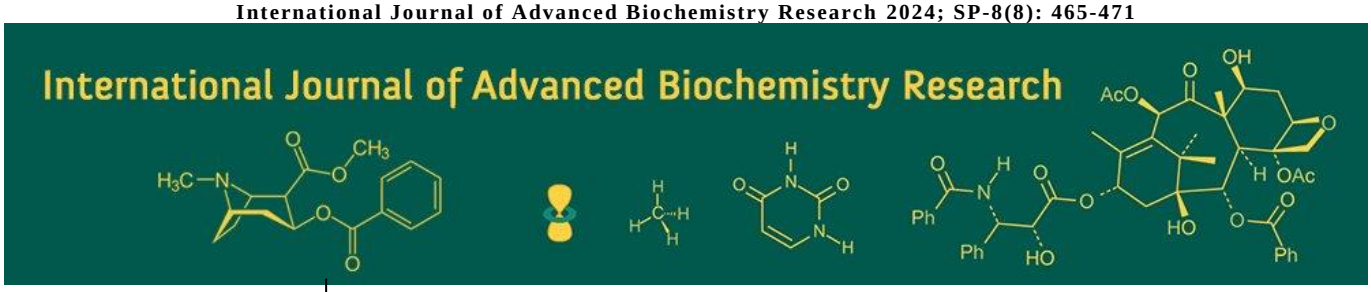

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The adoption gap of scientific fish farming practice among fish farmers of Tripura in relation to Pabda (*Ompok bimaculatus,* bloch 1794)

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Abstract
An attempted has been made to identify the adoption of scientific practices in Pabda fish farming. The study was carried out on two different blocks (Bishalgarh & Jampuijala) and select 50 farmers for socioeconomic factors like age, education, and land ownership significantly influence adoption rates. The study reveals higher adoption in Bishalgarh compared to Jampuijala, highlighting "adoption gaps" for practices like water testing and weeds control. Recommendations to bridge these gaps include hormone injection for breeding, management of cannibalism, and multifaceted interventions considering environmental, educational, and socioeconomic aspects. The study aims to promote sustainable aquaculture in Tripura by enhancing adoption of scientific practices and improving Panda production.

Keywords: Adoption gap, contemporary, extension and sustainable practices

1. Introduction
The Central Marine Fisheries Research Institute (CMFRI) estimates that in 2022– 2023, India produced 17.4 million metric tons of fish overall. It is projected that more than 70% of India's total fish production will come from aquaculture by 2030. In 2023, the fish output of Tripura achieved a record-breaking 83,000 metric tons (MT). Aquaculture is an excellent source of protein and is essential to the food sector. By assisting in the reduction of the load of wild catch, it has alleviated the stress on fisheries. It relieves some of the strain on wild capture and offers a steady supply to keep up with demand. Nonetheless, the aquaculture sector also poses several difficulties, including managing disease outbreaks, monitoring different water quality, and water pollution. One of the official states of North-East India, Tripura has a rich history dating back to its time as a princely state. This landlocked, mountainous state is situated in northeastern India and shares borders with the states of Mizoram and Assam on the national level as well as an international border that is encircled by Bangladesh on three sides (Saha *et al.,* 2005) [24].
In Tripura, there are three types of fish farming: tank, cage, and pond culture. Many species are raised by farmers, but the most common ones are Indian Major Carp and Exotic Carp, along with catfish, tilapia, Pangasius, tiger shrimp, prawns, and puntius sps. The Tripura government has put in place several programs and efforts to help fish producers and advance aquaculture. It covers financial aid for establishing fish hatcheries and nurseries, subsidies for building ponds, and the supply of high-quality fish seed. A large number of fish farmers use integrated fish farming systems, which blend fish farming with horticulture, poultry, duckery, and piggeries. This strategy has greatly improved farm production as well as livelihoods and the overall state of the economy. To increase production and profitability, farmers are increasingly utilizing contemporary technologies for pond management, such as disease prevention, feed management, and water quality testing with test kits.
The Pabda (*Ompok bimaculatus* Bloch, 1794), often known as Butter Catfish, is the state fish of Tripura. It is renowned for both its nutritious content and subtle flavour and muddy/sandy substrates in slow-moving or stagnant streams. It is originated from South Asia and it's found in Bangladesh, Nepal, Myanmar, Thailand, and other countries.

