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Assessing the knowledge of fish growers in the northeastern Ghats of Odisha: A study of their understanding on fish farming practices

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Abstract
The purpose of the study was to determine fish farmers' knowledge of scientific fish farming techniques in the Ganjam district of Odisha. The majority of fish farmers (50.8%) had a moderate degree of understanding in this area, according to the report. The knowledge of acceptable stocking rates in composite fish culture was found to be lowest (18.33%) and the highest (91.67%) among fish farmers regarding manure application in fish ponds. The majority of fish farmers who participated in the poll were middle-aged or younger, and most had only completed elementary or middle school. The majority of fish farmers showed a medium degree of inventive proneness, risk orientation, economic drive, and value orientation. They also had low to medium degrees of expertise in fish farming. Nonetheless, the majority of farmers exhibited a low degree of credit inclination. Most fish farmers showed a medium level of interest in mass media and in touch with extension agencies; however, they were not very cosmopolitan. The most important aspect that positively impacted the fish farmers' knowledge, according to the path analysis, was their propensity for innovation. It is advised that awareness campaigns, field days, demonstrations, exhibitions, Kissan Gosti, Kissan Mela, and other initiatives of a similar nature be held in order to raise the level of knowledge among fish farmers regarding scientific fish culture practices. These activities will also help to increase innovative proneness, contact with extension agencies, and participation from the mass media. Through these initiatives, fish farmers will be able to acquire the most recent information and expertise needed for productive fish farming methods.

Keywords: Knowledge, fish farmers, scientific fish farming

Introduction
Fish is a critical contributor to global food and nutrition security. With its rich protein content, essential micronutrients, and fatty acids, it is considered one of the most affordable and frequently consumed animal sources of food. As one of the fastest-growing food-producing sectors, fisheries and aquaculture plays a crucial role in economic development, generating livelihood opportunities, and enhancing national income.

In addition to providing direct income and improving food security, fisheries and aquaculture also have significant potential in promoting women's empowerment and social inclusivity as part of the larger national development agenda. By creating opportunities for women to participate in the sector, fisheries and aquaculture can help break down gender barriers and empower women to become active contributors to their communities' economic and social development, Sarangi *et al*. (2005) [14].

Furthermore, fisheries and aquaculture can help promote social inclusivity by providing employment opportunities to marginalized communities, including indigenous people, ethnic minorities, and rural populations. This sector can play a pivotal role in bridging social and economic inequalities by creating sustainable livelihood options for these communities. Overall, the fisheries and aquaculture sector is a crucial component of global food and nutrition security, economic development, and social inclusivity. It holds enormous potential to contribute to national development agendas by promoting gender equality, social inclusivity, and sustainable livelihoods, Tongia (2019) [19].

Being a coastal state, Odisha offers several chances for the growth of marine, brackish water, and inland fisheries. With its 480-kilometer coastline, 6.86 lakh hectares of freshwater resources, and 4.18 lakh hectares of brackish water resources, the state offers enormous potential for the development of the fishing industry.

By developing capture, culture, and culture-based capture fisheries, these resources can be effectively used to meet domestic market demands, boost export revenue, and produce a significant amount more fish. In addition, it can improve the food, nutrition, and livelihood security of women and youth in rural areas as well as create jobs and income opportunities for them. In order to achieve a farm productivity of five tons per hectare in aquaculture, the government has set a target of doubling inland fish production and raising exports to Rs. 20,000 crores in five years. Sustainable agricultural intensification is emphasized in this process. During the 2019–20 season, the state produced 8.16 lakh metric tons of fish overall.

To support this ambitious target, the government is committed to improving aquaculture productivity, modernizing fisheries infrastructure, and promoting fish-based entrepreneurship. Odisha has a tentative annual per capita fish consumption of 16.24 kg, which indicates the considerable potential for the fisheries sector to continue growing and developing. Overall, the fisheries sector in Odisha is poised for significant growth and development, with immense potential to generate employment, enhance incomes, and improve the livelihoods of rural communities while also meeting domestic market demands and boosting export earnings.

