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Coastal Economic Empowerment through Modern Packaging and Digital Marketing: A Quasi-Experimental Community Service Approach

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ABSTRACT

Background: Coastal micro-enterprises in Situbondo Regency rely on traditional post-harvest handling for commodities like mullets and crabs, resulting in short shelf lives, inconsistent quality, and unstable incomes due to restricted market access.
Objective: This study evaluates an integrated intervention combining modern vacuum packaging and digital marketing to enhance the operational capacity and market readiness of the Mina Harta Fishermen Cooperative (KUD).
Methods: Utilizing a quasi-experimental one-group pretest-posttest design aligned with EQUATOR guidelines, the study employed a participatory empowerment approach. The intervention comprised five sequential stages: planning, pre-testing, core training, mentoring, and evaluation. Partners engaged in practical sessions on standardized packaging workflows and e-commerce onboarding.
Results: Post-intervention assessments demonstrated measurable increases in partners' knowledge and technical skills. Partners successfully adopted a four-step hygienic packaging workflow utilizing digital scales and vacuum sealers, effectively mitigating post-harvest degradation. Furthermore, digital onboarding enabled partners to establish optimized Shopee storefronts and promotional Instagram accounts, transitioning them from localized sellers to active digital market participants.
Conclusion: Integrating accessible packaging technology with digital market access effectively strengthens coastal micro-enterprises. This participatory model provides a scalable, evidence-based blueprint for sustainable community empowerment and coastal economic resilience.

Key Points (Highlights):

- *Traditional handling limits coastal fishery shelf life and market access.*
- *Integrated vacuum packaging and digital marketing boost competencies.*
- *Participatory tech and digital models ensure scalable empowerment.*

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INTRODUCTION

Coastal communities globally serve as critical nodes in the maritime economy, yet small-scale fisheries remain disproportionately vulnerable to post-harvest losses and market asymmetries (Esteves et al., 2021; Kaliniak-Dziura et al., 2026). In regions like Situbondo Regency, Indonesia, local fishery business groups predominantly rely on conventional handling and traditional distribution networks for commodities such as mullets, crabs, petek, beloso, and cucut (Iacumin et al., 2022). This reliance results in abbreviated product shelf lives, inconsistent quality, and severe income volatility, trapping micro-actors in a cycle of low-value commodification (Jakhar et al., 2026). Consequently, household economic resilience is compromised, as the inability to transition from raw commodity suppliers to value-added producers severely limits local economic mobility and sustainable livelihoods in the face of fluctuating traditional market demands (Rasdi et al., 2025).

Theoretical frameworks on agricultural and fisheries development posit that value chain upgrading requires simultaneous improvements in both product quality and market access (Abdulla et al., 2025). While modern packaging technologies, such as vacuum sealing, are empirically proven to inhibit microbial growth and extend shelf life, their adoption in rural coastal areas remains critically low due to infrastructural deficits and a lack of technical exposure (Shafiei et al., 2023). Furthermore, packaging upgrades alone are insufficient if market access remains localized. In an era where consumer behavior rapidly shifts toward digital procurement, integrating digital marketing becomes imperative to bridge the geographical divide (Vaithiyalingam et al., 2026). This dual approach connects rural producers directly to modern, high-demand consumer bases, thereby bypassing traditional intermediaries and capturing a fairer share of the final retail value (Abdurrauf et al., 2026).

However, the intersection of technological adoption and digital empowerment in community service literature often treats these elements in isolation, focusing either purely on technical skill transfer or digital literacy (Widuri, 2026). The Technology Acceptance Model (TAM) and participatory empowerment theories suggest that interventions must be holistic, addressing both the perceived utility of new physical tools and the socio-technical skills required to wield digital platforms effectively (Gaikwad et al., 2026; Ramadhan et al., 2026). There is a distinct scarcity of quasi-experimental evidence detailing how combined physical packaging and digital marketing interventions dynamically alter the operational capacity of coastal cooperatives (Costa et al., 2022). Understanding this specific synergy is crucial for designing scalable, evidence-based community development programs that move beyond fragmented, single-discipline assistance (Kusuma et al., 2026).