They are nocturnal and scavenge on organic debris, tiny invertebrates, and crustaceans. The basic feed material for Pabda fry is tubifex larvae. Due to availability of good nutrients and consumers preference it's most demandable fish in Tripura state and fish is amazing because it can go for a respectable amount of time without food or water. One of the several Indigenous fish species found in Tripura is *O. bimaculatus*, sometimes referred to as pabda. The aim of current study to fulfil the gap between technology and its adaption rate in particular Tripura state.

2. Materials and Methods

2.1 Experimental Site and Design

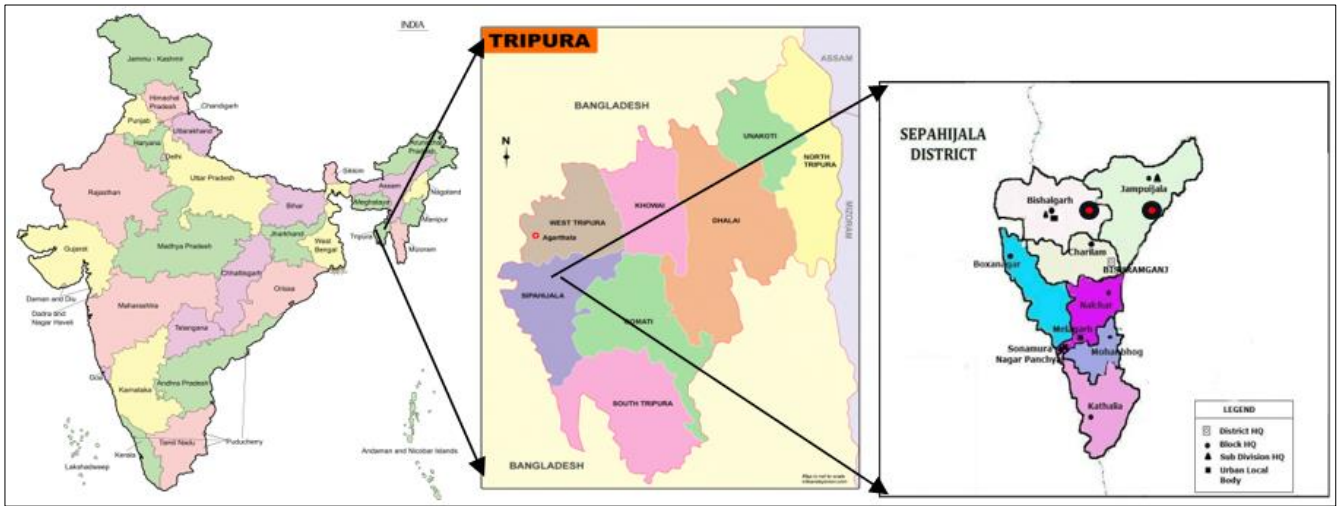

Fig 1: Map showcasing the study area

The study was carried out between August and November in the Sepahijala district, where two blocks namely Bishalgarh and Jampuijala. The survey was done on a small sample size of just 50 respondents from two blocks (25 respondents each) due to time and cost restrictions, which may limit the applicability of the findings.

To achieve the necessary goal for data collection, a well-structured questionnaire is required. A preliminary survey was created to gather data from the representative farmers. The questionnaire was pre-tested by interviewing several farmers who cultivated Pabda while keeping the study's aims in mind. Any required adjustments, changes, or deletions were then made, and the draft form was then finished. There is just primary data available. Primary data serve as the study's primary source. Because the information in the questionnaire was so important, the respondents were questioned in-depth. The questionnaire was not self-administered as is commonly believed; rather, an enumerator and researcher administered it. Because relevant information required for the study was left out, the data-collecting method was laborious but error-free. The majority of the time, fish production does not maintain accurate records of the quantity of feed used, the number of fingerlings, the production yield, and other various data. The responders' recollections provided the researcher with the response. The information obtained from the Lembucherra College of Fisheries was used to choose the responder. This choice was made with the ease of obtaining the data source in mind, which comes from these blocks. To acquire trustworthy data, a high level of cooperation from the respondents was anticipated.