With the goal of being a pioneer in aquaculture development and fisheries extension, the government of Odisha presented the "Odisha Fisheries Policy 2015" in September 2015. Its objectives include guaranteeing food security, livelihood, fisher welfare, and the creation of jobs. The goal of the policy is to support the sustainable use, preservation, and improvement of the fisher community's access to food and a stable income.

In addition to addressing social and environmental aspects, the strategy also addresses inadequacies in the legal and regulatory framework, their enforcement, the administrative structure, and finance methods such as subsidies, technology, and extension support. As part of the Odisha Agriculture Policy, SAMRUDDHI - 2020, the policy was updated and revised to guarantee the holistic growth of the fisheries sector.

The Odisha Fisheries Policy aims to provide an integrated approach to the development of the fisheries sector and fish farmers in the state. The policy's holistic approach and focus on sustainability, social welfare, and technological advancement reflect the government's commitment to promoting the growth of the fisheries sector while safeguarding the welfare of the fisher community. With this line the KVKs under OUAT/ICAR in the state are taking several initiatives for the development of fisheries sector in their respective districts. Krishi Vigyan Kendras (KVKs) are agricultural extension centers established by the Indian Council of Agricultural Research (ICAR) for providing need-based technological support to farmers. Inland fish farming is one of the key focus areas of KVKs across the country, including Odisha.

The bountiful aquatic resources of Ganjam District make it a prime destination for aquaculture in the state. With freshwater resources spanning 11,580.0 hectares, brackish water resources spanning 4,023.04 hectares, and a 60-kilometer coastline for marine fisheries, the district offers a wealth of opportunities for pond culture, reservoir fisheries, and shrimp culture. These resources are ideal for sustainable aquaculture practices that can provide a reliable source of income and nutrition for the local communities while preserving the natural ecosystem.

Materials and Methods

To promote scientific and sustainable fish farming practices, KVK, Ganjam-I provides training and capacity building programs to the farmers on various aspects of inland fish farming, such as pond preparation, seed selection, nursery management, stocking density, feeding, water quality management, disease control, and post-harvest handling. KVK also conducts on-farm trials and frontline demonstrations to showcase the latest technologies and best practices in fish farming, such as integrated fish farming with poultry, agriculture and horticulture. These activities aim to improve the productivity, profitability, and sustainability of fish farming systems, as well as enhance the socio-economic well-being of the fish farmers. Overall, KVK, Ganjam-I plays a crucial role in Ganjam district for empowering the inland fish farmers with knowledge, skills, and technologies to adopt innovative and profitable fish farming practices and improve their livelihoods.

The present research employed an ex-post facto research design during 2020-21 to study the inland fishery resources in Ganjam district of Odisha. Purposive and systematic random sampling techniques were combined. Four development blocks, Bhanjanagar, Jagannathprasad, Aska and Surada, were selected as they had a high number of fish farmers among the population. Simple random sampling was used to select three Gram Panchayats (GPs) from each block, making a total of twelve GPs for the study. A list of fish farmers was prepared in the selected Gram Panchayats, and the farmers were stratified based on the number of fish farmers. Proportionate stratified random sampling was used to select fish farmers from each GP. The study had a total of 120 fish farmers, proportionate to the number of farmers in each Gram Panchayat.

A teacher-designed knowledge test was administered to measure the knowledge of participants. The test included 41 questions, with each correct response being assigned one point. Therefore, the maximum score for knowledge was 41, while the minimum score could be zero. The level of knowledge was determined by the following formula.

$$0\text{Extent of knowledge} = \frac{\text{No of correct responses}}{\text{Total number of items}} \text{ X } 100$$

Twenty-three independent factors with the potential to affect the dependent variables were chosen for the study after a thorough review of relevant literature and discussion with subject matter experts. These elements included the participants' socio-personal, socio-economic, communicational, psychological, and situational aspects. Scott *et al*. (2004) [15] established techniques and scales for measuring these variables previously used in empirical research. Personal interviews were used to collect the data, and a pretested, structured interview schedule created especially for this study was used.

