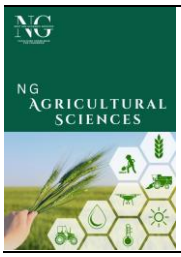

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Review Article

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Convergence in fisheries extension: bridging gaps for sustainable development

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HIGHLIGHTS

- Fisheries contribute 1.07% to India's GDP and employ 28 million people but face climate change and resource limitations.
- Various extension approaches (RAS, MVSE, FFS, MLE, Digital Extension) leverage advanced technologies like ICT, IoT, AI, and blockchain.
- Challenges include operational inefficiencies, digital divide, limited capacity, and funding constraints.

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ABSTRACT

The Indian economy depends heavily on fisheries because their annual GDP contribution amounts to 1.07% while providing jobs to more than 28 million people. India functions as the third-greatest fish producer worldwide because its fisheries business provides fundamental sustenance for food security and nourishment. The fishing industry experiences severe challenges because of climate change and passive market demands, and decreased available resources. The review inspects fisheries extension services to determine how well they tackle industrial shortcomings while producing sustainable outcomes. Convergence achieves its goal through joint operations between various stakeholders to boost the effectiveness of extension services. An evaluation process determines the joint effects of these approaches through which technology spreads while professionals develop new skills and gain access to markets. This review concludes by suggesting interagency cooperation efforts for better convergence together with increased education possibilities alongside blockchain and AI and IoT platform implementation. These interventions function as the base to increase fish farming capability and maintain a sustainable fisheries industry.

1. INTRODUCTION

Over several decades, fisheries have undergone sea transformations yet significantly contribute to India's economy (1.07% of the country's GDP). The fishery industry forms the livelihood for over 28 million people, notably our country's disadvantaged and marginalised communities. India firmly holds its position as the world's third-largest fish-producing country, contributing 7.96% to the

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global fish output. According to a survey report by the National Fisheries Development Board, Rs. 334.41 billion in export revenue is estimated to be produced by the aqua sector. Apart from its great economic importance, the fishery sector contributes immensely to food and nutritional security (Bhaumik, 2016). In compliance with the UN's Sustainable Development Goal, the Government of India has started prioritising the fishing industry to achieve a world free of hunger and malnutrition by 2030 (Ojha et al., 2020). As fish is a valuable source of intrinsic micronutrients, minerals, and fatty acids, a small portion can provide essential minerals like iodine, zinc, iron, calcium, phosphorus, potassium, and vitamins like A, D, and B (Mishra et al., 2017).

The changing demands and requirements for various aquaculture commodities in the era of globalisation necessitate that fishery farming communities adapt and compete for changes to feed and support the growing population sustainably (Masangano et al., 2017). Besides, some recent evidence highlights that the impact of climate change is a major concern for the fishing community. The coastal population is endangered by climate change, affecting their daily fish-catching activities (Sajesh et al., 2020). In this context, a strong extension system should mitigate these continuous hurdles. Extension and advisory services in the fishery sector mediate between research and the farming community. They provide the necessary information that the fishery farmers demand through different approaches to increase their livelihood (Sajesh et al., 2020). Cole (1977) explained in his study that fishery extension services promise to bring overall development to the fish industry. Some public and private sector entities and other organisations in India mainly provide advisory services. The central and state governments firmly establish policy guidelines, while the state departments effectively execute extension activities at the field levels through their respective Departments of Fisheries (DoFs) (De et al., 2008). The aqua farmers are provided technical, financial, and extension guidance from the Union government through various schemes.

Despite implementing numerous approaches, some of which may overlap with existing efforts, the fishing community still faces insufficient access to resources, hindering its overall growth (Pongener & Sharma, 2018). Since various stakeholders are involved in providing extension and advisory services to the aquaculture community, integrating their roles across the value chain is crucial. A concept like convergence appears in this scenario. Convergence implies collaboration between various stakeholders involved in a value chain and their participation at the required level. According to Sajesh et al. (2018), convergence entails a complex interplay of multiple actors, decisions, and resulting actions. It is imperative to analyse how decisions and actions by specific actors can either facilitate or impede the process. To bring convergence among various fish farming actors, it is important to analyse the challenges and problems hindering their coordination.

