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# Analysis of Technology Needs of MSMEs in the Fisheries Industry in Pekalongan City: A Digital Transformation-Based Approach and Increasing Competitiveness

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**ABSTRACT**

Micro, Small, and Medium Enterprises (MSMEs) play a crucial role in local economic development, including within the fisheries sector in Pekalongan City. This study aims to identify the most pressing technological needs and assess the readiness of fisheries MSMEs to adopt digital transformation. The research employed a mixed-methods approach through surveys of 30 MSMEs, in-depth interviews with stakeholders, and field observations. Data were analyzed using descriptive statistics, GAP analysis, Technology Readiness Level (TRL), and SWOT analysis. The research results show that the majority of MSMEs (86%) have not yet utilized digital technology in their production, packaging, or marketing processes. Three key technological needs were identified: (1) renewable energy-based drying machines to improve production efficiency; (2) vacuum packaging equipment to maintain product quality and extend shelf life; and (3) digital marketing and e-commerce platforms to expand market access. The main inhibiting factors include low digital literacy, limited capital for technology investment, and minimal training and technical assistance. These findings are consistent with previous studies emphasizing that digital transformation is a key factor in enhancing the competitiveness of fisheries MSMEs. This research recommends several strategies, including routine technology-based training, facilitating financing for the procurement of technological equipment, and strengthening partnerships between MSMEs, the government, and local technology startups. Accelerating digital transformation through the implementation of appropriate technology can significantly enhance the productivity and competitiveness of fisheries MSMEs in Pekalongan City, while also supporting the achievement of Sustainable Development Goals (SDGs) in the areas of industrial innovation and decent work.

## INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) play a crucial role in the Indonesian economy, including in the fisheries sector (Perdana et al., 2025; Sinha et al., 2024). Pekalongan, known as a coastal city with significant capture fisheries and aquaculture activity on the north coast of Java, has significant potential for developing the MSME-scale fisheries industry. However, this potential has not been fully utilized due to the low utilization of technology in the production, distribution, and marketing of fishery products.

Digital transformation has become a key factor in increasing the competitiveness of MSMEs in various sectors, including fisheries (Doktoralina et al., 2025; Ridho & Rachmawati, 2025). Digital

transformation is not just about adopting technology, but also about fundamental changes in how organizations create value through the use of digital technologies (Matt et al., 2015). MSMEs in the fisheries sector can improve supply chain efficiency, catch management, and market access through technologies such as the Internet of Things (IoT), e-commerce platforms, and geographic information systems (GIS) (Binay & Villenas, 2024; Kantal et al., 2025).

The rate of technology adoption in the small- and medium-scale fisheries sector remains relatively low, especially in developing countries. Limited infrastructure, low digital literacy, and a lack of supportive policies are key obstacles to the digital transformation of the small- and traditional fisheries sector (Guenard, 2021). This aligns with the findings of ( Zhou & Yang, 2021), who showed that fisheries MSMEs face challenges in effectively accessing information and communication technology (ICT), which impacts innovation and productivity.

A similar situation is also found in Pekalongan, where the majority of fisheries MSMEs still rely on traditional methods for production and marketing. A lack of understanding of the benefits of digital technology and limited human resources are obstacles to technological transformation. Therefore, a comprehensive and thorough analysis and identification of technology needs is essential to determine the types of technology that are most needed, the readiness of MSMEs to adopt it, and the strategies that can be implemented to accelerate digitalization.

This research is crucial to address these challenges and support the achievement of the Sustainable Development Goals (SDGs), particularly in the areas of industrial innovation and decent work. The results are expected to provide input for local governments, industry players, and other stakeholders in formulating targeted policies and technology assistance programs for MSMEs in the fisheries industry in Pekalongan City.

Previous research has highlighted the challenges faced by fisheries MSMEs in adopting digital technologies. For instance, (Guenard, 2021) noted that limited infrastructure and low digital literacy hinder technology adoption in the fisheries sector. Similarly, found that fisheries MSMEs struggle with accessing information and communication technology, impacting innovation and productivity (Zhou & Yang, 2021). While these studies provide valuable insights, they do not specifically address the technological needs of fisheries MSMEs in Pekalongan City. This research fills this gap by conducting a comprehensive analysis of the technological requirements and readiness of fisheries MSMEs in Pekalongan, providing a localized understanding of the challenges and opportunities in digital transformation.

The aim of this research is to identify and analyze the technological needs of fisheries MSMEs in the city of Pekalongan. The findings are expected to support the achievement of the Sustainable Development Goals (SDGs), particularly in the areas of industrial innovation and decent work, by enhancing the competitiveness and sustainability of fisheries MSMEs in Pekalongan.