Results and Discussion

Most fish farmers were in the middle aged or younger. The majority had finished their elementary and middle school education. The majority of them had low to medium expertise in fish farming, which is consistent with the findings of Arjun (2013) [3], Kumar *et al*. (2018) [5], and Meeran (1983) [7]. Since they had other sources of income, many of them belonged to the high-income group despite having tiny land

holdings and little social engagement. Fish culture was the next most important primary occupation after agriculture. The majority of those surveyed thought of fish culture as a side job.

A medium level of inventive proneness, risk orientation, economic drive, and value orientation was exhibited by most of the farmers. On the other hand, the majority of farmers showed little interest in taking out loans. Their cosmopoliteness was minimal, and they had only a moderate amount of interaction with extension agencies and mainstream media. Most of the study's ponds were medium-sized, dependent on rainwater, and had low to moderate water holding capacities. Weeds dominated most of these ponds, with infestation levels ranging from mild to moderate.

The degree to which respondents knew specifics about advised scientific fish farming practises in the study area was considered knowledge in this study.

a. Knowledge level of fish farmers regarding scientific fish culture practices

According to Table 1's findings, of the 120 fish farmers, 61, or 50.8%, had a medium level of knowledge, followed by 33, or 27.5 percent, who had a high level of knowledge, and 26 (21.7%) who had a poor level of knowledge. This is in line with the results of earlier research by Ahmad *et al*. (2012) [4], Awasthi *et al*. (2000) [1], Mahendra Kumar (1996) [6], Meeran (1983) [7], and Abhay *et al*. (2018) [2], who similarly found that most fish farmers knew just a moderate amount about fish rearing techniques. It is often recognised that education has a significant role in broadening one's knowledge by providing exposure to a variety of information sources.

Table 1: A quantified summary of fish farmers' socio-personal, socio-economic, communication psychological, and situational traits

S. No.	Variable	Fish farmers	
		No.	%
A.	**Socio-personal variable**		
1.	**Age**		
	Young (>30 years)	44	36.7
	Middle (31 to 45 years)	57	47.5
	Old (46 years and <)	19	15.8
2.	**Caste**		
	General	70	58.3
	SC	39	32.5
	ST	11	9.2
3.	**Family size**		
	Small family (< 5 members)	60	50
	Large family (>5 members)	60	50
4.	**Family type**		
	Nuclear	66	55
	Joint	54	45
5.	**Education**		
	Illiterate	5	4.2
	Can read and write	10	8.2
	Primary school	34	28.3
	Middle school	38	31.7
	Secondary school	17	14.2
	Higher secondary	11	9.2
	Graduation	5	4.2
6.	**Fish farming experiences**		
	Low (> 2 years)	55	45.8
	Medium (3 to 6 years)	53	44.2
	High (7 years and <)	12	10.0
B.	**Socio-economic variables**		
7.	**Occupation**		
	Main occupation	29	24.2
	Secondary occupation	91	75.8
8.	**Annual income**		
	Up to Rs. 0.11 lakh	8	6.67
	Rs. 0.11 lakh to Rs 0.22 lakh	22	18.33
	Rs. 0.22 lakh to Rs 0.33lakh	10	8.33
	Above Rs 0.33 lakh	80	66.67
9.	**Size of land holding**		
	Up to 2 acres	74	61.66
	2 to 5 acres	26	21.67
	More than 5 acres	20	16.67
10.	**Social participation**		
	Low social participation	55	45.8
	Medium social participation	47	39.2
	High social participation	18	15
11.	**Possession of fishing equipment**		
	No fishing equipment	49	40.8
	Having fishing equipments	71	59.2