2. EXTENSION APPROACHES FOR TECHNOLOGY DISSEMINATION IN THE FISHERY SECTOR

Earlier, it used to be only public sector organisations involved in disseminating farm technologies with approaches like On Farm Trials (OFT), frontline demonstrations (FLD), field visits, or fishers' meetings. But for the past few decades, the previous approaches have been revamped to strengthen the research-extension linkage (Kumaran et al., 2012). The renewed mechanisms are more demand-driven and technology-oriented and ensure sustainable development, incorporated with a pro-poor, socio-economic approach.

2.1. Rural Advisory Services (RAS)

Rural Advisory Services (RAS) creates a platform to deliver innovative mechanisms, technology-assisted information, improved farm management practices, production management methods, and other forms of support to the fish farming community and other actors involved (Christoplos, 2010). They provide better management and business development guidance. RAS serves innovative approaches coupled with better marketing strategies and information related to better prices, products, seasonality, standards, value addition, and many more (Hara & Issacs, 2012). Another major support they provide is a link between fish farmers and various stakeholders. RAS helps to create a place to facilitate better resources and information with the help of FPOs involved in the fishery sector. In recent years, the utilisation of various ICT tools has emerged as a crucial trend in delivering a comprehensive range of information to fishers, encompassing weather updates, prices, extension programs, and general fisheries-related information (Mohanty et al., 2020). To assist small-marginalised fish farmers, RAS is promoting institutional and policy change. Key reforms in the RAS approaches include the effective establishment of Rural Resource Centres (RRCs), Fishermen Cooperative Societies, and Farmers' Producers Organisations (FPOs) to enhance market accessibility (Mohanty et al., 2020). Furthermore, RAS strongly advocates for establishing groups by actively inviting individual fishers, irrespective of their impact

on the social, economic, and political landscape. Still, with a group and better networking, certain people in society can deal with the dynamic changes and face challenges (Davis et al., 2016).

RAS actively participates in training fish farmers to improve their abilities and agricultural expertise. RAS trains fish farmers through different educational programs and practical workshops to provide them with the required expertise and abilities for better production methods, alongside market readiness skills. Fisheries training consists of two components: sustainable aquaculture practice education and fish health management lessons and water quality regulation expertise, and modern fisheries technology knowledge. The capacity enhancement of fish farmers through RAS practices results in economic growth of fishing communities while ensuring environmental sustainability and a secure food supply.

Table 1. Overview of Contemporary Extension Approaches in Fisheries

Approach	Description	Key Features	Reference
Rural Advisory Services (RAS)	Provides innovative mechanisms, technology-assisted information, and improved farm management practices	ICT tools, Rural Resource Centres (RRCs), Fishermen Cooperative Societies, Farmers' Producers Organisations (FPOs)	Christoplos, 2010; Mohanty et al., 2020
Model Village System of Extension (MVSE)	Community-based approach ensuring proper use of technology and societal benefits	Action research, Commodity-based village development (CBVD), Regular monitoring and evaluation	Bhaumik, 2016; Mohanty et al., 2020
Farmers Field School (FFS)	Decentralized approach addressing complex field-level challenges	Learning-by-doing, Group observation, Field-based experiments, Gender supportive	FAO, 2014; Qurani et al., 2021
Market-Led Extension (MLE)	Focuses on market-oriented training and resources	Entrepreneurial capabilities, Market-oriented training, Cooperatives and business associations	Mohanty, 2022; Vishwanathan et al., 2023
Digital Extension	Utilizes ICT tools for better technology transfer	GPS and sonar systems, IoT, AI, Blockchain, Various web portals and applications	Omar & Chhachhar, 2012; Lahiri et al., 2020