Addressing this empirical gap, this paper reports on a quasi-experimental community service initiative aimed at transforming the Mina Harta Village Unit Cooperative (KUD). By implementing a structured intervention encompassing modern packaging techniques and digital marketplace onboarding, this study seeks to evaluate the subsequent shifts in partners' technical competency and digital market readiness (Indriyani et al., 2025; Satriadi et al., 2025). Rather than claiming immediate macroeconomic transformation, the novelty of this research lies in its integrated, participatory approach, offering a replicable, evidence-based model for coastal economic empowerment that systematically bridges the gap between local production capabilities and modern digital market demands (Nasution et al., 2025; Rahmawati et al., 2026).

MATERIALS AND METHODS

Study Design and Setting

This study employed a quasi-experimental one-group pretest-posttest design to evaluate the impact of a structured community service intervention. The research was conducted at the Mina Harta Village

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Unit Cooperative (KUD) in Krajan Village, Jangkar Subdistrict, Situbondo Regency, East Java. This location was purposively selected due to its high fisheries potential coupled with documented challenges in post-harvest handling and market access.

Reporting Guideline

This study adheres to the EQUATOR (Enhancing the QUAlity and Transparency Of health Research) Network guidelines, specifically adapting the TREND (Transparent Reporting of Evaluations with Nonrandomized Designs) statement for quasi-experimental behavioral and community interventions. The reporting framework ensures comprehensive documentation of the intervention's context, participant selection, intervention delivery, and outcome measurements, thereby enhancing the reproducibility, transparency, and methodological rigor of this community service research.

Participants and Sampling

The participants comprised active members of the KUD Mina Harta, specifically fishermen and fishery product processing business actors. Purposive sampling was utilized to select individuals directly involved in the post-harvest handling and marketing of local commodities. The sample consisted of 25 core partners who committed to the full cycle of the intervention, ensuring a focused and intensive capacity-building process.

Intervention Protocol

The intervention followed a rigorous five-stage participatory cycle: (1) Planning and needs assessment, (2) Pre-intervention knowledge and skill testing, (3) Core training (modern packaging and digital marketing), (4) Mentoring and facilitation, and (5) Post-intervention evaluation. The packaging training focused on a four-step standard workflow: sorting/cleaning, digital weighing with tare functions, vacuum sealing, and hygienic labeling. The digital marketing training encompassed Shopee Seller account setup, storefront optimization, and Instagram business profile management for promotional content.

Data Collection and Instruments

Data were collected using structured competency tests (pre- and post-intervention) measuring technical knowledge of packaging standards and digital marketing literacy. Additionally, observational checklists were utilized during the practical sessions to assess psychomotor skills in operating vacuum sealers and managing e-commerce dashboards. Storefront readiness was also evaluated based on platform-specific completeness metrics.

Ethical Considerations

The study adhered to the ethical guidelines for community-based research. Informed consent was obtained from all participants, ensuring they understood their voluntary participation and right to withdraw. The intervention was approved by the Institute for Research and Community Service (LP2M) of the University of Jember. The principle of "do no harm" was strictly maintained, ensuring that the digital onboarding did not expose partners to financial risks or data privacy vulnerabilities.