C.	**Communication variables**		
12.	**Mass media participation**		
	Low	45	37.5
	Medium	51	42.5
	High	24	20.0
13.	**Extension agency contact**		
	Low	32	26.7
	Medium	67	55.8
	High	21	17.5
14.	Cosmopoliteness		
	Low	49	40.8
	Medium	29	24.2
	High	42	35.0
D.	**Psychological variable**		
15.	**Innovative proneness**		
	Low	36	30.0
	Medium	50	41.7
	High	34	28.3
16.	**Credit orientation**		
	Low	49	40.8
	Medium	42	35.0
	High	29	24.2
17.	**Value orientation**		
	Low	37	30.8
	Medium	56	46.7
	High	27	22.5
18.	**Risk orientation**		
	Low	35	29.2
	Medium	61	50.8
	High	24	21.0
19.	**Economic motivation**		
	Low	36	30.0
	Medium	49	40.8
	High	35	29.2
E.	**Situational variable**		
20.	**Size of water body**		
	Up to 0.318 ha	16	13.33
	0.319 ha to 0.862 ha	79	65.83
	Above 0.862 ha	25	20.84
21.	**Duration of water availability**		
	Short and medium	64	53.3
	Long seasonal	56	46.7
22.	**Source of water**		
	Rain water	114	95
	Canal	0	0
	Both rain and canal	6	5
23.	**Extent of weed infestation**		
	Completely chocked	0	0
	Moderate extent	36	30.0
	Low extent	43	35.8
	No weeds	41	34.2

These findings imply that there may be room for improvement in respondents' knowledge, moving them from the medium to the high group. Similar to previous studies by Okwu *et al*. (2005) [8], Praveena (1993) [9], and Ranjan *et al*. (2017) [11], policy makers and extension workers should effectively use a variety of teaching methods to improve the socio-economic conditions of fishermen, including demonstration, field days, on-farm testing, exhibitions, film shows, educational tours, campaigns, farm clinics, seminars, workshops, and information and communication technologies like radio, TV, different audio-visual aids, and the internet. This will contribute to raising the level of understanding regarding marketing and cultural practices, among other areas of scientific fish culture.

Table 2: Distribution of respondents based on their level of knowledge of fish farmers towards scientific fish culture

(N= 120)

Category	No.	%	Mean	SD
Low	26	21.7	74.22	11.8
Medium	61	50.8		
High	33	27.5		

b. Fishermen's level of knowledge of a certain recommended scientific fish culture

Upon examining Table 2, it is evident that a noteworthy proportion of fish farmers demonstrated precise understanding concerning diverse facets of fish culture methodologies. Table 3 reveals that a significant number of participants were aware of the following topics: common organic manures used in fish

culture (88.33%), the significance of liming fish ponds (90.83%), and appropriate soil for fish culture (87.50%). The respondents also demonstrated awareness of the names of certain aquatic weeds (77.5%), the names of Indian Major Carps (85.83%), the need to eradicate excess aquatic weeds (80%), and the names of predatory and weed fish (81.67%), including the names of such fish (77.5%). Furthermore, a sizable portion of participants (78.33%) were aware of the significance of additional feeds. These findings suggest that fish farmers are somewhat knowledgeable about scientific methods for raising fish.

According to the study's results, fish farmers' expertise on a variety of topics ranged from 50% to 65%. The knowledge of the fish farmers was relatively high regarding things like how to fix acidic pond water (63.33%), how much lime is the right amount to use (55.35%), the benefits of manuring (59.17%), how much organic manure is needed (62.5%), the names of exotic carps (51.67%), which major carps grow the fastest (658.3%), which species combination is used in composite fish culture (60%), how big fish seed should be for stocking (60%), and the recommended manuring schedule to be followed after stocking (63.33%) the management of water quality (Including the need to cease feeding and manuring) (61.7%), the names of fish diseases (55.63%), and disease prevention techniques (52.50%).

The table that is being displayed demonstrates how many fish farmers lacked the necessary understanding about certain topics. For example, the majority of farmers did not know the minimum depth of water needed, the nutrients needed to produce fish food, the benefits of using inorganic fertilizers, the names of piscicides, how to apply mohua oil cake, how to eradicate weed and predatory fish, the ideal size for harvesting, when to harvest, or the necessity of growth monitoring. Additionally, the table shows that only a small percentage of farmers were aware of the proper stocking density of various fish species (18.33%) and the recommended feeding rate of supplemental feed (19.17%). These findings are fairly consistent with those of earlier studies by Som *et al*. (2020) [19] and Mahendra (1996) [6].

