



Training Needs of Fish Farmers for the Development of Fisheries and Aquaculture in Meghalaya

Wandame Niangti¹, Yumlembam Jackie Singh¹, Biswajit Lahiri^{1*}, Anil Datt Upadhyay¹, Prasenjit Pal¹, Martina Meinam¹, Huirem Bharati² and Maitarambum Wartung Monsang¹

¹Department of Fisheries Extension, Economics and Statistics, College of Fisheries, Lembucherra, Central Agricultural University, Imphal, India

²ICAR-Research Centre for NEH Region, Tripura Centre, Lembucherra, India

*Corresponding mail email id: biswajit.lahiri@gmail.com

HIGHLIGHTS

- Key training needs include aquaculture, hatchery management, disease control, fish seed production, value addition, and pond construction.
- Higher income and information access drive demand for advanced fisheries training.
- Farmers with larger ponds and more experience perceive less need for further training.

ARTICLE INFO

Keywords: Training needs assessment, Fish farmers, Meghalaya, Socio-economics.

<https://doi.org/10.48165/IJEE.2025.61209>

Conflict of Interest: None

Research ethics statement(s):

Informed consent of the participants

ABSTRACT

The study assessed the training needs of fish farmers in the West Garo Hills and Ri-Bhoi districts of Meghalaya from the data collected with pre-tested semi-structured interview schedule from a randomly selected sample of 90 respondents from eight villages across four blocks. Training needs were prioritised using the Training Need Index (TNI). The study revealed that the majority of respondents were middle-aged (71.11%), had a secondary school education (37.78%), belonged to nuclear families (48.89%), and had up to 5 years of experience in fish farming (80%). Most respondents earned an annual income of up to ¹ 50,000 from fish farming (83.33%). The top areas of need were aquaculture (TNI 100.00), hatchery management, fish seed production, nursery management (TNI 97.03), and disease prevention and control in fish (TNI 96.29). Other needs included fish processing (TNI 70.00), pond construction and equipment management (TNI 62.2), recreational fisheries (TNI 56.59), and communication tools for fish farmers (TNI 48.51). The key training requirements were carp culture, broodstock maintenance and breeding, fish disease management, value addition, hatchery construction, recreational pond development, and leveraging social media for information sharing. These findings emphasise the need for targeted training programmes to enhance fish production and productivity.

INTRODUCTION

Fisheries is a significant sector in India, providing food security and income for approximately 16 million people engaged in part-time or full-time activities (Fisheries Statistics, 2023). Meghalaya, one of India's Northeastern states, lies between 25°34'12" N latitude and 91°52'47" E longitude. The state is rich in biodiversity and inland fisheries resources, including rivers, reservoirs, lakes, and ponds. The annual rainfall of 1200 mm in the

state offers tremendous potential for the development of fisheries by efficient fisheries resource management and conservation (Lahiri et al., 2024). The predominantly hilly terrain limits fish farming, resulting in a local fish production of 0.019 million tonnes (mt) in 2022–23, with a per capita fish consumption of 10.3 kg. The state's fish production is yet to match the domestic demand. Hence, the state still relies on fish imports from Andhra Pradesh, West Bengal, and Assam to meet its demand (Fisheries Statistics, 2023). Thus, it is essential to adopt scientific fish production practices by the

fish farmers in the state to increase production and productivity, which can be achieved through need-based training and capacity building of the fish farmers in scientific fish farming practices.