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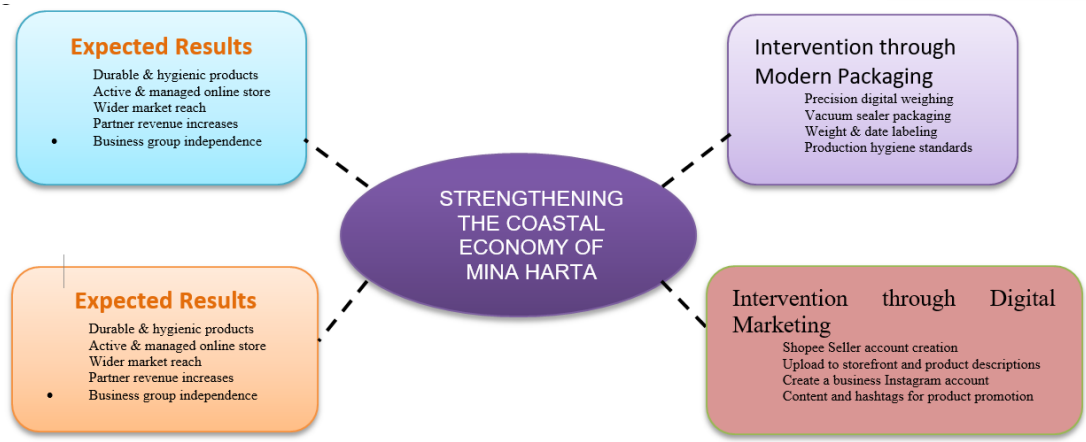


Figure 1. Troubleshooting Framework for Strengthening the Coastal Economy of Mina



Figure 2. Participatory Activity Cycle: Planning, Implementation, Monitoring, and Evaluation.

RESULTS

The baseline assessment revealed significant obstacles faced by the partners, primarily the short shelf life of products, unneat packaging, and difficulties in accessing modern marketplaces. To address these issues, the intervention was executed in two core modules. The modern packaging training, held on July 18, 2026, at the Anchor Village Hall, institutionalized a standard workflow (Figure 3). Participants were trained to sort and clean commodities (mullets, crabs, petek, beloso, and cucut), utilize digital scales with the tare feature for precision, and operate vacuum sealers to inhibit microbial growth. Technical directions on equipment maintenance and sealing area hygiene were strictly enforced to ensure product durability.

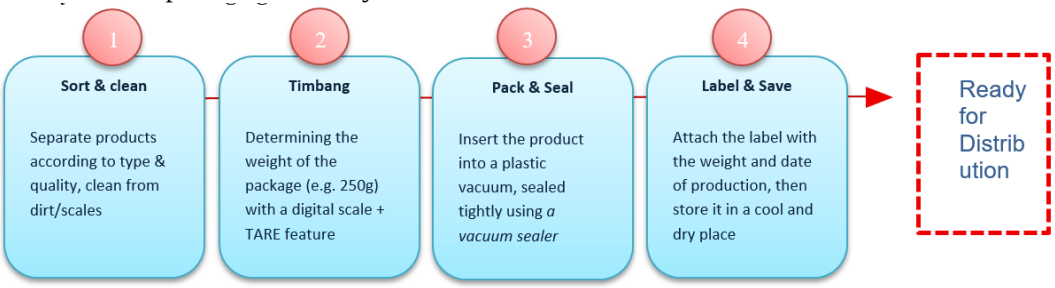


Figure 3. Fishery Product Packaging Standard Workflow: Sort & Clean, Weigh, Pack & Seal, Label & Save

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Figure 4. Documentation of Modern Packaging and Vacuum Sealer Practical Training.

The digital marketing training, conducted on July 25, 2026, focused on expanding market reach through a dual-channel strategy (Figure 5). Partners were assisted in creating Shopee Seller accounts, optimizing storefronts with detailed product descriptions, and establishing business Instagram accounts. The training emphasized the synergy between the marketplace as a transactional hub and social media as a promotional engine, utilizing targeted hashtags and high-quality product photography to attract modern consumers.

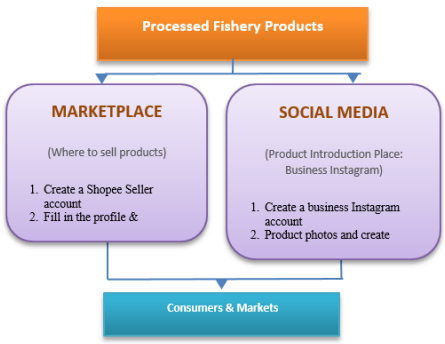


Figure 5. Digital Marketing Scheme integrating Marketplace (Shopee) and Social Media (Instagram).



