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Evaluation of knowledge gain among fisheries trainees participating in fisheries training programmes

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Abstract

Training programmes play an important role in improving the knowledge and skills of fish farmers and fisheries personnel. However, there is limited information on how effective these programmes are in increasing trainees' knowledge, especially in the fisheries sector. Therefore, this study assessed the knowledge gained by trainees who participated in fisheries training programmes conducted by the College of Fisheries, Central Agricultural University, Lembucherra, Tripura, during 2022-2023. A pre-test and post-test quasi-experimental research design was used. A total of 228 trainees, including 188 fish farmers and 40 line department officials, were selected through complete enumeration. Knowledge was measured before and after the training using a structured questionnaire, and the data were analysed using descriptive statistics, Relative Knowledge Gain (RKG), paired *t*-test, and correlation analysis. The results showed a significant improvement in knowledge after the training ($p < 0.05$). The mean knowledge score of fish farmers increased from 7.84 to 15.03, with a Relative Knowledge Gain of 83.93%, while the score of line department officials increased from 14.58 to 19.95, with a Relative Knowledge Gain of 41.01%. Education, farming experience, and innovativeness were positively related to knowledge gain. The study concludes that well-planned fisheries training programmes are effective in improving technical knowledge and should include more practical sessions and need-based content to further strengthen fisheries extension and technology adoption.

Keywords: Training evaluation, knowledge gain, RKG, Tripura, quasi-experimental research

Introduction

In India, food and nutritional security concerns for its continuously increasing population need a multifaceted approach to fish farming/livestock production (Hundal *et al.*, 2016) [32]. The Food and Agriculture Organization (FAO, 2024) [26] estimates that 713 and 757 million people, or 8.9 and 9.4% of the world's population, respectively, may have experienced hunger in 2023. 52% of the world's 767.9 million undernourished people live in the area, with Southern Asia accounting for 83% of them. However, due to the COVID-19 pandemic, war, and climate change, the number of undernourished people in the Asia-Pacific area surged from 370 million in 2020 to 396 million in 2021, and the PoU increased to 9.1%. The second Sustainable Development Goal (SDG 2) aims to eradicate all types of

malnutrition by 2030 and guarantee that everyone has year-round access to sufficient, safe, and nourishing food. One way to achieve Sustainable Development Goal 2 (zero hunger) is to use fish and fisheries products as a source of animal protein. According to Christiaensen *et al.*, (2011) [20], agricultural development is thought to be up to 3.2 times more successful than any other sector in reducing poverty in low-income, resource-rich nations. Because poverty and food insecurity are closely related (FAO, 2002; de Alan *et al.*, 2015) [22], agricultural development may also help reduce hunger, especially for women, whose empowerment in agriculture increases household food security and nutrition. Fisheries and aquaculture are one of the world's fastest-growing businesses, and India is the world's second-largest producer of fish after China; hence, fisheries and

aquaculture are considered a growing industry in the Indian economy (Tacon, 2020) ^[70]. India also accounts for 10.14 per cent of the yearly average growth rate (Anonymous, 2019) ^[5]. Fish is recognised as a nutrient-rich animal food choice for many nutritionally vulnerable people. Fish is rich in protein and contains nearly all bioavailable minerals, including calcium, iodine, iron, zinc, phosphorus, selenium, and fluorine (Bene *et al.*, 2016). Fisheries and aquaculture provide dietary essentials for human consumption and play an important role in economic development opportunities and generating livelihoods through their contributions to food and nutritional security, national income, and employment opportunities (Kumar and Shivani, 2014) ^[36]. Approximately 80 per cent of farmers in the NE area are small (less than 1.44 ha) or marginal (less than 0.40 ha).

Furthermore, as the population grows, the average amount of land holdings shrinks with time (De and Singh, 2017) ^[23]. To exploit the available resources to their potential, technical assistance needs to be provided. The massive need for training among farmers, farm women, and extension workers is not being met in both qualitative and quantitative terms. Lack of education in agricultural-related fields or skill development is one barrier to young people's involvement in agriculture (Salvago *et al.*, 2019; Yeboah *et al.*, 2020) ^[60, 73]. Youth in rural Ethiopia are interested in entering the agricultural sector as a result of government initiatives to boost productivity and skills as well as introduce modern and improved farming techniques; in Indonesia, vocational training has been found to increase the likelihood of a successful career in the agricultural sector (Yeboah *et al.*, 2020) ^[73]. Therefore, there is a need to give technical and training support to farmers in order to raise aquaculture production. It is emphasized that providing appropriate training in improved fish-farming practices can increase the rate of technology adoption in these resource-poor family groups.

Training is a process in which trainees develop knowledge, skills, and attitudes through a sequence of programmes. It also fills the gap between what they have and what they require (Beach, 1980) ^[9]. Training is a structured communication process for workforce development that seeks to bring about desired changes in knowledge (K), skills (S), practice (P), attitude (A), behaviour (B), and other areas (O) that correspond to a position's requirements. Thus, training is a mix of K, S, P, and O that results in a shift in attitude and behaviour among extension workers working on agricultural development projects and programmes (Misra, 1999) ^[44]. It also increases an individual's knowledge, skills, and attitude in preparation for a particular job. When situations change, people should learn new skills, gain new information, and adopt new attitudes. Training is an ongoing process that never ends at any stage of life; it changes the employee's thinking and brings a good attitude toward other people and the workplace (Ganesh and Indradevi, 2015) ^[27]. With the advancement of information and communication technology (ICT), young people now have more opportunities to develop their skills and obtain pertinent information. As a result, they are in a good position to comprehend market dynamics as well as institutional and financial systems, which allows them to start and profit from processes of change in the agricultural sector (Gyimah-Brempong and Kimenyi, 2011; Roser *et al.*, 2016)