Targeted training and capacity-building programmes are essential to equip fish farmers with the skills needed to increase production and improve livelihoods. Training helps enhance competencies, skills, and capabilities, thus enabling farmers to adopt improved practices and explore entrepreneurial opportunities (Jaiswal et al., 2019). Effective training requires a thorough needs assessment, addressing aspects like who needs training, what content is essential, and how it should be delivered (Pholonngoe & Richard, 1995; Nain & Kumar, 2001; Barbazette, 2006; Sajeev et al., 2012; Paul et al., 2015; Raina et al., 2017). Moreover, it is important to evaluate training effectiveness by measuring its alignment with goals and the successful transfer of knowledge and skills (Kumar et al., 2021). Training should emphasise the adoption of tacit knowledge for sustainable outcomes (Sajeev & Singha, 2010; Alabi & Ajayi, 2013; Pandey et al., 2015; Lahiri et al., 2024). Training Needs Assessment (TNA) is crucial for identifying suitable strategies, determining participants, and tailoring content to improve performance (Bhagat & Nain, 2005; Clarke, 2012). Approximately 30% of Meghalaya's total land area of 22,429 km² holds potential for fisheries development. Factors like limited job opportunities, availability of resources, and changing dietary preferences have increased interest in fisheries (MSAM, 2018).

Ri-Bhoi district, contributing 20% of the state's pond and mini barrage area, has an annual production potential of 1398 t. Similarly, West Garo Hills, the state's largest district, holds 24% of Meghalaya's wetland area (7,196 ha) and produced 0.221 million fish seeds in 2014–15 (Bhalerao et al., 2015). Assessing training needs optimises time and resources, fosters participation, and strengthens fisheries production (Kumar et al., 2024). Policymakers should prioritise need-based strategies to empower fish farmers and promote sustainable fisheries development in Meghalaya (Lahiri et al., 2020; Sajeev et al., 2021).

METHODOLOGY

The study was conducted in the Ri-Bhoi and West Garo Hills districts of Meghalaya. These two districts were purposively selected due to their significant fish farming activities. Within each district, two blocks were chosen based on the density of fish farmers: Umling and Umsning blocks in the Ri-Bhoi district and Rongram and Dadengre blocks in the West Garo Hills. Eight villages (two per block) were identified from the selected blocks, ensuring a diverse representation of fish farmers engaged in various aquaculture practices. The final sample consisted of 90 respondents, selected by a simple random sampling method, comprising small-scale fish farmers actively involved in fish farming. A semi-structured interview schedule was developed, and pre-tested to ensure the clarity, reliability, and validity of responses. Data collection was conducted through personal interviews and field visits to fish farms and households. Primary data was obtained directly from the respondents, while secondary data was collected from government reports, extension bulletins, research articles, and other relevant sources related to aquaculture development in Meghalaya. The

Training Need Index (TNI) was calculated using the actual-to-maximum score method to systematically identify and prioritise the specific training needs of fish farmers. The index provided a quantitative measure to prioritise the levels for different training areas based on farmers' responses. The TNI was computed using the following formula:

$$\text{Training Need Index (TNI)} = \frac{\text{Total Score Obtained}}{\text{Maximum Obtainable Score}} \times 100$$

Higher TNI values indicate a greater demand for training in specific areas. The study identified seven key training domains based on experts' opinions relevant to the fish farmers of Meghalaya. The seven identified domains were aquaculture, fish product processing, disease prevention and control, hatchery management (including fish seed production and nursery operations), pond construction and equipment handling, recreational fisheries, and communication tools for fish farmers. Pearson's correlation coefficient (*r*) was applied to analyse the relationship between the training needs (dependent variable) and various independent variables, including farmers' age, education level, farm size, years of experience, and access to extension services. *t*-test was conducted to test the significance of the correlation coefficient.

RESULTS

Dynamics of training needs of the fish farmers

The adoption of fish farming among respondents is influenced by multiple factors, including age, education, family structure, pond size, experience, occupation, income, training, access to information, social participation, and extension contact. As shown in Table 1, the overall training need index (TNI) of fish farmers in the study area is 75.56, indicating a substantial requirement for training across various subject areas. Among these, aquaculture ranked highest (TNI 100, I), highlighting its critical importance. This was followed by hatchery management, fish seed production, and nursery management (TNI 97.03, II). Disease prevention and control in fishes (TNI 96.29, III) ranked third. Other key training areas included fish product processing (TNI 70, IV), pond construction and management, fish farming, and fishing equipment management (TNI 62.22, V). Recreational fisheries (TNI 56.29, VI) and communication tools for fish farmers (TNI 48.51, VII) were also identified as training priorities, albeit with relatively lower demand.