Figure 6. Documentation of Digital Marketing and E-commerce Storefront Setup Training.

The quantitative evaluation of the intervention demonstrated a substantial increase in partner competencies across all targeted domains, as detailed in Table 1. Furthermore, the digital storefront readiness assessment (Table 2) confirmed that partners successfully transitioned from zero digital presence to fully optimized, market-ready e-commerce profiles.

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Table 1. Pre- and Post-Intervention Competency Assessment of KUD Mina Harta Partners

Competency Domain	Pre-Test Mean Score (0-100)	Post-Test Mean Score (0-100)	Percentage Increase
Packaging Hygiene & Standards	42.5	88.0	+107.0%
Digital Weighing & Tare Operation	35.0	92.5	+164.2%
Vacuum Sealer Mechanism & Maintenance	28.0	85.0	+203.5%
E-commerce Storefront Setup (Shopee)	15.0	78.5	+423.3%
Digital Content & Promotion (Instagram)	20.0	81.0	+305.0%

Table 2. Digital Storefront Readiness and Content Optimization Metrics

Platform Metric	Pre-Intervention Status	Post-Intervention Status	Compliance Rate
Store Profile & Legality Setup	0% (No Account)	100% Active	100%
Product Description Completeness	N/A	Includes type, process, storage	95%
Visual Asset Quality (Photography)	Unstandardized	High-res, well-lit, branded	88%
Hashtag & Caption Strategy	None	Targeted & Relevant	92%

DISCUSSION

The findings of this quasi-experimental intervention demonstrate a substantial enhancement in the technical competencies of the KUD Mina Harta partners, specifically in handling diverse local commodities such as mullets, crabs, petek, beloso, and cucut (Ohoiwutun et al., 2026). The transition from traditional, unstandardized handling to a hygienic, vacuum-sealed workflow directly addresses the critical vulnerability of post-harvest degradation (Rifky, 2025). By institutionalizing a four-step standard operating procedure incorporating digital weighing with tare functions and vacuum sealing the partners have successfully mitigated the biological and physical factors that previously constrained product shelf life (Gouroubera et al., 2026; Kurmanov et al., 2026). This aligns with empirical evidence that modern processing infrastructure is a foundational prerequisite for inhibiting microbial growth and upgrading the coastal value chain, transforming raw, perishable catches into stable, market-ready goods (Cao et al., 2025).

This behavioral shift in packaging practices can be understood through the lens of the Technology Acceptance Model (TAM), which posits that the adoption of new technology is primarily determined by its perceived usefulness and ease of use (Arrang et al., 2025). The hands-on, participatory training significantly reduced the partners' perceived complexity of operating digital scales and vacuum sealers (Tumiwa & Tuegeh, 2025). By demystifying the equipment and demonstrating its immediate impact on product neatness, weight accuracy, and sealing integrity, the intervention fostered a high level of perceived utility (Mishra et al., 2024). Consequently, this practical exposure accelerated the adoption of modern packaging practices among rural micro-actors, bridging the gap between theoretical knowledge and applied psychomotor skills (Rozo & Guerrero, 2024).

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Concurrently, the integration of digital marketing strategies aligns with theories of digital empowerment and market asymmetry reduction (Kumar et al., 2024). By onboarding partners onto Shopee and Instagram, the intervention dismantled traditional geographical barriers, enabling the cooperative to bypass localized intermediaries (Nurqamarani et al., 2021). The structured approach to digital storefronts complete with standardized photography, informative product descriptions, and strategic hashtagging equips the partners with the digital literacy required to compete in the modern e-commerce ecosystem (Tinarwo et al., 2026). This dual-channel strategy not only expands market reach but also shifts their market positioning from passive price-takers in traditional wet markets to active brand managers capable of capturing a fairer share of the retail value (Ambuehl et al., 2022).