Information was gathered through quick assessment using a combination of quantitative, qualitative, and participative methodologies. Rapid Rural Appraisal (RRA) is a collection of techniques used to gather data from rural communities in a participatory manner. RRA has an advantage over other techniques in that it allows a larger population to participate, which increases the likelihood of more accurate data being obtained. Triangulation is used to quickly assess sources of accurate information. The pilot survey, survey instrument modification, and sample frame preparation were all part of the pre-survey process. Markets and fish farms were visited to prepare the questionnaire. To observe agricultural and marketing techniques, several excursions to farms and marketplaces were undertaken. The production season, the culture period, farming techniques, the utilization of inputs (seed, feed, fertilizer, and labor), productivity, and the socioeconomic circumstances of farming households were the main topics of the one-hour interviews with farmers.

2.2 Method of Analysis

In this research, the non-acceptance of a suggested practice was operationalized as the "adoption gap." Both the adoption gap and the extent of adoption were calculated since it was necessary to determine the adoption gap before determining the extent of adoption. Ajore and Singh (1998) [2] proposed the following formulas, which were used to calculate the average adoption gap.

Adoption Gap = R – A/R * 100

Where,
R= Recommended package
A = Adopted package

Average Adoption GAP = Σi/n

Where,
i = Adoption gap (%) in a particular package
n = Total number of packages

3. Results

The location chosen for the study satisfies both the specific goal established for it and the potential for farmer participation. While pabda fish are farmed throughout

Tripura, one of the most significant areas is the district of Sepahijala, namely the blocks of Jampuijala and Bishalgarh. The ultimate goals of this research were to close the adoption gap and encourage sustainable methods to boost Tripura's scientific fish farmers' productivity in producing Pabda. It has been shown that several variables point to fish producers' reluctance to implement all advised procedures. Adoption was influenced by spousal education, training, extension interactions, and sources of income other than farming, and high adopters were more productive than non-adopters. We may now employ a different technique for Pabda's efficient breeding instead of stripping and sacrificing the male. This technique involves giving the fish the necessary dosage of hormone injections and setting up the tank with a shower or other features to encourage the fish to spawn naturally. Farmers may implement this strategy with ease and reliability as it will assist in maintaining the male population without requiring any sacrifice. Due to their cannibalistic character, the Pabda have a high mortality rate, which is another serious problem. To lessen this cannibalism, appropriate nutrition should be given in the beginning, such as tubifex for ten to fifteen days followed by plankton feeding. Because of their tiny mouths, tubifex should be coarsely minced before feeding them. It is now possible to cultivate tubifex on fish farmers' land, which will provide simple access for feeding.

3.1 Socio-Economic Status of Farmers

Farmers' socioeconomic characteristics may be seen from a variety of angles based on several factors, including their standard of living, the socioeconomic environment in which they reside, and the kind and degree of their involvement in national development initiatives. The study took into account the socioeconomic attributes of the sample farmers, including their age and family size, level of education, employment status, ownership of pond land, farming experience, and level of training. Table 3.1 shows that, of the two blocks (Fig. 3.1), the age group 18 ≤ 35 years is similar, but the Bishalgarh block is higher than the Jampuijala block in the > 35 ≤ 45 years and > 45 years age groups. (Fig. 3.2) explains that the percentage of people without formal education is higher in the Bishalgarh block and lower in the Jampuijala block. In the Bishalgarh block, there is less primary qualification than in the Jampuijala block. While middle school qualifications are identical, Bishalgarh block has higher secondary qualifications than the Jampuijala block. While only the postgraduate qualification is present in the Jampuijala block, the graduate qualification is likewise equivalent in both blocks. (Fig. 3.3) illustrates the ownership of pond property and demonstrates that each block includes an equal amount of marginal and small pond land. According to (Fig. 3.4), which assesses agricultural experience, Bishalgarh block has more farmers than Jampuijala block in the category of three to six years, while Jampuijala block has more farmers than Bishalgarh block in the category of six to twelve years, and it is similar in the category of more than six years. (Fig. 3.5) explains the occupational status, where fish is high in the Bishalgarh block as primary and high in the Jampuijala block as secondary. According to (Fig. 3.6), there are more attended farmers in the Bishalgarh block than non-attended farmers in the Jampuijala block.