^[57]. Cheteni (2016) ^[19] asserts that skill-training interventions promote youth involvement or agricultural entrepreneurship. According to Julliet *et al.*, (2010) ^[34], training programs are now a crucial aspect of working in an organisation. A training program is not complete until the procedures and results have been evaluated. Training evaluation is the most key component of any training program. In general, successful training programs begin with identifying training requirements and finish with training evaluation (Gopal, 2008) ^[29]. According to Julliet *et al.*, (2010), assessment of learning in training activities offers a standard by which organisations may gauge how successful training is (Lundy, 2002) ^[38] demonstrated how post-training follow-up facilitates the shift from documented to applied and locally applicable knowledge. Evaluation is the systematic process of gathering and examining data in order to assess whether and to what extent objectives were or are being met Boulmetis and Dutwin (2000) ^[14]. Training evaluation ensures that applicants' knowledge can be used in their workplaces or daily tasks. In the simplest of ways, evaluation is the assessment of objectives with outcomes to answer the question of whether training has accomplished its objectives (Topno, 2012) ^[71]. According to Phillips and Ostroff, training assessment may be used as a diagnostic method to allow programs to be revised in order to achieve the many aims and objectives. Programs can therefore be chosen or changed using the information. Good assessment data can show how beneficial the training program is. In fact, this kind of data can demonstrate the training's financial advantages. Evaluations may assess the validity and clarity of exercises, questions, and examinations. They have to assess the talents, information, and skills that the program is intended to impart. Evaluation frequently offers a way to validate tools.

There is adequate evidence to indicate that organizations do not place as much emphasis on the evaluation and objective assessment of the efficacy and results of their training programs as they do on their planning and execution (Rajeev *et al.*, 2009) ^[55]. Inadequate funding, insufficient time, a lack of experience, naive faith in training solutions, or a lack of techniques and resources are all potential causes of subpar assessments (McEvoy and Buller, 1990) ^[41]. Most organisations do not collect the information to determine the utility of their own training programs (Goldstein, 1993) ^[28]. Aside from the great regard that training staff may have for them, many training activities continue to receive low ratings. For instance, a Phillips study reveals that trainee responses, which are recorded at the conclusion of the course, are the most popular type of assessment. Pre- and post-tests, follow-up questionnaires, and participant assessments are comparatively uncommon. Previous research studies on various training institutions have focused on the effect of the training program on the extension methods; there are limited studies conducted on the training evaluation of the fisheries training programmes. With this aspect, the present study aims to evaluate the various fisheries training programs conducted by the College of Fisheries, Tripura, Agartala (CAU), both on-campus and off-campus, in terms of knowledge gain. The objective of the present study is "To assess the knowledge gained by trainees in intended training programmes".

Material and methods

A) Description of study area

The northeast India is the for the present study, which includes the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura (with a total geographical area of 2.55 lakh km² (about 8% of the country), of which 43% is located at an elevation of 300m, 30% between 300 and 1200m above MSL, and 27% above 1200m above MSL) (Chakravarty et al., 2012)^[17], has been blessed with abundant biodiversity and fisheries resources. The area has been divided into two biogeography zone-Eastern Himalaya and north-eastern India, based on floristic composition, the naturalness of the flora and the local climate (Chakravarty et al., 2012)^[17]. Cultivable area in the NE regions (62.04%) is less than the national average (73.05%) (Sahoo, 2013)^[59]. About 80% of the farmers in the NE region belong to small (less than 1.44ha) and marginal (less than 0.40 ha) categories, moreover, with the increase in population, the average size of land holding is gradually reduced over the years (De and Singh, 2017)^[23]. The region produces around 0.214 million metric tons of fish per year, over half of which comes from aquaculture, yet this is insufficient to meet the region's food needs. Rivers, Coldwater streams, floodplain wetlands, reservoirs, lakes, ponds, paddy fields, and mini-barrages exist in the region to support large-scale aquaculture activities (FAO, 2011)^[25]. The fish farmers in the region achieve considerably less production than the national average of 2400 kg/ha per year. As a result, farmers' average production was just 1400 kg/ha per year (Barman et al.,

2012)^[7]. Fish farmers of different states of the North-Eastern region of India gain training conducted by the College of Fisheries Lembucherra, Agartala (CAU) to improve their knowledge, and skills regarding aquaculture. College of Fisheries Lembucherra, Agartala provides different kinds of training to farmers and line departments on different subjects e.g.: pond preparation and pond management, feed formulation, fish processing, capacity building, entrepreneurship and business start-up. It provides training programmes both on the college campus and off campus.

B) Research design

The quasi-experimental research design was adopted for the present study; it is an empirical interventional study used to estimate the causal impact of an intervention on a target population without random assignment. According to Campbell and Stanley (1966)^[15], Experimental designs that are not randomized are quasi-experimental; in these designs, the researcher can manipulate or observe the manipulation of treatment.

The theoretical basis of evaluation and research designs, and their practicability, were taken into consideration when selecting appropriate methods to measure the effectiveness and outcomes of training programmes. The evaluation indicators selected in the study were: trainee feedback, trainee knowledge gained, and the adoption and economic benefits of the training programmes. In the present study, a “pre-test and post-test” quasi-experimental research design was used.