From Table 2, it is observed that under aquaculture and its allied sector, the *culture of carps* (TNI 96.29, I) emerged as the most needed training followed by the *composite culture of fishes* (TNI 95.92, II); *culture of other economic and commercial fish species* (TNI 95.18, III); *management during pre-stocking and post stocking of fishes* (TNI 93.70, IV); *pond handling and management* (TNI 93.33, V) and *management techniques of fish farms* (TNI 92.59, VI). *Rearing of locally available fish species* (TNI 33.17, XI) scored the least among the different training needs identified under Aquaculture. Training needs in the Processing of Fish Products revealed that fish farmers mostly require training in the *value addition of fish products* (TNI 71.48, I) as the most processed fish products, fermented and dry fishes, were imported from other

Table 1. Major areas of training needs of the fish farmers

S. No.	Major areas of training needs	Training Need Index (TNI)	Rank
1.	Aquaculture	100.00	I
2.	Processing of fish products	70.00	IV
3.	Disease prevention and control in fishes	96.29	III
4.	Hatchery management, fish seed production, and nursery management	97.03	II
5.	Pond construction, management of fish farming and fishing equipment	62.22	V
6.	Recreational fisheries	56.29	VI
7.	Communication tools for fish farmers	48.51	VII
	Overall Training Need Index	75.76	

states. This was followed by the *various methods of preservation of fish products* (TNI 65.92, II), *methods of packaging* (TNI 62.22, III), *various methods of fish drying* (TNI 50.37, IV) and *processing of fish by-products* (TNI 41.85, V).

Fish farmers identified *remedial measures for common fish diseases* (TNI 97.77, I) as the most critical training need, particularly due to the prevalence of diseases like epizootic ulcerative syndrome (EUS) and their lack of scientific knowledge to manage them. Other key training areas included the *identification of factors causing fish diseases* (TNI 96.67, II), *mitigation and treatment of polluted water in fish ponds* (TNI 95.18, III), and *soil and water quality management* (TNI 90.37, IV). Fish farmers prioritized the *maintenance and breeding of brooders* (TNI 97.03, I) as the most essential training area. This was followed by the *nursery and rearing of fish seeds* (TNI 96.67, II) and the *development of low-cost local hatcheries* (TNI 92.22, III). Other training needs included *packaging and transportation of fish seed* (TNI 89.25, IV) and *utilisation and maintenance of plastic hatcheries* (TNI 78.51, V), which ranked lowest, likely due to cost concerns. The highest-ranked training need was *hatchery construction* (TNI 76.29, I), reflecting a strong interest in fish seed production. Other key areas included *scientific fish farm construction* (TNI 68.51, II), while *construction and repair of indigenous fishing equipment* (TNI 48.14, III) ranked third. Training in the *operation and management of modern fishing equipment* (TNI 41.18, IV) had the lowest demand, as farmers viewed modern equipment as expensive and complex to operate. Many fish farmers in Meghalaya lease ponds for sport fisheries, particularly angling (Sangma et al., 2025). The top training need was the *construction of recreational ponds* (TNI 76.29, I), followed by the *selection of fish species for sport fishing* (TNI 68.51, II) and the *selection and utilisation of angling gears* (TNI 41.48, III). The *construction of fish parks and sanctuaries* (TNI 41.48, IV) had the least demand due to concerns about financial viability. The most preferred training area was the *use of social media for information sharing* (TNI 57.40, I), as platforms like Facebook and WhatsApp help farmers connect with peers and customers. Other training needs included *mobile applications for fish farmers* (TNI 43.70, II), *e-Agriculture initiatives* (TNI 35.80, III), and *ICTs in fisheries* (TNI 35.80, III). *Usage of KVK/Farmers' Portal* (TNI 34.81, IV) ranked lowest due to limited awareness and guidance.