2.2. Model Village System of Extension (MVSE) approach

Model Village System of Extension (MVSE) is an approach that includes the community in ensuring technology is used properly in the fisheries and also helps the fisheries sector grow in a way that benefits society and gives people access to technology (Bhaumik, 2016). The approach is based on futuristic knowledge and skills. MVSE links producer to consumer by encouraging the active participation of all stakeholders. The approach incorporated with action research allows the organisation to mould its analysis according to individual requirements and implement practical individual-level changes (Mohanty et al., 2020). Increasing capacity development among the fishing community is another major role of this approach. Commodity-based village development (CBVD) is a major component of MVSE, creating a great marketing opportunity for fish farmers.

Through the MVSE approach, community members gain self-reliance along with empowerment since it puts them in control of their development initiatives. MVSE promotes fish farmer dedication by both involving residents in leadership roles and permitting them full control of their development programs. Cellular telephone networks promote technology distribution effectiveness because they

also distribute development benefits equally throughout community groups. MVSE uses regular monitoring assessments and evaluations to measure the impact of its initiatives before making essential program changes to meet new issues and possibilities.

2.3. Farmers Field School (FFS) approach

The previous extension approaches were more centralised, failing to meet the aqua farmers' basic needs. With more decentralized mechanisms, FFS emerged as a solution to address complex field-level challenges. The facilitator of any FFS can be a member from any NGO, a private company, or a public entity, and they provide extension services to the fish farmers. This approach systematically and effectively analyses the problems, provides the best alternatives, and strongly influences the participants to adopt the most suitable practices for their farming systems (FAO, 2014). A learning-by-doing approach that integrates group observation, discussion, and dissection and encourages field-based experiments and better decision-making abilities, followed by actions (Qurani et al., 2021). With the support from FFS, the fishery farming practices have become more technology-aided rather than practising conventional ones. This approach is considered gender supportive as it promotes the equal participation of female fish growers in society.

Fish farmers receive essential support through the FFS approach, which helps them create Continuous Learning and Adaptation practices. FFS develops a supportive atmosphere that fosters farmers to interact with one another for learning and tackling problems, and finding local solutions through experience exchange. Fish farmers gain improved technical abilities through this collaborative method and develop robust social networks that increase community resistance to challenges. Fish farmers who participate in FFS acquire abilities that allow them to address environmental changes and market requirements as well as technological progress, thus contributing to fisheries sector sustainability.

2.4. Market-Led Extension (MLE) approach

A significant revolution is occurring in the fishery industry due to changing consumption practices, technological innovation, diversification in marketing strategies, etc. Major changes have been found in the production, export, and marketing activities in the fishery sector all over the country (Vishwanathan et al., 2023). The fishery extension has also changed from being more production-oriented to market-oriented. The MLE approach focuses on harnessing advanced technologies and digital media to educate and empower fish farmers about various farming techniques, processing, value addition, consumer preferences, and market insights, fostering improvement and innovation in the industry (Mohanty, 2022). This approach promotes fish farmers as fish entrepreneurs who are expected to adopt diverse practices appropriate to local farming conditions to ensure maximum profit by exploring the market demand.

MLE features a decisive emphasis on developing entrepreneurial capabilities for fish farmers. The market-oriented training and resources make fish farmers capable of recognizing and exploiting developing market possibilities. Fish farmers strengthen their market capabilities through the identification of consumer wants as they create new value-added goods while searching for different distribution methods. Building cooperatives and business associations under the MLE approach helps fish farmers to get better prices as well as receive credit facilities and support joint infrastructure development. The MLE approach helps fish farmers to develop business capabilities, which simultaneously improves both their financial stability and boosts the total growth and competition power of the fisheries sector.