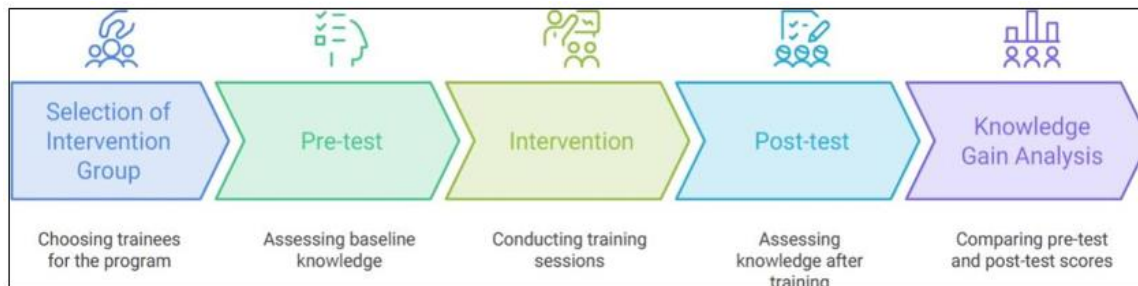


Fig 1: Quasi-experimental research design

C) Sampling Procedure

For the present study, the north-east region was selected purposively. The region is blessed with huge natural resources, where a large number of farmers are engaged in farming, and average *per capita* fish consumption is also high in this region. College of Fisheries, situated in the northeast region, plays an important role in fisheries development in this region (Munilkumar and Nandeesh, 2007)^[46].

The farmers and officials of line departments from different states of north-eastern India who had participated in training programmes conducted by College of Fisheries were selected for study in which 146 fish farmers and 40 officials of line department (fisheries officer, FI and extension officer) were selected from the on-campus training programme and 42 fish farmers were selected from off-campus training programmes which were conducted at Krishi Vigyan Kendra (KVK) and village panchayat in Sepahijala, Agartala during 2022-2023. A complete

enumeration sampling technique was used to select the respondents. Primary data was collected by using a pretested semi-structured interview schedule through the personal interview method. The secondary information regarding the training programme was collected from different published and unpublished sources. A pilot study was administered on 30 sample respondents to judge the efficacy of the interview schedule and necessary modifications and alterations were made to the interview schedule based on the feedback received from the pilot study. Operationalisation and measurement of variables based on the available literature and in consultation with the experts, and certain relevant independent and dependent variables were identified and included in the study that fit into the objective of the study. To ascertain the socio-economic information of trainees, a pre-structured interview schedule was used. Information on knowledge gained by trainees during the training programme, a set of multiple-choice questions was developed and used to ascertain the data. To assess the

perception level of trainees, a 5-point Likert scale ranging from strongly agree [5] to strongly disagree [1] was used. To get perceived suggestions about the training programme, frequency and percentage were used.

D) Knowledge gained by trainees

Knowledge can be defined as information, an idea or a skill which is learned through a learning experience in an appropriate teaching-learning situation. The main aim of any training programme is to increase the skills, knowledge and attitude of trainees in a particular area. To assess the knowledge gain by trainees, a set of 25 multiple-choice questions in five subjects related to fisheries and aquaculture was administered to the trainees both before training and after the training programme. '1' score for a correct response and '0' score for an incorrect response was given for analysis of the knowledge level and gain in knowledge. Pre- test and post-test knowledge gain was analysed to calculate relative knowledge gained by using the formula:

$$\text{Relative Knowledge gain (\%)} = \frac{\text{Post test} - \text{Pretest}}{\text{Pre test}} \times 100$$

Respondents will be categorised into three groups viz. low [total score on knowledge less than (Mean-½ S.D.)], moderate [total score on knowledge between (Mean±½S.D.)] and high [total score on knowledge more than (Mean+½S.D.)]. Paired *t*-test/ANOVA was used to analyse the data of the pretest and post-test. Hundal *et al.*, (2016) [32]; Chakraborty *et al.*, (2022) [16] also used this method to assess the knowledge gained by the trainees.

Hypothesis

H₀: There is no significant difference in the knowledge level of trainees before and after the training programme.