## RESEARCH METHOD

This study employed a mixed methods approach (Salkind, 2020), combining quantitative and qualitative techniques to obtain a comprehensive understanding of the technological needs and readiness of fisheries MSMEs in Pekalongan City. Data were collected through three methods: (1) a quantitative survey using a structured questionnaire distributed to fisheries MSMEs to assess technology usage, constraints, and specific needs; (2) in-depth qualitative interviews with key stakeholders such as the Maritime Affairs and Fisheries Service, MSME associations, and selected business actors to gather contextual insights beyond quantitative measurement; and (3) field observations conducted to directly examine production facilities, distribution processes, and existing technology utilization. The data analysis employed descriptive statistics to identify trends in technology use, GAP analysis to determine the disparity between current and ideal technological conditions, the Technology Readiness Level (TRL) framework (NASA, 2022; OECD, 2023) to assess MSME readiness for technology adoption, and SWOT analysis to formulate development

strategies based on strengths, weaknesses, opportunities, and threats. The research population consisted of all fisheries sector MSMEs in Pekalongan City involved in processing and marketing fishery products, while the sample was purposively selected from MSMEs operating for at least three years and demonstrating potential for digital technology adoption

## RESULTS AND DISCUSSION

This study was conducted on 30 fishery MSMEs in Pekalongan City engaged in seafood processing, such as salted fish, fish floss, and shrimp crackers. Data were collected through questionnaires, interviews, and field observations. The results indicate that the majority of MSMEs have not adopted modern technology in their production, distribution, or marketing processes, as shown in the following table.

**Table 1. Results of the Technology Adoption Questionnaire for Fisheries MSMEs in Pekalongan City**

| Technology Adoption Categories | Number of Respondents | Percentage (%) |
|---|---|---|
| Not yet adopted modern technology | 26 | 86% |
| Already adopted modern technology | 4 | 14% |
| **Total** | **30** | **100%** |

source: processed data

Based on the results of a questionnaire conducted on 30 fishery MSMEs in Pekalongan City engaged in processing seafood such as salted fish, fish floss, and shrimp crackers, it was found that the majority of respondents, namely 26 business actors (86%), have not adopted modern technology in their production, distribution, or marketing activities. Only 4 business actors (14%) have utilized technology to support their business activities. This finding indicates that the level of technology utilization in fishery MSMEs in Pekalongan City is still low, so there is a need for encouragement and mentoring so that business actors can increase efficiency and competitiveness through the application of modern technology.

Most MSMEs still use traditional processing equipment, such as drying fish using sunlight, manual packaging, and conventional financial recording.

Interviews with several fisheries MSMEs revealed that most still rely on manual production processes. One salted fish entrepreneur stated that they still use traditional methods for drying and processing fish. He noted that using drying machines or other modern equipment is quite expensive, while production capacity remains limited. This aligns with questionnaire findings, which indicate that the majority of MSMEs have not yet adopted modern technology.

Furthermore, limited human resources were a frequent factor in interviews. Several business owners stated they struggled to operate new technologies, such as automated packaging machines or digital marketing applications. "We were offered training on how to use online sales applications, but many were unfamiliar with them. Ultimately, they still felt more comfortable selling directly to the market," said one shrimp cracker entrepreneur. This indicates that technology adoption requires ongoing support, not just equipment procurement.

In terms of needs, MSMEs consistently cite the importance of processing and packaging technology. A fish floss producer stated that packaging quality is crucial for a product's appeal in the modern market. They hope for support in the form of vacuum sealers or packaging technology that can extend the product's shelf life. Furthermore, several MSMEs also consider digital marketing an urgent need, given the growing online market and the ability to reach consumers beyond Pekalongan.

Several interviews also expressed hope for government or related agency assistance in

providing access to capital for technology investment. "If there were a machine assistance program or soft loans, we would definitely try. Currently, the challenge is capital, while business profits are still mediocre," explained one small business owner. This demonstrates that MSME digital transformation efforts are not only about technological readiness, but also closely related to financial aspects and managerial support. The level of technology adoption by fisheries MSMEs in Pekalongan City is as follows.

**Table 2. Level of Technology Use by Fisheries MSMEs in Pekalongan City**

| Aspects of Technology Use | Number (n) | Percentage (%) |
|---|---|---|
| Still manual/traditional | 18 | 60% |
| Semi-modern (simple machines, not yet digital) | 8 | 26.7% |
| Modern (machine + digital application) | 4 | 13.3% |

source: processed data

Based on the questionnaire analysis, there are three main technological needs perceived by fisheries MSMEs in Pekalongan City. Forty percent of respondents emphasized the importance of production technology, particularly solar- or electric-powered drying machines, to improve time efficiency and maintain product quality. Furthermore, 33.3% of business owners mentioned the need for packaging technology, such as vacuum sealers, to maintain freshness, extend shelf life, and increase product appeal in the market. Meanwhile, another 26.7% considered digital marketing technology through e-commerce platforms and social media to be essential for expanding consumer reach and increasing competitiveness. These findings indicate that fisheries MSMEs in Pekalongan require integrated technological support, from the production process and packaging to digital marketing strategies.