Table 3.1: Describing the socioeconomic conditions of respondents

S. No.	Attribute	Bishalgarh (N= 25)	Jampuijala (N= 25)
1.	**Age group**		
	18 ≤ 35 years	6	6
	>35 years ≤ 45 years	10	9
	>45 years	9	10
2.	**Education Qualification**		
	Illiterate	4	2
	Upto Primary (1-5)	1	2
	Upto middle school (6-8)	4	4
	Upto Secondary (9-10)	10	6
	Upto Higher Secondary (11-12)	1	5
	Graduate	5	5
	Post Graduate	0	1
3.	**Pond Land Ownership**		
	Marginal	24	24
	Small	1	1
4.	**Farming experience**		
	Upto 3 yrs	9	8
	Above 3 yrs to 6 yrs	8	9
	More than 6 yrs	8	8
5.	**Occupation Status**		
	Primary	2	1
	Secondary	23	24
6.	**Trained Farmers**		
	Attended	20	16
	Non- attended	5	9

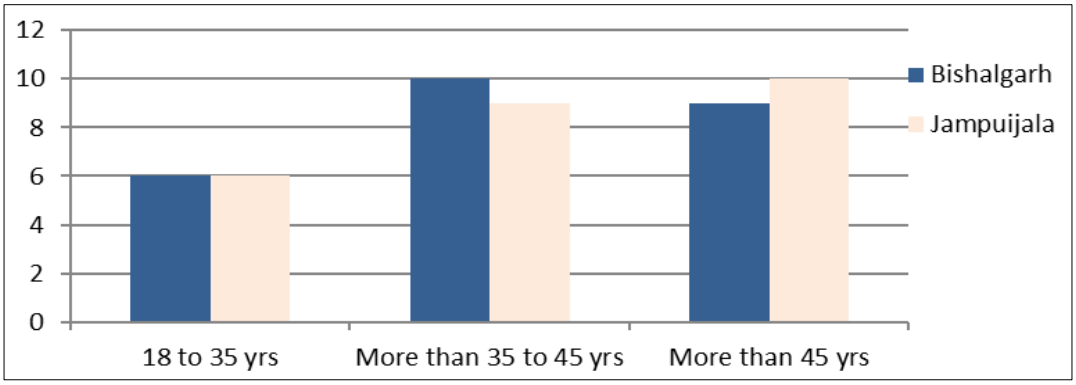

Fig 3.1: Graphical representation of Age Group

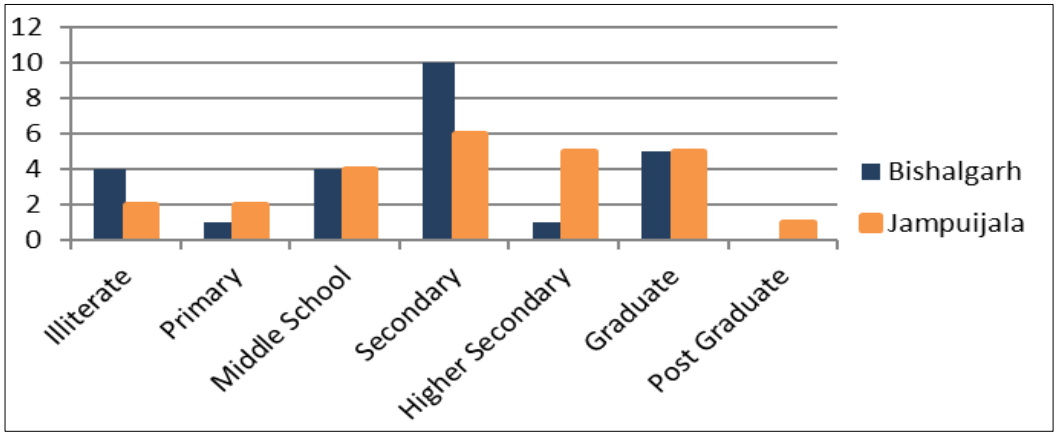

Fig 3.2: Graphical representation of Education Qualification

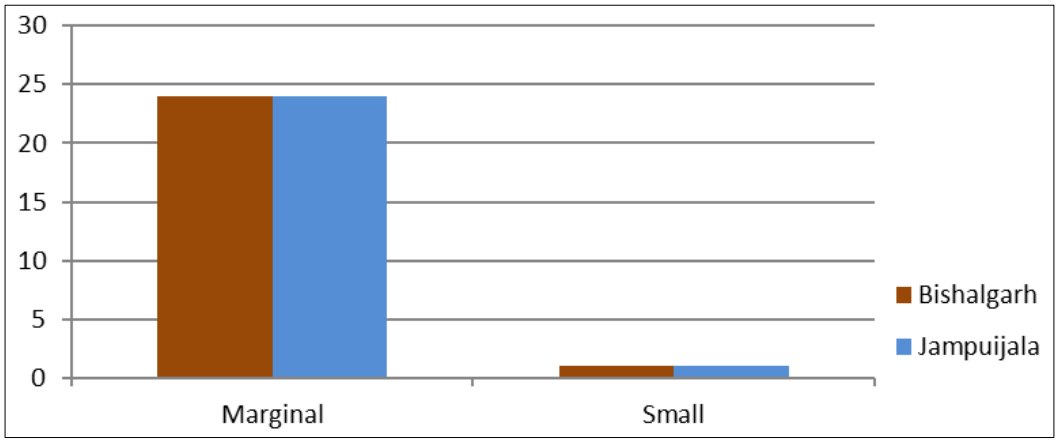

Fig 3.3: Graphical representation of Pond land holding

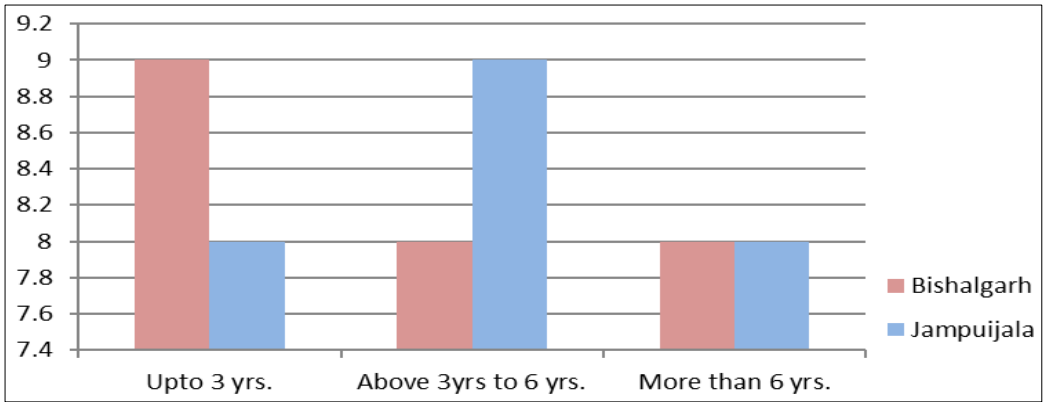

Fig 3.4: Graphical representation of Farming experience

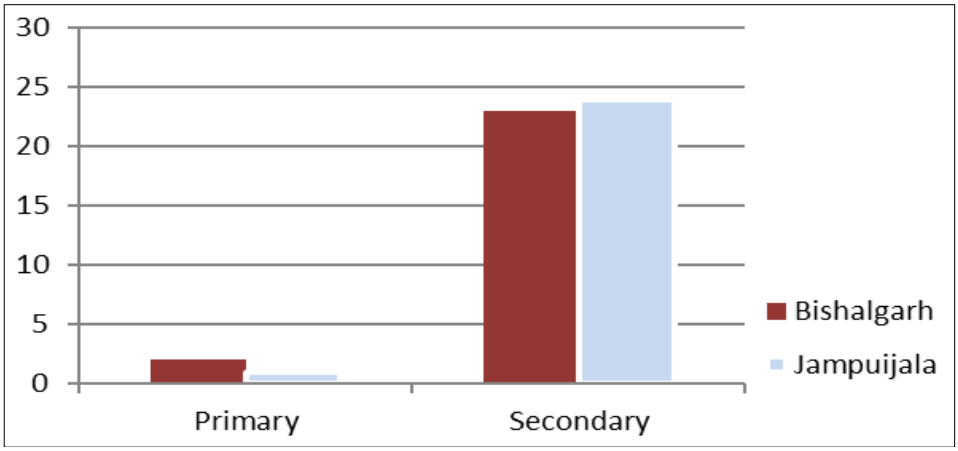

Fig 3.5: Graphical representation of occupation

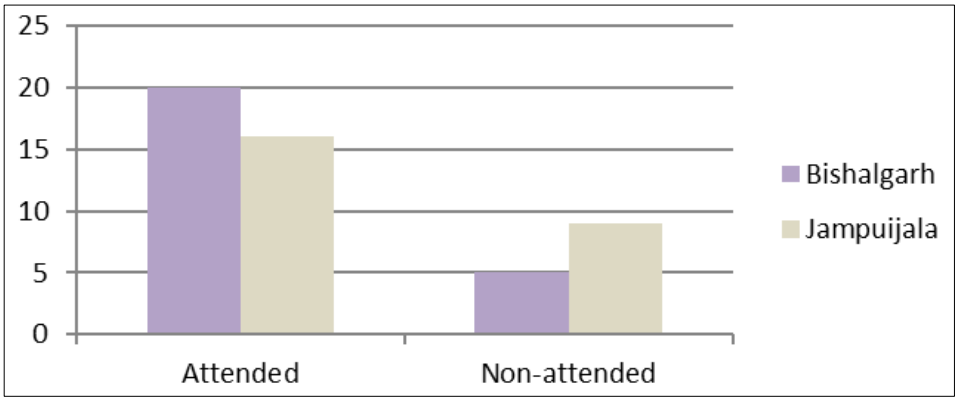