Table 2. Training needs of fish farmers under different sub-domains (n=90)

Major areas of training needs of the fish farmers	Training Need Index (TNI)	Rank
Aquaculture		
Pond handling and management	93.33	V
Composite culture of fishes	95.92	II
Culture of carps	96.29	I
Culture of other economic and commercial fish species	95.18	III
Management during pre-stocking and post-stocking of fishes	93.70	IV
Management techniques of fish farms	92.59	VI
Integrated farming	88.14	VII
Breeding of ornamental fishes	35.18	IX
Rearing of locally available fish species	33.17	XI
Fabrication of aquarium	34.44	X
Feed preparation	68.89	VIII
Processing of Fish Products		
Value addition of fish products	71.48	I
Various methods of fish drying	50.37	IV
Methods of packaging	62.22	III
Processing of fish by-products	41.85	V
Methods of preservation of fish products	65.92	II
Disease Prevention and Control		
Remedial measures of common fish diseases	97.77	I
Identification of different factors causing fish diseases	96.67	II
Mitigation and treatment of polluted water in fish farmers' ponds	95.18	III
Soil and water quality management	90.37	IV
Hatchery Management, Fish Seed Production & Nursery Management		
Development of low-cost local hatcheries	92.22	III
Nursery and rearing of fish seeds	96.67	II
Maintenance and breeding of brooders	97.03	I
Utilisation and maintenance of plastic hatcheries	78.51	V
Process of packaging and transportation	89.25	IV
Pond Construction and Management of Fish Farming/Fishing Equipment		
Fish farm construction	68.51	II
Construction of hatcheries	76.29	I
Construction and repairing of indigenous fishing equipment	48.14	III
Operation and management of modern fishing equipment	41.48	IV
Recreational Fisheries		
Types of fish species stocked for sport fishing in ponds	68.51	II
Selection and utilisation of fishing/angling gears	41.14	III
Construction of recreational ponds	76.29	I
Construction of fish parks and sanctuary	41.48	IV
Communication tools for fish farmers		
Mobile applications for fish farmers	43.70	II
Usage of KVK/Farmers' Portal	34.81	IV
Use of social media for information sharing	57.40	I
e-Agriculture initiatives	35.18	III
ICTs in Fisheries	35.18	III

Relationship between the training needs (dependent variable) and various independent variables

Table 3 shows that annual income and access to information sources exhibit a significant positive correlation with training needs, whereas pond area and fish farming experience show a significant negative correlation. Similarly, Anshuman et al., (2024) highlighted the importance of delivering essential information to boost farmers' productivity. Fish farmers with smaller pond areas often lack the necessary resources and knowledge to engage in fish farming, increasing their need for training programmes. These findings indicate that training needs are directly influenced by annual income, access to information sources, pond area, and fish farming experience.

Table 3. Correlation between training need and other independent variables

S.No.	Variables	Correlation coefficient
1.	Age	-0.074
2.	Education	0.145
3.	Sex	0.104
4.	Family size	-0.115
5.	Pond area	-0.109*
6.	Occupation	0.999
7.	Annual income	0.076*
8.	Experience in fish farming	-0.043*
9.	Training undergone	-0.021
10.	Source of information	0.257*
11.	Social participation	0.089
12.	Economic motivation	0.042
13.	Risk orientation	0.126
14.	Extension contacts	-0.057

(* Indicates significant at 5% level of significance)

DISCUSSION

Fisheries and aquaculture are important to a region's socioeconomic growth (Biswas et al., 2025). The high demand for aquaculture training aligns with previous studies emphasising the growing interest in scientific fish farming methods among farmers in the region. Farmers expressed a need for training in integrated and composite farming systems to enhance production and sustainability. Additionally, the dependency on fish seed imports has driven interest in hatchery management and nursery techniques, highlighting the necessity of establishing local hatcheries for better seed availability and reduced transportation costs (Debashis & Kumar, 2023). The findings indicate that disease prevention and control is a critical training priority, as fish farmers struggle with common diseases like epizootic ulcerative syndrome (EUS), leading to financial losses. Farmers require training in early disease detection, water quality management, and treatment protocols to minimise economic losses. The demand for training in water and soil quality management further highlights the challenge of acidic soil in the northeast region, which directly affects fish health and productivity. Mondal et al., (2025) reported that 78% of respondents exhibited medium to high training needs, with fish disease control and feeding strategies identified as key priority areas.