**Table 3. Major Barriers to Technology Adoption**

| Constraint | Number (n) | Percentage (%) |
|---|---|---|
| High investment costs | 12 | 40% |
| Lack of HR skills | 8 | 26.7% |
| Limited technology access | 5 | 16.7% |
| Lack of information & assistance | 3 | 10% |
| There is no urgent need | 2 | 6.6% |

source: processed data

Based on the questionnaire results, the main obstacle faced by fisheries MSMEs in Pekalongan City in adopting technology is the high investment costs mentioned by 40% of respondents, making it difficult for many business owners to purchase or access modern equipment. Furthermore, 26.7% of business owners admitted to having limited human resource (HR) skills in operating new technology. Other factors that also pose obstacles are limited access to technology (16.7%), minimal information and assistance regarding technology use (10%), and a small proportion (6.6%) who feel there is no urgent need to switch to modern technology. These findings confirm that the main problems lie in the financial aspects and HR competency, which require support through access to capital and ongoing training.

**Table 4. Specific Technology Requirements**

| Types of Technology | Information | Percentage (%) |
|---|---|---|
| **Production Technology** | Solar or electric powered drying machines to increase time efficiency and product quality. | 40% |
| **Packaging Technology** | Vacuum sealer tool to maintain freshness and increase product selling power. | 33.3% |
| **Marketing Technology** | Digital marketing and e-commerce platforms as a means of online promotion and sales. | 26.7% |

source: processed data

Based on the analysis, the primary technological needs of fisheries MSMEs in Pekalongan City focus on three key aspects. Forty percent of respondents emphasized the need for production technology, particularly solar- or electric-powered drying machines, to speed up processing while maintaining product quality. Furthermore, 33.3% of business owners require packaging technology in the form of vacuum sealers, which maintain freshness, increase shelf life, and improve product appearance to make them more competitive in the market. Meanwhile, 26.7% of respondents considered digital marketing technology through e-commerce platforms and social media essential to expand consumer reach and increase competitiveness. These findings indicate that meeting technological needs in the production, packaging, and marketing sectors is key to driving the digital transformation of fisheries MSMEs in Pekalongan.

## Discussion

The research results show that the level of technology use by fisheries MSMEs in Pekalongan City is still dominated by manual or traditional methods, while only a small proportion have utilized modern digital-based technology. This condition illustrates a gap in technology utilization that has implications for low product efficiency and competitiveness in the market. Based on the needs analysis, there are three main aspects that are considered most important: production technology in the form of solar-powered or electric drying machines to improve quality and efficiency, packaging technology such as vacuum sealers to maintain freshness and improve product appearance, and digital marketing technology through e-commerce platforms and social media to expand consumer reach. However, the adoption of these technologies is still hampered by high investment costs, limited human resource skills, and limited access to information and technology. Therefore, the digital transformation of fisheries MSMEs in Pekalongan City requires comprehensive support through financing, human resource capacity building, and technological assistance to be able to increase competitiveness sustainably.

These findings align with research, which confirmed that fisheries MSMEs in coastal areas of Indonesia still face significant obstacles in adopting technology, particularly in the post-harvest and distribution stages (Yuliani & Suryadi, 2021). Key inhibiting factors include a lack of training, limited access to technology, and limited capital, which were also found among fisheries MSMEs in Pekalongan. This indicates that the challenges faced by fisheries MSMEs are structural and require comprehensive policy intervention to encourage digital transformation.

The problems faced by fisheries MSMEs in Pekalongan City can be categorized as structural issues because they encompass fundamental, interrelated aspects, ranging from limited capital and low-quality human resources to access to technology and information. The majority of MSMEs still rely on manual methods in their production processes, not because they don't recognize the importance of technology, but because of limited financial resources and operational skills. Reliance on traditional methods makes it difficult for MSMEs to increase production capacity, maintain product quality, and compete in an increasingly competitive market. Without structural changes, this

condition will continue to hamper the digital transformation process (Bongkriwan et al., 2024).