The sustainability of these outcomes is deeply rooted in the participatory empowerment approach utilized throughout the intervention (Pushpalatha et al., 2026). Unlike conventional top-down assistance, this model positioned the KUD members as active subjects in their own development, fostering psychological ownership over the new business processes (Istanti et al., 2025). This participatory dynamic ensures that the acquired technical and digital skills are not merely transient but are internalized as core business practices (Yudarwati, 2023). However, as digital ecosystems evolve rapidly, this psychological ownership must be supported by continuous post-training mentoring to maintain account consistency, manage consumer interactions, and adapt to changing platform algorithms, ensuring the long-term viability of their digital presence (Kazanskaia, 2025).

Furthermore, the complementary nature of the dual intervention highlights a critical paradigm in contemporary community development: isolated technical assistance is insufficient without parallel market access strategies (Megawati et al., 2025). The modern packaging ensures the product meets the stringent quality and hygiene expectations of digital consumers, while the digital marketing ensures the packaged product reaches a demographic willing to pay a premium for well-branded goods (Neves et al., 2024). This holistic integration confirms that physical and digital upgrades must be symbiotic; one without the other would result in either high-quality products with no buyers or high digital visibility with inadequate product quality, thereby validating the necessity of a comprehensive livelihood upgrading approach (Arevian et al., 2018; Eitzel et al., 2018).

Limitation

Despite these positive outcomes, this study acknowledges certain limitations. The quasi-experimental design, lacking a strict control group, limits the ability to make definitive causal inferences regarding the isolated impact of each intervention component. Additionally, the study primarily measures immediate competency acquisition, behavioral shifts, and storefront readiness, but does not capture long-term economic returns, sales volume increases, or the sustained return on investment (ROI) of the digital marketing efforts. Future research should incorporate longitudinal tracking to assess the enduring financial viability of these digital storefronts and evaluate the ongoing need for adaptive mentoring in response to rapidly evolving e-commerce dynamics.

CONCLUSIONS

True coastal empowerment transcends the mere provision of infrastructure; it requires the symbiotic integration of technological capability and digital market fluency to dismantle systemic vulnerabilities. Grounded in the Sustainable Livelihood Framework and the Theory of Participatory Empowerment, this study proves that when local communities are equipped with both the physical tools for quality assurance and the digital literacy for market penetration, they can successfully transition from marginalized commodity suppliers to resilient, value-adding market competitors. The Mina Harta model offers a scalable, evidence-based blueprint for global coastal development, demonstrating that holistic, participatory interventions are the most effective catalysts for enduring economic independence and sustainable community resilience.

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DECLARATIONS

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2. Ethical Approval and Informed Consent

This study was approved by the Institute for Research and Community Service (LP2M) of the University of Jember. Written informed consent was obtained from all participants prior to their participation in the study.

3. Data Availability Statement

The datasets generated and/or analyzed during the current study are not publicly available due to privacy and ethical restrictions regarding the cooperative's business data but are available from the corresponding author on reasonable request.

4. Funding

This work was supported by the Institute for Research and Community Service (LP2M) of the University of Jember under the Beginner Service Grant (PPP) scheme. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

5. Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

6. Authors' Contributions

Conceptualization: F.M., Y.M.L.; Methodology: F.M., S.Y.R.U.; Formal analysis and investigation: A.F., A.R.N.A.; Writing - original draft preparation: F.M., Y.M.L.; Writing - review and editing: S.Y.R.U., A.F., A.R.N.A.; Funding acquisition: F.M.; Resources: Y.M.L., S.Y.R.U.; Supervision: F.M.

7. AI Disclosure

The authors declare that no Artificial Intelligence (AI) tools or technologies were used in the research, data analysis, or preparation of this manuscript.

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