Fig 3.6: Graphical representation of Trained farmers

The term "adoption rate" refers to the proportion of the population that has embraced the advised behaviors. Six of the suggested practices were only partially implemented, indicating that Bishalgarh Block had a greater acceptance rate than Jampuijala Block. Of the suggested practices, only two are fully accepted by both blocks, while seven are not implemented at all. This indicates that adoption rates are lower in Jampuijala and higher in the Bishalgarh block.

Table 3.2 explains the discrepancy in adoption between the blocks. The adoption gap percentage of the two blocks combined is indicated by the six partially adopted recommended practices: testing of the soil and water is 14.28%; aquatic weed control is 20%; application of inorganic fertilizers (urea & super phosphate) is - 40% (indicating a higher adoption rate for the Jampuijala block); fish seed density (no./ha) is 15.78; post-stocking manuring with organic manures is 31.81%; and periodic netting to monitor fish growth and health is 17.64%. This indicates that there is a smaller adoption gap in the Bishalgarh block and a larger adoption gap in the Jampuijala block.

Table 3.2: Comparison of Adoption Rates between Bishalgarh and Jampuijala Blocks

S. No.	Recommended Practices	Bishalgarh (n=25) Adoption rate%	Jampuijala (n=25) Adoption rate%
1.	Testing of soil and water	84	72
2.	Application of lime for improving soil and water quality	+	+
3.	Control of aquatic weeds	60	48
4.	Control of predators and undesirable fish fauna	_	_
5.	Initial manuring with organic manures (RCD or poultry).	+	+
6.	Application of inorganic fertilizer (urea and superphosphate)	40	56
7.	Stocking of the recommended number of different fish species along with Pabda	_	_
8.	Density of stocking of fish seed (no./ha)	76	64
9.	Ratio of stocking of selected species	_	_
10.	Size of the fish seed stocked for Pabda and others	_	_
11.	Precautionary measures during stocking	_	_
12.	Use of supplementary feeds in prescribed proportion	_	_
13.	Rate of feeding/day	_	_
14.	Post-stocking manuring with organic manures	88	60
15.	Periodic netting to check the growth and health of fishes	68	56

Full adoption is denoted by a (+).
No adoption is denoted by a (-).
Partial adoption is shown with the adoption rate percentage.