Result and Discussion

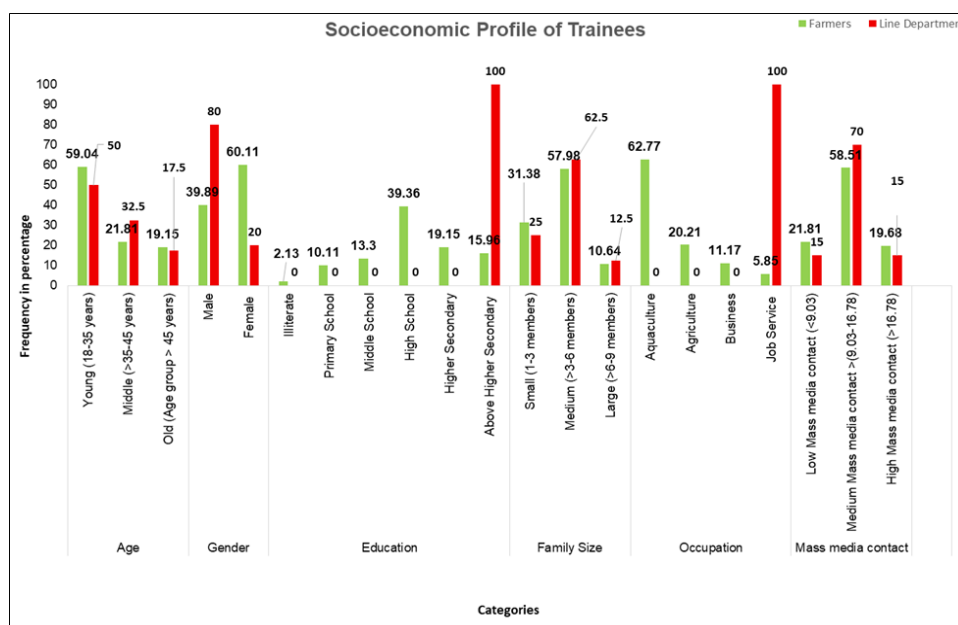
A) Demographic profile of respondents

This section consists of the socio-profile characteristics of the trainees. The socio-economic profile of trainees such as fish farmers and officials of the line department and other extension personnel (fishery officer, fishery inspector, subject matter specialist and other extension officers) who participated in oncampus or off-campus training programmes conducted by the College of Fisheries, CAU, Lembucherra, Tripura. The socio-economic profile included age, gender, education, family size, occupation and mass media contact, and the psychological profile includes innovativeness, Market orientation, scientific orientation, economic orientation, and perception level of trainees. Observed from Figure 1, the socioeconomic profile of the trainees revealed that most farmer respondents were young (59.04%), female (60.11%), belonged to the Scheduled Tribe category (44.68%), and had education up to the high school level (39.36%). Education has consistently been identified as an important determinant of technology adoption and decision-making among farmers (Rogers, 2003 [56]; Kumar, 2020; Rahman *et al.*, 2019 [53]; Muddassir *et al.*, 2022). Whereas 50 percent of department official trainees were young [18-35], 80 percent were male, and 100 percent of line department respondent were having education above

higher secondary. This indicates that the young age group is more receptive to innovation and improved technology. Similar findings were reported by Rajan *et al.*, (2011) [54], Kumar and Sharma (2018) [35], Rahman *et al.*, (2019) [53], Saha and Dutta (2018) [58], and Argade *et al.*, (2023), who observed that the majority of fish farmers belonged to the young and middle-aged categories. Similar observations regarding gender participation in aquaculture and fisheries-related activities were reported by Adewuyi *et al.*, (2010) [2], Ahmed *et al.*, (2015) [3], and Das *et al.*, (2021) [21]. Most farmer trainees and line department trainees had medium-sized family's 57.98 percent and 62.50 per cent respectively. Similar findings were reported by Saha and Dutta (2018) [58], Barman *et al.*, (2017) [8], and Islam *et al.*, (2020) [33], who found that most fish farming households belonged to the medium family-size category which is in line with the findings of Nirmalkar *et al.*, (2022) [47], and possessed pond areas up to 0.40 ha (64.89%), corroborating the results of Upadhyay *et al.*, (2012) [72]. Aquaculture was the primary occupation for 62.77 per cent of the farmers trainees where as 67.00 percent official of line department were engaged in aquaculture as a secondary occupation. Similar observations were reported by Rajan *et al.*, (2011), Adewuyi *et al.*, (2010), and Singh *et al.*, (2021) [65], who found fish farming to be the principal occupation of a majority of aquaculture farmers. Most farmer trainees belonged to the medium annual income category (81.91%). Furthermore, the majority of farmers trainees and line department trainees had medium levels (9.03-16.78) of mass media exposure 58.51 percent and 70.00 per cent, respectively. This finding corroborates the results of Pandey *et al.*, (2014) [50], Meena *et al.*, (2017) [42], Mande and Darade (2011) [40], and Patel *et al.*, (2020) [51], who reported that most farmers possessed a medium level of mass media exposure and information-seeking behaviour. Singh and Tanwar (2020) [66] emphasized that extension services, ICT tools, and social media platforms play a crucial role in disseminating information and enhancing technology adoption among fish farmers. According to Singh *et al.*, (2010) [67], adoption decisions for beekeeping were highly influenced by trainee occupation and age, while adoption decisions for mushroom cultivation were significantly influenced by family income and education. Form the table 1 observed that the psychological profile of the respondents (farmers and line department trainees), where majority of the farmers trainees (77.66%) and line department trainees (72.50%) were exhibiting the medium level (10.07- 13.47) of the innovativeness, market orientation 67.02 percent farmers trainees and 70.00 percent had medium level of market orientation, medium level of scientific orientation for farmers trainees (70.21%) and line department trainees (72.50%), medium economic orientation for farmers trainees (62.23%) and for line department trainees (72.50%). Similar trends were reported by Dubey *et al.*, 2011; Goswami, 2016) [24, 30], who found that fish farmers commonly exhibit moderate levels of adoption-related characteristics. These findings indicate that the trainees were predominantly small-scale fish farmers with moderate socio-economic status and considerable potential to benefit from training and extension intervene.

Table 1: Psychological profile of trainees

Profile	Categories	Percentage
Innovativeness	Farmer (n=188) $X=11.40$, $\sigma=1.76$	
	Low innovativeness (<9.64)	10.11
	Medium innovativeness ($>9.64-13.16$)	77.66
	High innovativeness (>13.16)	12.23
	Line department (n=40) $X=11.78$, $\sigma=1.70$	
	Low innovativeness (<10.07)	17.50
	Medium innovativeness ($>10.07-13.47$)	72.50
	High innovativeness (>13.47)	10.00
Market orientation	Farmer (n=188) $X=11.74$, $\sigma=1.86$	
	Low market orientation (<9.88)	14.36
	Medium market orientation ($>9.88-13.61$)	67.02
	High Market orientation (>13.61)	18.62
	Line department (n=40) $X=12.48$, $\sigma=1.83$	
	Low market orientation (<10.07)	20.00
	Medium market orientation ($>10.07-13.47$)	70.00
	High Market orientation (>13.47)	10.00
Scientific orientation	Farmer (n=188) $X=9.10$, $\sigma=1.44$	
	Low scientific orientation (<7.66)	11.17
	Medium scientific orientation ($>7.66-10.54$)	70.21
	High scientific orientation (>10.54)	18.62
	Line department (n=40) $X=10.10$, $\sigma=1.83$	
	Low scientific orientation (<8.67)	7.50
	Medium scientific orientation ($>8.67-11.53$)	72.50
	High scientific orientation (>11.53)	20.00
Economic orientation	Farmer (n=188) $X=12.64$, $\sigma=1.55$	
	Low economic orientation (<11.10)	22.87
	Medium economic orientation ($>11.10-14.19$)	62.23
	High economic orientation (>14.19)	14.89
	Line department (n=40) $X=12.80$, $\sigma=1.65$	
	Low economic orientation (<11.14)	17.50
	Medium economic orientation ($>11.14-14.45$)	72.50
	High economic orientation (>14.45)	10.00

