, education, income, farming experience, training, and extension contact. To improve BMP adoption, the study emphasizes the need for targeted educational efforts and training programs focused on profitable culture practices and marketing tactics. Enhancing access to critical inputs, reducing middlemen, and leveraging extension activities through various agencies and ICT are crucial. Strategies should include phase-specific demonstrations, entrepreneurship training, and using experienced farmers as 'master trainers.' Establishing a Farmer-to-Farmer (F2F) communication network can further facilitate knowledge exchange and the adoption of scientific practices. Addressing these factors can enhance the productivity and sustainability of seabass farming in West Bengal and similar coastal regions in India.

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