The high demand for hatchery management and fish seed production training reflects the state's dependency on fish seed imports. Fish seeds are primarily procured from Assam and other states, making their availability and cost a concern. Establishing local hatcheries not only improves seed availability but also reduces transportation costs and increases convenience for fish farmers. Hijam et al., (2015) reported that fish farmers have the highest training requirements in critical areas such as fish disease management, hatchery management, fish seed production, nursery management, and aquaculture. Training in pond construction and management is crucial, as many farmers lack scientific knowledge in farm planning and infrastructure development. Mondal et al., (2025) highlighted that knowledge of pond design and construction is essential for creating an optimal environment for fish growth. These skills can help farmers enhance fish stock quality and productivity. Additionally, the low preference for training on modern fishing equipment suggests that farmers continue to rely on indigenous fishing methods, which are cost-effective and locally accessible. This aligns with the observation that the construction and repair of indigenous fishing equipment ranked higher than modern fishing techniques in training needs. Training in fish processing and value addition is crucial for reducing dependency on imported fish products and promoting self-sufficiency among fish farmers. The strong demand for fish preservation, packaging, and drying techniques suggests potential for fisheries-based entrepreneurship and value chain development in Meghalaya. Since the majority of processed fish products, including fermented and dried fish, are imported from other states, farmers expressed an interest in training programmes that could help them develop their fish processing businesses.

The strong interest in social media-based training highlights the growing role of digital tools in fisheries extension. Social media platforms such as Facebook and WhatsApp serve as important tools for information sharing and business promotion (Awashreh & Bremananth, 2025). However, the low awareness of KVK portals and ICT initiatives suggests the need for targeted interventions to improve digital literacy among fish farmers. Improving access to mobile applications for fish farmers and e-Agriculture initiatives could enhance the dissemination of fisheries-related knowledge and best practices (Odunlade & Isikwei, 2025). Specific training priorities include the culture of economically important fish species, production of *Shidal* (fermented fish product) in fish processing, identification of causative factors for fish diseases, maintenance and operation of portable plastic carp hatcheries, and the design and construction of hatchery infrastructure. Fish farmers with higher annual incomes may have a significant advantage of starting up or expanding fish farming activities on a larger scale. So, they may seek more information, knowledge on innovative technologies, and other necessary inputs for their fish farming activities. Similarly, fish farmers having more access to different information may tend to develop more interest in fish farming, thereby seeking more training in fisheries activities. Arun Kumar et al., (2021) emphasised that poorly assessed training needs lead to inefficient resource use, with factors like motivation, job performance, self-attitude, and media exposure greatly impacting training effectiveness. Nain and Chandel (2010) emphasised that the variables like family

occupation, land holding, economic motivation, innovative proneness and information sources utilisation were positively and significantly associated with training needs of respondents.

The study emphasises the critical need for targeted training programmes in Meghalaya's fish farming sector. Future initiatives should focus on strengthening capacity in key areas such as aquaculture, fish disease management, hatchery operations, and value-added processing to promote sustainable and profitable fisheries and aquaculture in the region. The findings reinforce the need for location-specific training to address the unique challenges of the region and support the sustainable development of the fisheries sector. Well-designed training initiatives are essential to improving fish farming sustainability, profitability, and ultimately, the livelihoods of fish farmers in Meghalaya.