Therefore, it can be concluded that although fish farmers are knowledgeable about the fundamentals and standard procedures involved in fish farming, they are not sufficiently knowledgeable about scientific fish farming. Poor communication skills, a lackluster scientific curriculum in training programmes, and a limited educational background could all be contributing causes to this. Regarding the application rate of manures, fertilizers, and diseases, similar findings were reported by Pourouchottamane *et al*. (2012) [10], Roy *et al*. (2019) [12], and RJ Young (2023) [13]. Praveena (1993) [9] also reported similar findings.

Innovative proneness had the strongest positive effect on farmers' knowledge, according to the path analysis results, which are shown in Table 4. This variable was indirectly impacting knowledge through involvement in the mass media, interaction with extension agencies, and risk orientation. It had the largest directed effect (0.3613). Indeed, seven factors were discovered to use creative proneness as a means of exerting their indirect influence, demonstrating the important role that inventive proneness plays in knowledge enhancement.

Table 3: Fish farmers' level of knowledge with respect to particular aspects of the scientifically prescribed fish culture

Sl. No.	Practices	Responses (yes)	
		No.	%
A	**Pre-stocking practices**		
1.	Good soil type for fish culture	105	87.50
2.	Minimum depth of water required for fish culture	26	21.67
3.	Nutrients required for production of natural fish food organisms in fish pond	47	39.17
4.	Use of lime in fish culture	109	90.83
5.	Correction in acidic condition of fish culture pond / tank	76	63.33
6.	Recommended dosage of lime used in general	66	55.00
7.	Use of manure the fish culture ponds	110	91.67
8.	Advantages of manuring fish culture pond	71	59.17
9.	Name of some common organic manures used in fish culture	106	88.33
10	Rate of application of cow dung (including initial dose and subsequent monthly doses)	77	64.17
11.	Days interval in between manure application stocking of fish seed	35	29.17
12.	Use of inorganic fertilizers in addition to organic manures in fish culture	74	61.67
13.	Advantages of using inorganic fertilizer	34	28.33
14.	Necessity to eradicate excess aquatic weeds	96	80.00
15.	Name some aquatic weeds	93	77.50
16.	Desirability of predatory and weed fishes	98	81.67
17.	Mention any two predatory and two weed fishes.	93	77.50
18	Manual method of eradication / control of predatory and weed fishes	46	38.33
19.	Name any piscide used in fish culture	36	30.00
20.	Recommended dosage of mohua oil cake or bleaching powder	33	27.50
B	**Stocking practices**		
21.	Name three Indian major carps	103	85.83
22.	Name three exotic carps	62	51.67
23.	The fastest growing major carp and exotic carp	79	65.83
24.	Catla and silver carp are surface feeders.	44	36.67
25.	Rohu is a column feeder Mrigal feeds on bottom vegetation	94	78.33
C	**Common carp is omnivorous**		
26.	Type of fish grows well in weed infested ponds	22	18.33
27.	Recommended rate stocking for irrigation tanks when CFC is practiced	73	60.83
28.	The recommended species combination for composite fish culture		
	3 SSP – 400 C : 300 R : 300 M (or 300 CC)		

	4 SSP – 300 C : 250 R : 150 M : 300 CC		
	6 SSP – 150 C : 250 R : 100 M : 200 SC : 100 GC : 200 CC		
29.	The ideal size of fish seed for stocking	72	60.0
D	**Post stocking practices**		
30.	Necessity of supplementary feeding	94	78.33
31.	Name the commonly used supplementary feeds.	94	78.33
32.	Best method of feeding	67	55.83
33.	Rate of supplementary feeding	23	19.17
34.	Time of manuring after stocking	97	80.83
35.	The recommended manuring schedule to be practiced after stocking	76	63.33
36.	Indicators of oxygen depletion in fish pond	98	81.67
37.	Necessary to stop manuring and feeding when pond water turns greenish	75	62.50
38.	Name any fish disease that occurs in fish culture ponds	67	55.83
39.	Control disease outbreaks	63	52.50
40.	Necessary to check the growth after stocking	58	48.33
41.	In general, after how many months of stocking should the fish crop be harvested	43	35.83
42.	The optimum size of harvesting	46	38.33