**Fig 2:** Socio-economic profile (Age, Gender, Education, Family size, Occupation and Mass media**B) Knowledge gained by trainees in the attended training programmes**

The training programme is considered to be successful when it achieves predetermined objectives. *Knowledge* gained by *farmer trainees* was assessed through a set of questions about training, before and after the training programme. The

questions were related to fish farming, feed formulation, fish preservation, ICT and communication etc. The results obtained from the analysis of data on respondents' knowledge and skills gained are presented in the following subsection.

1) Knowledge gain of farmer trainees in training programmes: It can be observed from Table and Table 3 that the mean knowledge score after the completion of the training programme was 15.03, compared with 7.84 before training. The dimensions of knowledge gain and the set of questions for each dimension were used to assess improvement in the knowledge level of trainees. The frequency and percentage of trainees who answered correctly or incorrectly before and after training were estimated, and then a two-sample mean test was applied to assess the difference in mean knowledge level before and after training. It is reflected from Table that 40.29 per cent of *farmer trainees* knew pond construction and water quality management before the training programme, which improved significantly ($P<0.05$) after the training programme (68.75%). Similarly, 40.21 per cent of *farmer trainees* had prior knowledge on the subject of fish rearing and feed management, which improved to 66.28 per cent after attending the training programme. Similarly, on the subject of breeding and larval rearing, nearly half of the respondents (40.03%) had knowledge prior to the training programme, which improved significantly ($P<0.001$) after the training programme (67.95%). It also revealed that on average, 19.02 per cent of *farmer trainees* had prior knowledge about the fish health management, which increased to 59.18 per cent after successful completion of the training programme. In the case of knowledge on harvest and post-harvest technology, an average 30.98 per cent of *farmer trainees* had prior knowledge and the knowledge level increased to 56.65 per cent after the

training programme. The data further revealed that 33.98 per cent of *farmer trainees* had prior knowledge about information and communication technology which significantly ($P<0.05$) improved (57.06%) after a training programme. It is also evident from the Table 35 that overall, 33.54 per cent of *farmer trainees* had knowledge in a different dimension of fisheries and aquaculture, which improved significantly ($P<0.001$) after attending the training programme (61.69%).

The above results indicated that more than 84.20 per cent improvement in the knowledge level of the farmers trainees after attending the training programmes. A paired *t*-test was conducted (Table 4) to evaluate the effect of the training programme on the knowledge level of the *farmer trainees* by comparing the mean knowledge score of the pre-training knowledge level and the post-training knowledge level of the *farmer trainees*. The mean score of pre-training knowledge was (mean=7.84, $n=188$), and the mean score of post-training knowledge was (mean=15.03, $n=188$). The test statistics revealed that there is a significant difference in the knowledge level of trainees before and after the training programme at the 0.0093 level (2-tailed). A similar type of finding was also reported by Sharma *et al.*, (2014)^[64] and Biswas *et al.*, (2008)^[13] as a significant change in the knowledge score of dairy farmers after attending training. The result suggests that the training programme conducted by the College of Fisheries, Lembucherra, Agartala, both on-campus and off-campus has a positive impact on the knowledge level of the farmers trainees.

Table 2: Impact of training programme on the knowledge level of farmers pre and after the training programmes

Statement	Correct responses (n=188) (%)		Mean correct responses	
	Pre-Training	Post Training	Pre-Training	Post Training
Pond construction and water quality management-				
a) What is desire colour of water for fish Growth	149 (79.26%)	176 (93.62%)	0.793	0.936
b) How much quantity of cow dung is required for fertilize one hectare of pond	56 (29.79%)	110 (58.51%)	0.298	0.585
c) How much quantity of Lime is required to correct the water pH	58 (30.85%)	131(69.68%)	0.309	0.697
d) What is optimum concentration of dissolve oxygen for fish culture	40 (21.28%)	100 (53.19%)	0.213	0.532
Average: -	75.75 (40.29%)	129.25 (68.75%)	0.403	0.688
Fish rearing and feeding management-				
a) What is the optimum stocking density of fish culture (fingerling/ kani	84 (44.68%)	96 (51.06%)	0.447	0.511
b) How much percentage of feed should be done for per kg of fish body weight	75 (39.89%)	112 (59.57%)	0.399	0.596
c) What is the optimum fish production in scientific fish culture (culture of IMC	46 (24.47%)	96 (51.06%)	0.245	0.511
d) What are the ratio of fishes in Polyculture of Catla, rohu and mrigal	86 (45.74%)	164 (87.23%)	0.457	0.872
e) Name of the fish found in bottom of the pond	87 (46.28%)	155 (82.45%)	0.463	0.824
Average: -	75.60(40.21%)	124.60 (66.28%)	0.402	0.663
Breeding and larva rearing-				
a) Catla, Rohu and Mrigal are breed during	95(50.53%)	108 (57.45%)	0.505	0.574
b) Fish seed should be stocked in which time	67 (35.64%)	125 (66.49%)	0.356	0.665
c) Size of the IMC fish Fry	72 (38.30%)	139 (73.94%)	0.383	0.739
d) Which stage of fish is culture in nursery pond	67 (35.64%)	139 (73.94%)	0.356	0.739
Average: -	75 (40.03%)	128 (67.95%)	0.400	0.680
Health care management-				
a) Saprolegniasis disease is mostly occur in which stage of fish	30 (15.96%)	83 (44.15%)	0.160	0.441
b) Which one is the important fish disease occurring in north east	52 (27.66%)	124 (65.96%)	0.277	0.660