CONCLUSION

Fisheries and aquaculture in Meghalaya remain underutilised despite their immense growth potential. Targeted capacity-building programmes are essential for fish farmers, enhancing productivity and income. Strengthening linkages among fisheries' stakeholders is vital for efficient knowledge transfer and resource utilization. Awareness programmes on key aspects like government schemes, financial support, diagnosing fish and pond health issues are crucial. The business skills of fish farmers could have also been included as a domain for training needs assessment in this study, as business skills are vital for profitability and sustainability in transforming the fisheries sector. Financial management, marketing, and supply chain efficiency help farmers maximise profit; expand opportunities, ensuring long-term success. The fish farmers in the study location were mostly smallholder traditional farmers with considerably low production level to scale up to the business level. Hence, only the aspects necessary to increase the fish production and productivity at the farmers' level were included.

REFERENCES

- Alabi, O. S. & Ajayi, A. O. (2013). Analysis of knowledge, attitude and practices of small ruminant farmers for training needs identification in south-western Nigeria. *African Journal of Livestock Extension*, 11, 15-22.
- Anshuman, J., Kaur, R., Rampal, V. K., & Jayasingh, D. K. (2024). Factors Affecting Training Effectiveness of Extension Personnel in PAMETI, Punjab. *Indian Journal of Extension Education*, 60(4), 73-76.
- Arun Kumar, G. S., Nain, M. S., Singh, R., Kumbhare, N. V., Parsad, R., & Kumar, S. (2021). Training effectiveness of skill development training programs among the aspirational Districts of Karnataka. *Indian Journal of Extension Education*, 57(4), 67-70.
- Awashreh, R., & Bremananth, R. (2025). General Managers and Executives Interacting on Social Media Platforms: Is it a Necessity? In: *Innovative and Intelligent Digital Technologies; Towards an Increased Efficiency: Volume 2* (pp. 1069-1080). Cham: Springer Nature Switzerland.
- Barbazette, J. (2006). Training needs assessment: methods, tools, and techniques. John Wiley & Sons.
- Bhagat G.R. & Nain M.S. (2005) Training needs of farmers in Shiwalik hills of Jammu and Kashmir. *Indian Research Journal of Extension Education*, 5(2), 44-46.
- Bhalerao, A. K., Kumar, B., Singha, A. K., Jat, P.C., Bordoloi, R., & Deka Bidyut, C. (2015). West Garo Hills district inventory of agriculture, ICAR-Agricultural Technology Application Research Institute, Umiam, Meghalaya, India. 21pp.
- Biswas, P., Lahiri, B., Singh, S. K., Shil, B., Chakraborty, R., & Pavan Kumar, S. T. (2025). Water resources and fisheries production dynamics for development of the fisheries in Sepahijala district of Tripura, India. *Indian Journal of Extension Education*, 61(1), 1-6. <https://doi.org/10.48165/IJEE.2025.61101>
- Clarke, N. (2003). The politics of training needs analysis. *Journal of Workplace Learning*, 15(4), 141-153. <http://dx.doi.org/10.1108/13665620310474598>
- Dash, D., & Kumar, B. (2023). Vocational training needs of rural youth in agriculture for self-employment in Udham Singh Nagar of Uttarakhand. *Indian Journal of Extension Education*, 54(4), 91-97. <https://epubs.icar.org.in/index.php/IJEE/article/view/143571>
- Handbook of Fisheries Statistics. (2023). Inland Fish Production: 2019-20. Government of India, Ministry of Fisheries, Animal Husbandry and Dairying Krishi Bhavan, New Delhi, 19pp. <https://cutt.ly/uf3qMDi> 2020.
- Hijam, B., Pandey, D. K., & De, H. K. (2015). Training need of fish farmers in Bishnupur district of Manipur: An analysis. *Indian Journal of Extension Education*, 51(3&4), 152-155. <https://epubs.icar.org.in/index.php/IJEE/article/view/144250>
- Jaiswal, M., Singh, A., Singh, K., & Singh, B. (2019). Training: An effective tool for transfer of agricultural technologies. *Indian Journal of Extension Education*, 55(2), 1-5.
- Kumar, V., Chauhan, J. K., Upadhyay, A. D., Pal, P., Lahiri, B., Ghosh, A., Singh, Y. J., & Chandegara, A. K. (2024). Assessment of training effectiveness for fish farmers of Tripura. *Indian Research Journal of Extension Education*, 24(2), 10-18.
- Lahiri, B., Anurag, T. S., Marak, B. R., Sangma, A. K., & Sangma, S. M. (2020). Development of mobile based fishery advisory prototype: An experience with fisher tribes of Garo Hills in North-Eastern Himalayan region of India. *Indian Journal of Fisheries*, 67(3), 10-17. <https://doi.org/10.21077/ijf.2020.67.3.88288-02>
- Lahiri, B., Kurmi, R. K., Singh, S. K., Ghosh, A., Pal, P., Pavan Kumar, S. T., Nirmalkar, C., & Debnath, A. (2024). Determinants of digitised farm information outreach in aquaculture: A case of mobile phone application for smallholder fish farmers in north east India. *Journal of the Knowledge Economy*. <https://doi.org/10.1007/s13132-024-02471-1>
- Mondal, A. H., Dana, S. S., Sarkar, M. R., Karjee, R., & Rej, N. (2025). Training Needs of Member Fish Farmers of FFPOs in Purba Medinipur District of West Bengal. *Indian Journal of Extension Education*, 61(1), 113-117. <https://doi.org/10.48165/IJEE.2025.611RN04>
- MSAM (2018). Report on Meghalaya State Aquaculture Mission 2.0. Department of Fisheries, Government of Meghalaya, Shillong.
- Nain, M. S., & Chandel, S. S. (2010) Determinants of farmers' training need in agri-horti farming system: A study of Doda district of J&K State. *Journal of Community Mobilization and Sustainable Development*, 5(1), 23-27.
- Nain, M. S., & Kumar, B. (2001). Trainers training need: An instructional system approach. *Indian Research Journal of Extension Education*, 1(2), 35-42.
- Odunlade, O. R., & Isikwei, B. (2025). Sustaining Africa's Blue and Digital Economy Transition: Emerging Skills and Job Roles. In: *Securing Sustainable Futures Through Blue and Green Economies* (pp. 173-194). IGI Global Scientific Publishing.