Table 4: Path analysis of selected independent variables with knowledge of fish farmers towards scientific fish culture practices

Variables	Correlation coefficient	Direct effects	Rank	Total indirect	Rank	Variables through which substantial indirect effects are channeled through		
						I	II	III
Socio-personal								
X5 Education	0.3150	0.1161	5	0.1954	12	0.1284 (X15)	0.0899(X13)	0.0618(X12)
X6 Fish farming experience	0.3295	0.1049	6	0.2246	11	0.1453(X13)	0.0463(X15)	0.0340(X14)
Socioeconomic								
X8 Annual income	0.2407	0.0410	10	0.2371	10	0.1015 (X15)	0.053(X12)	0.037(X13)
X9 Land holding	0.2027	0.0423	9	0.2501	6	0.0704(X15)	0.042(X17)	0.037(X19)
X10 Social participation	0.2831	0.0432	8	0.2406	8	0.0775(X13)	0.065(X15)	0.035(X14)
Communication								
X12 Mass media participation	0.3771	0.1240	4	0.2470	7	0.0385(X13)	0.0214(X15)	0.0112(X18)
X13 Extension agency contact	0.4202	0.2217	2	0.2403	9	0.1160(X12)	0.0597(X15)	0.00485(X19)
X14 Cosmo-politeness	0.4312	0.0529	7	0.4823	2	0.2390(X15)	0.1238(X13)	0.0582(X12)
Psychological								
X15 Innovative proneness	0.5160	0.3613	1	0.2847	5	0.1471(X12)	0.0534(X13)	0.0494(X18)
X17 Value orientation	0.4920	0.1794	3	0.3654	4	0.1943(X13)	0.1137(X12)	0.0597(X15)
X18 Risk orientation	0.5127	0.0235	12	0.4221	3	0.1278(X15)	0.0.0617(X12)	0.0540(X5)
X19 Economic motivation	0.4093	0.007	13	0.5004	1	0.2272(X18)	0.1310(X13)	0.0529(X10)
Situational								
X23 Extent of weed infestation	0.1963	0.034	11	0.1885	13	0.0576(X10)	0.0528 (X19)	0.0264(X14)

Residual effect: 0.4593

With a correlation coefficient of 0.4202**, a direct effect of 0.2217, and an indirect effect of 0.2403 on farmers' knowledge, extension agency contact was the second most significant variable. The combined indirect effect of this variable was mediated by involvement in the media, propensity for innovation, and financial incentive. Nine variables were using it to exercise their indirect influence. Similar findings published by Singh *et al*. (2014) [16], Som *et al*. (2019) [17], and Urdy (2009) [20], it is logical to predict that farmers who had more interaction with extension organizations would be more interested in learning about scientific fish farming practices.

It was also shown that there was a substantial positive correlation and contribution from mass media engagement to the variation in farmers' knowledge. With an additive direct effect (0.1240) and total indirect effect (0.2470), it was possible for farmers to learn more about scientific fish farming techniques if they were exposed to more mass media, including radio, television, and newspapers.

Conclusion

According to the study's findings overall, the majority of respondents (50.8%) knew a decent amount about scientific fish farming. It is advised that inventive proneness, communication with extension agencies, and mass media involvement be expanded in order to improve this scenario. In order to facilitate farmers' access to the most recent information regarding scientific fish culture practises, technology dissemination systems ought to concentrate on planning awareness campaigns, field days, demonstrations, exhibitions, kissan gosti, kissan mela, and other events. To enhance the process of reorienting the fishery extension system and offer farmers technical and input support, authorities should also create and oversee a visitation schedule for extension officials and implement an assessment system at the highest level.

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