2.5. Digital Extension approach

The discovery of ICT tools has positively impacted the fishery sector. Earlier, the fish sailors used to grab weather information through radio or television only. But now, in the era of digitalization, the use of different ICT devices has become a new normal for them. Including digital media in the extension approach suggests providing a better technology transfer. ICT-driven extension services can potentially empower the fishing community by improving access to resources and information (Omar & Chhachhar, 2012). Some case studies highlighted that extension organizations like Digital Green (NGO) use an innovative digital platform to attract community engagement. ICAR, State Agriculture Universities, and KVKs are developing various applications and online portals to directly spread information related to aquafarming (Lahiri et al., 2020). Some Computer-based web portals and applications developed by them are aAQUA, TNAU AGRITECH portal, ITC Aqua Choupal, mKRISHI fisheries, Vanami shrimp app, CIFTFISHPRO, INCOIS, CIFT Lab Test, and many more. GPS and sonar systems were made accessible in coastal areas in a very cost-effective way through different wireless service providers (Mohanty et al., 2020). However, there is still a need to embrace new technologies like

IoT, AI, and blockchain through effective extension approaches.

Fish farmers obtain information through the digital extension approach because it changes their methods of knowledge acquisition. The deployment of IoT alongside Artificial Intelligence and blockchain technologies enables fish farmers to obtain operational data instantly thus maximizing production procedures by tracking the supply chain transparently. Quick decisions become possible because IoT sensors disclose water quality measures alongside temperature and fish health indicators to users. The models which use AI analytics provide both market predictions and forecasts to improve available resource planning. Blockchain implementation in supply chains establishes dependable systems that lowers cases of fraud and builds trust among consumers. Fisheries managers who employ the previously mentioned technological solutions within digital extension practices drive both operational efficiency and sustainability while achieving profitable economics and digital empowerment for disadvantaged groups.

3. CHALLENGES IN CONVERGENCE

3.1. Inadequate Operational Efficiency and Isolation

Current operational performance levels of different line departments at the state and district levels show inadequacies, together with a dominant pattern of isolated work environments. The absence of effective connections or no connectivity existed between different stakeholders in the past and continues at some points (Ojha, 2017). The lack of connections diminishes essential coordination processes, together with information sharing that determines effective convergence. The extension approaches adopt supply-driven practices instead of demand-driven methods, which fail to implement essential input from fish farmers. Efforts to develop effective initiatives require knowing the fish farmers' viewpoints because their feedback allows service providers to design programs that match community realities.

Table 2. Challenges in Achieving Convergence in Fisheries Extension Services

Challenge	Description	Impact	Reference
Inadequate Operational Efficiency and Isolation	Lack of effective connections and isolated work environments	Diminished coordination and information sharing	Ojha, 2017
Digital Divide and Limited ICT Utilisation	Restricted use of ICTs in rural areas	Hindered data distribution and application of modern technologies	Pongener & Sharma, 2018
Limited Capacity of Public Extension Advisory Services	Insufficient number of extension personnel and training deficits	Poor acceptance of modern techniques and inadequate support in remote areas	Pongener & Sharma, 2018
Funding Constraints for Convergence	Insufficient budget for operational costs and training programs	Fragmented and less effective extension services	Ojha et al., 2020

3.2. Digital Divide and Limited ICT Utilisation

The fishing community in rural areas faces restricted utilisation of information and communication technologies (ICTs) during the present digitalisation age. The ongoing digital divide, both for males and females, presents a major impediment which prevents them from receiving and making proper use of technical knowledge (Pongener & Sharma, 2018). Workers in fishing communities face a significant obstacle because the digital divide blocks essential data distribution and stops them from applying contemporary technologies for maximising production levels and accessing markets. The resolution of this issue demands thorough work to establish better digital infrastructure and education programs for digital skills development.

3.3. Limited Capacity of Public Extension Advisory Services

Lack of public extension advisory service capacity stems primarily from insufficient numbers of extension personnel present in different organizations. Extensive training deficits among professionals exist because this shortage fails to deliver proper coverage and support to fish farmers based in remote or underdeveloped areas. The insufficient number of extension personnel prevents immediate delivery of appropriate guidance thus causing poor acceptance of modern techniques at production sites. Extension services need improved capacity with additional trained staff in order to fulfil expanding needs within the fishing community.