Table 3.3: Adoption Gaps of Recommended Aquaculture Practices

S. No.	Recommended Practices	Adoption Gap %
1	Testing of soil and water	14.28
2	Control of aquatic weeds	20
3	Application of inorganic fertilizer (urea and superphosphate)	-40
4	Density of stocking of fish seed (no./ha)	15.78
5	Post-stocking manuring with organic manures	31.81
6	Periodic netting to check the growth and health of fishes	17.64
Average Adoption Gap		9.91±10.30

Note: A negative adoption gap indicates that Block B (Jampuijala block) has a higher adoption rate than Group A (Bishalgarh block)

Discussion

The socioeconomic differences between the blocks of Bishalgarh and Jampuijala highlight how intricately agricultural growth is intertwined with the region. Diverse degrees of readiness and capacity to interact with agricultural innovations and take part in national development projects are reflected in differences in education, farming experience, variety in occupations, and training involvement. Targeted interventions like job training, education programs, and fair resource allocation might help close the gaps in agricultural output and improve the socioeconomic standing of farmers in both blocks (Nova *et al.*, 2019) [20] have also demonstrated via their study that there was a significant range in the socioeconomic status of the farmers who were chosen, rather than all of them having the same socioeconomic traits. Farmers' socioeconomic traits have an impact on their patterns of output nearly half of the TN farmers (50.65%) and the majority of AP farmers (66.56%) were older than 40 but younger than 50. About one-third (33.40%) and half (49.35%) of the respondents in TN and AP, respectively, were under 40 years old.

Although adoption rates in Bishalgarh are generally higher, the different adoption gaps highlight the need for sophisticated strategies to support agricultural innovation. Effectively closing these gaps can support increased sustainability, productivity, and socioeconomic growth in both blocks. Further discovered that the average practice-wise adoption gap was 32 and 28% in AP and TN, respectively. This indicates that farmers in AP and TN implemented around 68 and 72% of the GMPs, respectively. It is compelling proof of what I discovered. Discovered the disparity in fish farmers' adoption of composite fish culture technology and discovered that most of them had low adoption. Additionally, discuss the productivity of the carp polyculture in the pond and the adoption of better management techniques, proving my results in the process.

It will need a multipronged strategy to bridge the adoption gap in sustainable aquaculture, taking into account environmental, educational, and socioeconomic aspects. Bishalgarh and Jampuijala blocks can transition to more resilient and sustainable aquaculture practices by supporting regulations, boosting education, encouraging community involvement, and improving technology adaption. This comprehensive approach ensures a sustainable future for aquaculture in the area by improving environmental stewardship while also boosting the economic and social well-being of agricultural communities. The significance of O. bimaculatus as a potential species for aquaculture diversification initiatives has been studied, who also explain sustainable aquaculture and take into account the species' conservation value.

Conclusion

Compared to farmers who adopted basic and intermediate methods, high users of complex procedures saw better productivity. Extension resources are required to raise awareness and, consequently, adoption, such as training and small-group discussions. This might be accomplished by hiring field-level extension personnel and providing training. Encouraging the respondent's spouse in particular to get extension services might aid in the broader adoption of better management techniques. It could be easier to implement better management practices if extension personnel made more local visits. Improved management practices might be promoted by closer collaboration between research, governmental, and non-governmental groups as well as farmer-to-farmer contacts. Increasing the diversity of your income sources might also be quite important for adoption.

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Conflict of Interest

The authors state that there are not at all conflicts of interest regarding the publication of this research paper.

Author Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Diana Debbarma. The first draft of the manuscript was written by Diana Debbarma and Mahendra Kumar Yadav and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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