region				
c) Gas Bubble disease is occurred due to	49 (26.06%)	131 (69.68%)	0.261	0.697
d) Gil rot disease is due to	12 (6.38%)	107 (56.91%)	0.064	0.569
Average: -	36 (19.02%)	111 (59.18%)	0.190	0.592
Harvest and post-harvest technology-				
a) What is the name of net used for harvest the fish	25 (13.30%)	76 (40.43%)	0.133	0.404
b) After harvesting fish should be kept in	82 (43.62%)	94 (50.00%)	0.436	0.500
c) Which one is the chief method of fish preservation	46 (24.47%)	103 (54.79%)	0.245	0.548
d) Fish is the good source of -	80 (42.55%)	153 (81.38%)	0.426	0.814
Average: -	58 (30.98%)	107 (56.65%)	0.310	0.566
Information and communication technology-				
a) Which application is used for send money	104 (55.32%)	158 (84.04%)	0.553	0.840
b) Kishan Call Centre is launched to	43 (22.87%)	82 (43.62%)	0.229	0.436
c) Full form of KCC	33 (17.55%)	76 (40.43%)	0.176	0.404
d) Email is used for	53 (28.19%)	68 (36.17%)	0.282	0.362
Average: -	58 (30.98%)	96 (51.06%)	0.310	0.511
Overall average Reponses: -	63.06 (33.54%)	33.54 (61.69%)	0.335	0.617

Paired *t*-test significant level $P < 0.05$ (2-tailed)

Table 3: Impact of training on the knowledge level of trainees

Pair t-test	Mean	Std. Deviation	Std. Error	t	Sig. (2-tailed)
Pretest	7.8404	3.88416	.28328	-23.504	.0009
Posttest	15.0319	3.66790	.26751		

Knowledge gain by farmer trainees during the training programme: From Table observed that, prior to the training programme, the majority (59.57%) of *farmer trainees* belonged to low-level knowledge category which may be attributed to their habitual situation to form patterns of *farmer trainees* throughout the years relying on conventional varieties with no modification, followed by 36.70 per cent of trainees had a medium level of knowledge, and only 3.72 per cent of farmers trainees had a high level of knowledge. Whereas, after attending the training programme, 56.91 per cent of farmers trainees belonged to the high level of knowledge category, followed by 40.96 per cent of farmers trainees had a medium level of knowledge and only 2.13 per cent of trainees had a low level of knowledge.

Table 4: Distribution of farmer trainees according to their knowledge level pre- and after the training programmes

SN.	Knowledge level	Pre-training F (n=188)	Post-training P
1.	Low (up to 8.29 score)	112	59.57
2.	Medium (>8.29 to 14.55 score)	69	36.70
3.	High (>14.55 score)	7	3.72
	Total	188	100

$X=11.42$, $\sigma=3.13$

2) Knowledge gain of line department trainees in training programmes: It is indicated in Table 5, that the mean knowledge score after completion of the training programme was 19.95, as compared to the mean knowledge before training, which was 14.58. The calculated 't' value (Table 6) was found to be significant, which clearly indicate that there was a significant increase in knowledge level after attending the training programme. An average of 52.08 per cent of line department trainees knew pond construction and water quality management prior to the training programme, whereas this proportion was increased significantly

($P < 0.01$) after the training programme (70.50%), similarly about 56.67 per cent line department trainees had prior knowledge on the subject of fish rearing and feed management, which increased to 69.04 per cent after the training programme. Similarly, on the subject of breeding and larva rearing, more than half of the respondents (44.17%) had knowledge prior to the training programme, which significantly ($P < 0.05$) improved after the training programme (58.33%). It also revealed that an average of 31.25 per cent of line department trainees had prior knowledge about the health care management of fish, after the training programme, the average improved to 56.88 per cent of responses. In the context of harvest and post-harvest technology, an average of 60.00 per cent of line department trainees had prior knowledge, which improved by 80.63 per cent after the training programme. The data further revealed that 43.75 per cent of line department trainees had prior knowledge about information and communication technology, which significantly ($P < 0.05$) improved (70.63%) after the training programme. Overall, increase from 47.99 per cent to 67.67% of line department trainees' knowledge in different dimensions of fisheries and aquaculture after the training programme and this increase was significant at $P < 0.01$. Results of the paired *t*-test indicated that there was a significant difference in the knowledge level of the line department trainees prior to and after the training programme. The mean score for pre-training knowledge was (Mean= 14.58, $n=40$) and the mean score for the post-training knowledge was (Mean=19.95, $n=40$). The test statistics revealed that there is a significant difference in the mean score of knowledge score of trainees before and after the training programme at the 0.0090 level (2-tailed). Results suggest that the training programme conducted by the College of Fisheries Lembucherra has a positive and significant impact on the knowledge level of the line department trainees.