3.4. Funding Constraints for Convergence

Adequate funding for operational costs together with training and skill development programs prevents the departments in the fish sector from achieving successful convergence. The insufficient budget hinders the implementation of complete advisory programs which causes extensions services to become fragmented and less effective. Sustainable development and implementation of integrated fishery solutions together with continuous training for extension staff and fish farmers requires adequate funding. Sustainable convergence demands both enhanced budgetary funding and exploration of different funding options to guarantee financial sustainability.

Table 3. Strategic Recommendations for Enhancing Fisheries Extension Services

Strategy	Description	Expected Outcome	Reference
Public Sector Facilitation	Streamline and enhance the "lead and supplement" dynamic	Improved coordination and service delivery	Vipinkumar, 2018
Pluralistic Extension Service Providers	Incorporate diverse providers to address specific needs	Enhanced convergence and overall change	Sajesh et al., 2018
Public-Private Collaboration	Leverage strengths of both sectors for better convergence	Complementary and supplementary roles for improved outcomes	Sajesh et al., 2018
Technology and Policy Support	Implement advanced technologies and supportive policies	Sustainable resource use and digital empowerment	Lahiri et al., 2020; Mohanty et al., 2020

4. WAY FORWARDS

- The public sector fishery extension service provider should be a facilitator and enabler to streamline and enhance the "lead and supplement" dynamic in a given situation (Vipinkumar, 2018).
- In general, it has been observed that public sector extension service providers demonstrate strong performance in terms of backward linkages. In contrast, private sector service providers possess a comparative advantage in forward linkages. Non-governmental organisations (NGOs), civil society organisations (CSOs), and community-based organisations (CBOs) have been observed to exhibit favourable outcomes in the realm of community mobilisation (Sajesh et al., 2018).
- The importance of incorporating pluralistic extension service providers into the system needs to be emphasised while also considering allocating backup responsibilities to alternative extension service providers in specific circumstances to bring about overall change.
- Public and private extension service providers possess distinct roles that are not necessarily interchangeable but should be viewed as supplementary and complementary to one another to bring about better convergence (Sajesh et al., 2018).

5. CONCLUSIONS

The fisheries sector stands out as a vibrant and thriving industry within the Indian economy. It continues to outperform other agricultural sectors, making significant contributions to food security and nutritional well-being. Besides, fisheries extension is also exploring new trends and addressing many

challenges. Still, insufficient resources, access to real-time validated information, incompetent extension advisors, inadequate financial resources, and the gender digital divide are major roadblocks to sustainable improvement. These issues and challenges have been hampering the convergence process among the line departments. Shreds of evidence highlighted that the fisheries extension systems lack strong human resources and budgetary allocation, which results in meeting the emerging problems. The use of advanced technologies like IoT AI and the implementation of policies should be there to support the fishers and fish farmers in sustainably harnessing the resources.

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REFERENCES

Bhaumik, U. (2016). Fisheries extension, its status and strategies for development of inland fisheries in the country. *International Conference on Aquatic Resource & Sustainable Management*, 66–68.

Christoplos, I. (2010). *Mobilizing the potential of rural and agricultural extension*. https://www.fao.org/3/i1444e/i1444e00.pdf

Davis, K., Rasheed Sulaiman, V., Cho, K. M., Xia, X., Susumu, G., & Cardenas, V. (2016). Investment in extension and advisory services in Asia-Pacific region: Status and opportunities. In *High Level Policy Dialogue on Investment in Agricultural Research for Sustainable Development in Asia and the Pacific* (pp. 90). https://www.apaari.org/wp-content/uploads/2021/10/Investment-in-Extension-Asia-Pacific.pdf

De, H. K., Saha, G. S., Srichandan, R., & Vipinkumar, V. P. (2008). New initiatives in fisheries extension. *Aquaculture Asia*, 13(3), 16–19.