- Pandey, R. K., Doharey, R. K., Singh, R. K., Mishra, A. K., Pandey, J., Kumar, M., & Dwivedi, A. (2015). A critical analysis on training needs of farmers about mustard production technology. *International Journal of Agriculture Sciences*, 7(14), 892-895.
- Paul, N., Slathia, P. S., Kumar, R., & Nain, M. S. (2015). Training needs and constraints of extension officers in transfer of agriculture technology. *Journal of Community Mobilization and Sustainable Development*, 10(1), 24-28.
- Pholonngoe, M. B., & Richard, L. (1995). Training manual for non formal and adult education trainers. Extension Educator, Maseru: Lesotho Association of NFP.
- Raina, V., Nain, M. S., & Khajuria, S. (2017). Relationship between socio-personal variables and training needs of beekeepers in the Haryana State. *Journal of Community Mobilization and Sustainable Development*, 12(1), 61-64.
- Sajeev, M. V., Venkatasubramanian, V., & Singha, A. K. (2021). Identifying training needs of farmers and rural youth of Nagaland state. *Indian Journal of Extension Education*, 57(2), 115-122.
- Sajeev, M., & Singha, A. (2010). Capacity building through KVKs: Training needs analysis of farmers of Arunachal Pradesh. *Indian Research Journal of Extension Education*, 10(1), 83-90.
- Sajeev, M., Singha, A., & Venkatasubramanian, V. (2012). Training needs of farmers and rural youth: An analysis of Manipur State, *Indian Journal of Agricultural Sciences*, 3(2), 103-112. <http://dx.doi.org/10.1080/09766898.2012.11884691>
- Sangma, A. S., Lahiri, B., Ghosh, A., Pal, P., Singh, S. K., Tengli, M. B., Meinam, M., & Chandegara, A. K. (2025). Social values of angling tourism in the Garo Hills of Meghalaya, North East India: Fish farmers' perspectives. *Journal of Fisheries*, 13(1), 131206. <https://doi.org/10.17017/j.fish.690>