Table 5: Impact of a training programme on the knowledge level of line department pre and after the training programme

Statement	Correct responses (n=40) (%)		Mean correct responses	
	Pre -Training	Post- Training	Pre - Training	Post - Training
Pond Construction and water quality management-				
e) What is the desired colour of water for fish Growth	33 (82.50%)	36 (90.00%)	0.825	0.900
f) How much quantity of cow dung is required to fertilize one hectare of pond?	15 (37.50%)	30 (75.00%)	0.375	0.750
g) How much Kg of Urea is required to fertilize one kani of the pond?	18 (45.00%)	20 (50.00%)	0.450	0.500
h) What is the optimum concentration of dissolved oxygen for fish culture	27 (67.50%)	28 (70.00%)	0.675	0.700
i) What is the optimum pH of Water for fish culture	19 (47.50%)	27 (67.50%)	0.475	0.675
j) How much quantity of Lime is required to correct the water pH?	13 (32.50%)	19 (47.50%)	0.325	0.475
Average: -	20.83 (52.08%)	26.67 (70.50%)	0.521	0.667
Fish Rearing and Feeding Management-				
e) How many times in a day feeding should be done?	30 (75.00%)	35(87.50%)	0.750	0.875
f) Rate of application of bleaching power for eradication of weed fish and other aquatic animals in nursery pond	21 (52.50%)	26 (65.00%)	0.525	0.65
g) What is the optimum fish production in scientific fish culture (culture of IMC)?	18 (45.00%)	25 (62.50%)	0.450	0.625
h) Recommended stocking density of spawn of Osteobrama belangeri	23 (57.50%)	28 (70.00%)	0.575	0.700
i) What is the ratio of fishes in Polyculture of Catla, rohu and mrigal?	26 (65.00%)	27 (69.23%)	0.650	0.692
j) Pengba is predominantly	18 (45.00%)	24 (60.00%)	0.450	0.600
Average: -	22.66 (56.67%)	27.5 (69.04%)	0.566	0.690
Breeding and Larva Rearing-				
e) Catla, Rohu and Mrigal are bred during	26 (65.00%)	27 (67.50%)	0.650	0.675
f) Which stage of fish is culture in the nursery pond?	29 (72.50%)	30 (75.00%)	0.730	0.750
g) Fecundity of Cirrhinus reba	22 (55.00%)	28 (70.00%)	0.550	0.700
h) Desirable% of survival of spawn to Fry of carps	10 (25.00%)	20 (50.00%)	0.250	0.500
i) Fecundity of Osteobrama belangeri (180-220g)	7 (17.50%)	21 (52.50%)	0.175	0.525
j) Hatching period (hour) of Osteobrama belangeri	12 (30.00%)	14 (35.00%)	0.300	0.350
Average: -	17.67 (44.17%)	23.33 (58.33%)	0.442	0.583
Health care management-				
e) Saprolegniasis disease is mostly occurs in which stage of fish	26 (65.00%)	35 (87.50%)	0.650	0.875
f) Which one is the important fish disease occurring in the northeast region?	4 (10.00%)	16 (40.00%)	0.100	0.40
g) Gas Bubble disease is occurs due to	14 (35.00%)	23 (57.50%)	0.350	0.575
h) Gil rot disease is due to	6 (15.00%)	17(42.50%)	0.150	0.425
Average: -	12.5 (31.25%)	22.75 (56.88%)	0.313	0.569
Harvest and Post -harvest Technology-				
f) What is the name of the net used for harvest the fish?	28 (70.00%)	34 (85.00%)	0.700	0.850
g) After harvesting fish should be kept in	14 (35.00%)	28 (70.00%)	0.350	0.700
h) Which one is the chief method of fish preservation?	16 (40.00%)	27 (67.50%)	0.400	0.675
i) Fish is a good source of -	38 (95.00%)	40 (100.00%)	0.950	1.000
Average: -	24 (60.00%)	32.25 (80.63%)	0.600	0.806
Information and communication technology-				
e) Google is a	14 (35.00%)	30 (75.00%)	0.350	0.750
f) Android is a	12 (30.00%)	29 (72.50%)	0.300	0.725
g) Which application is used for send money?h) Kishan Call Centre is launched to	40 (100.00%) 4 (10.00%)	40 (100.00%) 14 (35.00%)	1.000 0.100	1.000 0.350
Average: -	17.5 (43.75%)	28.25 (70.63%)	0.470	0.706
Overall average Reponses: -	19.19 (47.99%)	26.79 (67.67%)	0.485	0.670

Table 6: Impact of a training programme on knowledge level of line department trainees

Pair 1	Mean	Std. Deviation	Std. Error Mean	t	Sig. (2-tailed)
Pretest	14.58	3.47	0.549	-17.142	0.0093
Posttest	19.95	3.05	0.482		

Relative knowledge gain

$$RKG = \frac{\text{Post Test Score} - \text{Pre Test score}}{\text{Pre Test Score}} \times 100$$

Relative Knowledge Gain (RKG) was calculated to assess the percentage increase in trainees' knowledge relative to

their baseline knowledge level before attending the training programme. The analysis revealed the farmers' trainees had a relative Knowledge Gain of 83.93 per cent, while officials of the line department had a relative knowledge gain of 41.01 per cent, indicating that the farmers trainees acquired more knowledge from base knowledge. In the case of the official of the line department, they already have a high base

knowledge about fisheries and aquaculture; the training programmes improved their knowledge by 41 per cent. Argade *et al.*, (2023) observed significant positive improvements in fish farmers' knowledge following skill development training programmes conducted in Bihar. Singh and Tanwar (2020) [66] reported that vocational training programmes on integrated fish farming significantly enhanced trainees' knowledge levels, confirming the usefulness of knowledge gain measures in evaluating fisheries training programmes.