Food and Agriculture Organization (FAO). (2014). *The state of world fisheries and aquaculture 2014*. Rome: FAO. https://www.fao.org/3/i3720e/i3720e.pdf

Hara, M., & Isaacs, M. (2012). Current state of extension and advisory services in South African fisheries. https://agritrop.cirad.fr/570038/1/document_570038.pdf

Kumaran, M., Ravichandran, P., Panigrahi, A., Sinha, M. K., Nagarajan, S., Vimala, D. D., & Ponniah, A. G. (2012). Effectiveness of sensitisation on the awareness levels of fishery extension officers on Pacific white shrimp (*Litopenaeus vannamei*) farming in India. *Indian Journal of Fisheries*, 59(4), 123–129.

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.2020.67.3.97400-02

Masangano, C. M., Kambewa, D., Bosscher, N., & Fatch, P. (2017). Malawi's experiences with the implementation of pluralistic, demand-driven and decentralised agricultural extension policy. *Journal of Agricultural Extension and Rural Development*, 9(9), 185–195. https://doi.org/10.5897/JAERD2017.0861

Mishra, S. S., Rakesh, D., Dhiman, M., Choudhary, P., Debbarma, J., Sahoo, S. N., & Mishra, C. K. (2017). Present status of fish disease management in freshwater aquaculture in India: State-of-the-art review. *Journal of Aquaculture & Fisheries*, 1(003), 14. https://doi.org/10.24966/AAF-5523/100003

Mohanty, A. K. (2022). *Advances in extension techniques for the development of fisheries sector*. ICAR-CIFT.

Mohanty, A. K., Sajeev, M. V., & Sajesh, V. K. (2020). *Innovative extension approaches for sustainable technology dissemination in fisheries*. ICAR-Central Institute of Fisheries Technology.

Ojha, S. N. (2017). Fisheries extension and social entrepreneurship. In S. C. Babu & S. Dey (Eds.), Social entrepreneurship in aquaculture (pp. 335–348).

Ojha, S. N., Dey, S., & Babu, S. C. (2020). A bottom-up approach for a private fisheries extension system: A framework and action plan for an aqua-chamber of commerce in India (Vol. 1931). *International Food Policy Research Institute*. https://doi.org/10.2499/p15738coll2.133697

Omar, S. Z., & Chhachhar, A. R. (2012). A review on the roles of ICT tools towards the development of fishermen. *Journal of Basic and Applied Scientific Research*, 2(10), 9905–9911.

Pongener, B., & Sharma, A. (2018). Constraints faced by the fishery enterprises: A SWOC analysis. *International Journal of Current Microbiology and Applied Sciences*, 7(5), 1595–1603. https://doi.org/10.20546/ijcmas.2018.705.192

Qurani, I. Z., Fawzi, N. I., Fadilah, R., & Kismorodati, W. (2021, May). Empowering fish-farmer through coastal field school: Towards sustainable aquaculture practice. In *IOP Conference Series: Earth and Environmental Science* (Vol. 750, No. 1, p. 012054). IOP Publishing. https://doi.org/10.1088/1755-1315/750/1/012054

Sajesh, V. K., Padaria, R. N., & Sadamate, V. V. (2018). Pluralism in agricultural extension in India: Imperatives and implications. *Economic Affairs*, 63(4), 1017–1025. https://doi.org/10.30954/0424-2513.4.2018.31

Sajesh, V. K., Suresh, A., Mohanty, A. K., & Sajeev, M. V. (2020). *Streamlining fisheries extension*. ICAR-Central Institute of Fisheries Technology.

Vipinkumar, V. P. (2018). Establishing fish-based enterprises for livelihood security: Scopes and opportunities.

Viswanathan, N. S., Yadav, M., Sharma, A., & Dornadula, V. H. R. (2023). Marketing strategies of fish and fishery products in India: An empirical study of market intermediaries. *Journal of Survey in Fisheries Sciences*, 10(3S), 3273–3280. https://pure.jgu.edu.in/id/eprint/5907