Another structural obstacle is the lack of supporting infrastructure that can accelerate technology adoption. Access to modern technology remains limited, both in terms of availability and affordability (Dzikrullah & Chasanah, 2024). Furthermore, the lack of training and mentoring makes it difficult for businesses to utilize existing technology. This factor creates a gap between technology availability and the ability of MSMEs to optimally adopt it (Novrianty et al., 2025). As a result, technological innovation, which should support increased competitiveness, has not had a significant impact on fisheries MSMEs (Arifin et al., 2025).

Therefore, comprehensive and integrated policy interventions are needed. Local governments and relevant institutions need to provide more inclusive access to capital, for example through soft loan schemes or grants for the procurement of appropriate technology. Furthermore, human resource capacity building programs through technical training, digital literacy, and ongoing mentoring must be prioritized to enable MSMEs to operate and utilize technology effectively. Policy interventions should also include the development of a digital ecosystem, such as the provision of local marketing platforms, technology-based distribution systems, and adequate logistics network support (Setiawati & Ginting, 2024).

With comprehensive policies, digital transformation for fisheries MSMEs extends beyond technology procurement to include human resource empowerment, strengthening market access, and developing supporting infrastructure. This is crucial to ensure that digitalization truly delivers tangible benefits, increasing production efficiency, expanding markets, and ultimately boosting the competitiveness of fisheries MSMEs at the local, national, and global levels.

Furthermore, highlighted that the mismatch between available technology and the operational capabilities of MSMEs poses a challenge in the adoption process (Suharti & Prabowo 2023). This situation is also reflected in the fisheries MSMEs in Pekalongan, where most business actors still rely on traditional methods due to limited skills in operating modern equipment and digital applications. Although the potential for developing the seafood processing industry in Pekalongan is quite large, limited technological innovation makes it difficult for MSME products to compete in both local and national markets.

Many businesses still rely on traditional methods for production, packaging, and marketing. This often results in inconsistent product quality, short shelf life, and packaging that is less competitive than similar products produced with more modern technology (Prabawa & Fitriani, 2020). This makes it difficult for Pekalongan's fishery MSMEs to penetrate the modern market, leaving them limited to traditional markets with relatively low bargaining power.

Limited innovation also has an impact on low product diversification (Nengsih et al., 2025). The abundant potential of marine products in the coastal areas of Pekalongan has not been fully processed into high value-added products due to limited equipment and technical skills. For example, the use of modern technology-based drying machines or vacuum sealers can extend shelf life while maintaining product quality, but because costs and skills are obstacles, most MSMEs cannot utilize them. This makes the competitiveness of Pekalongan MSME products tend to stagnate and lose out, both in the local market which is starting to be filled with products from other regions, as well as in the national market which demands higher quality standards.

This situation demonstrates that technological innovation is key to driving the transformation of fisheries MSMEs in Pekalongan, enabling them to improve quality, production efficiency, and competitiveness. Without adequate support, the region's vast potential for seafood processing risks being underutilized (Mawaldi & Mokodompit, 2024). Therefore, collaboration between the government, educational institutions, the private sector, and MSME communities is essential to accelerate technology transfer, provide mentoring, and create access to financing that supports the sustainable adoption of innovation.

Furthermore, this study also supports (Irawan et al., 2022) argument that utilizing simple digital technologies, such as local marketplace applications and digital-based financial management

systems, can help MSMEs expand their market reach while improving operational efficiency. In the Pekalongan context, the need for digital marketing technology is a key finding that can serve as a gateway to accelerating digital transformation.

Furthermore, the adoption of appropriate technology has been shown to significantly impact productivity and competitiveness. Demonstrated that the use of solar-powered drying technology in several coastal areas can increase production by up to 35%, while the application of vacuum packaging can double the shelf life of products, ultimately increasing the income of MSMEs (Herlina 2024). This aligns with the findings of (Wulandari et al., 2022) who stated that the use of appropriate technology not only increases efficiency but also strengthens market confidence in product quality. Therefore, supporting the adoption of digital production, packaging, and marketing technologies is a key strategy in increasing the competitiveness of fisheries MSMEs in Pekalongan City.

## CONCLUSION

The study on fisheries Micro, Small, and Medium Enterprises (MSMEs) in Pekalongan City reveals that most have yet to adopt modern technology in production, packaging, or marketing, limiting efficiency and market reach. The primary technological needs identified are renewable energy-based drying machines, vacuum packaging equipment, and digital marketing and e-commerce platforms. Barriers to adoption include low technical literacy, limited access to funding, and insufficient technology training. The research concludes that implementing appropriate technology can enhance productivity and competitiveness, suggesting that local governments, cooperatives, and training institutions should collaborate to provide regular digital training, financing assistance, and partnerships with technology startups. Future research should focus on developing sector-specific digital innovation models and assessing the long-term impacts of technology adoption on sustainable fisheries MSME growth.

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