C) Relationship of Independent variables with Knowledge gain by trainees

From Table 7, it is evident that education, experience and innovativeness have positive and significant correlation with knowledge level on fish farming of the trainees. From this, it is evident that as education increases, the level of knowledge of trainees also increases. It facilitates their having better access to farm information sources such as farm magazines, farm bulletins, books on aquaculture, etc. and possessing a better capacity to grasp things and analyze and interpret them in proper ways. Further, educated people have more exposure to extension agencies, scientists,

research stations, etc., which also contributes to their increased knowledge. The similar finding was reported Sriramana (2014) [69]. In the case of farming experience, the table shows that there is a positive and significant relationship between farming experience and the knowledge level of trainees. It is evident that as farming experience increases, the level of knowledge of trainees also increases. This might be due to most of the fisheries trainees having medium farming experience, which allows them to grasp training concepts more easily and apply new knowledge effectively during the training programme. Their practical experience could enhance their ability to relate the theoretical concept to real-world situations. It is clear from the table that there was a positive and significant relationship between innovativeness and the level of knowledge of the trainees. This means that the higher the innovativeness of the trainees, the higher the level of knowledge gained. This trend might be because farmers with high innovativeness desire to seek changes in farming techniques and introduce changes in their own operations. This desire makes him acquire innovations directly from scientists in terms of knowledge about recommended practices.

Table 7: Correlation coefficient of profile characteristics of trainees with their knowledge gain

Socio-economic profile	Correlation Coefficient (r)	Sig. (2-tailed)
Age	-0.098	0.180
Education	0.244**	0.001
Experience	0.146*	0.046
Pond area	0.065	0.376
Family size	-0.132	0.070
Annual Income	0.133	0.069
Occupational status	-0.108	0.141
Innovativeness	0.177*	0.015
Market orientation	-0.038	0.604
Scientific orientation	-0.117	0.110
Economic orientation	0.052	0.480
Mass Media	0.098	0.182
Extension Contact	-0.112	0.126
Perception of Trainees	-0.084	0.252

* Correlation is significant at 0.05 level (2 tailed), **Correlation is significant at 0.01 level (2 tailed)

Discussion

The findings revealed that the majority of fish farmer trainees belonged to the young age group, indicating a greater willingness among younger farmers to adopt innovations and participate in training programmes (Bello, 2000; Argade *et al.*, 2023) [10]. According to Singh *et al.*, (2010) [67] Age and trainee occupation had significant influence on the adoption decision of beekeeping vocation, whereas education and family income significantly affected the adoption decision of farmers. Most respondents had education up to the high school level, which may facilitate better understanding and adoption of improved aquaculture practices (Abdullahi, 2010) [1]. Similar findings were reported by Nyamwamu *et al.*, (2014) [48] and Chauhan *et al.*, (2022) [18]. The majority of respondents belonged to medium-sized families and possessed pond areas up to 0.40 ha, reflecting the predominance of small-scale fish farming. Similar observations were reported by Upadhyay *et al.*, (2012) [72]. Small pond owners can benefit significantly from training programmes that enhance productivity and resource utilisation. Family size also influences household

income and labour availability (Ali *et al.*, 1995) [4]. Most trainees had limited fish farming experience, which may increase their willingness to learn and adopt improved technologies (Lawal, 2021) [37]. The respondents exhibited medium levels of economic orientation, market orientation, mass media exposure, and extension contact, all of which positively contributed to training effectiveness. Similar findings have been reported by Singh *et al.*, (2023), Sangma *et al.*, (2022) [61], and Sennuga *et al.*, (2020) [62]. The increase in knowledge may be attributed to the practical demonstrations, expert interactions, and need-based training content provided during the programme. Similar results were reported by Senthilkumar *et al.*, (2016) [63], who found substantial improvement in knowledge levels of fish farmers after training interventions. Sennuga *et al.*, (2020) also emphasized that training enhances farmers' knowledge, skills, and capacity to adopt improved technologies. Likewise, Lynton and Pareek (2011) stated that training serves as a systematic process for increasing knowledge, developing skills, and bringing desirable changes in attitudes and behaviour. The findings are further supported

by Chauhan *et al.*, (2022), who reported significant knowledge enhancement among fisheries trainees following participation in structured training programmes. Therefore, the observed knowledge gain confirms that training is an effective extension tool for strengthening the technical competence of fish farmers and promoting the adoption of improved aquaculture practices. The positive effectiveness of training programmes observed in the study is in agreement with the findings of Senthilkumar *et al.*, (2016), who reported significant improvements in knowledge and skills among trained fish farmers. Overall, socio-economic and communication characteristics played an important role in influencing the effectiveness of fisheries training programmes. The findings of Mgendi *et al.*, (2021) ^[43] indicate that a number of factors, including the number of years of education of the household head, sex, size of farmland owned by farmers, distance from household to the training center (ATDC), association membership, access to extension advice, credit, and irrigation farm, are likely to have a significant impact on the farmers' participation in the training program.

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Conclusion

From this research finding it can be concluded that the training programmes conducted by the College of Fisheries, Agartala, Tripura, in different subject areas: fish processing, fish by product, aquaculture, pathology, marketing and information and communication technology, have improved the knowledge, skill, and overall confidence of the farmers from the northeast India who participated in the training programmes. In the context of the knowledge gain, the majority of trainees acquired skills and knowledge in training programmes from the base knowledge; evidence from the relative knowledge gain and paired *t*-test score showed a significant difference. Overall, the training programmes were highly effective in terms of knowledge and skill gain. To further improve the effectiveness of training programmes, the majority of the trainees suggested that adequate duration for training should be provided, more focus should be given on the practical portion etc.

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