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Designing an Integrated E-Commerce Digital Financial Platform for Small Coastal Industries Based on the Blue Economy

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ABSTRACT

Coastal micro and small enterprises (MSEs) in Indonesia face persistent challenges in financial management and market access, primarily due to low digital literacy and the absence of locally tailored digital platforms, which limit their contribution to the sustainable blue economy agenda. This study aims to design and develop "Jeruju Digital," an integrated digital platform combining a simple financial management system and e-commerce features, specifically tailored for MSEs processing *Acanthus ilicifolius* (jeruju leaves) in Jaring Halus Village, Langkat Regency, North Sumatra. This research employed a Research and Development (R&D) approach using the Waterfall software development model, progressing through five sequential stages: needs analysis, system design, implementation, black-box functional testing, and user evaluation, with 20 MSE respondents assessed via a 5-point Likert-scale questionnaire. The resulting platform integrates two core modules — a financial reporting tool covering daily transaction logs, profit-and-loss statements, cash flow, and balance sheets, and an e-commerce module for product catalog management, ordering, and payment — achieving 100% success across 15 black-box test functions and an overall user satisfaction score of 4.50 ("Very Good"), indicating high usability and suitability for coastal MSE contexts. These findings demonstrate that "Jeruju Digital" meaningfully improves operational efficiency, financial transparency, and market reach for coastal small businesses, offering a replicable model for digital transformation in Indonesia's maritime sectors in alignment with the national blue economy strategy.

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1. INTRODUCTION

One strategic approach currently being promoted by the government is the blue economy, an economic development model based on the sustainable, environmentally

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friendly, and inclusive use of marine resources [1]. Within this framework, the Indonesian government, through the Ministry of Maritime Affairs and Fisheries, has established the National Action Plan for the Blue Economy 2023–2045 as a roadmap to strengthen the maritime sector within the context of a green and digital economy. The blue economy concept is integrated into a country's sustainable economic development efforts [2], [3]. The achievement of the blue economy concept depends on the cooperation of local communities in preserving environmental resources and fostering sustainable development for the country [4].

Conceptually, the blue economy aims to encourage the growth of innovative marine sectors, strengthen the economic resilience of coastal communities, and attract investment that supports environmental conservation. Its implementation requires not only a national strategy but also the active involvement of local communities in maintaining marine ecosystems and utilizing coastal potential productively [5]. However, achieving sustainable development targets in this sector remains a serious challenge. Several indicators, such as poverty reduction and improving the welfare of coastal communities, have not shown significant results [6], [7]. One of the main causes is business practices that are not yet sustainable and still lack technological support [8].

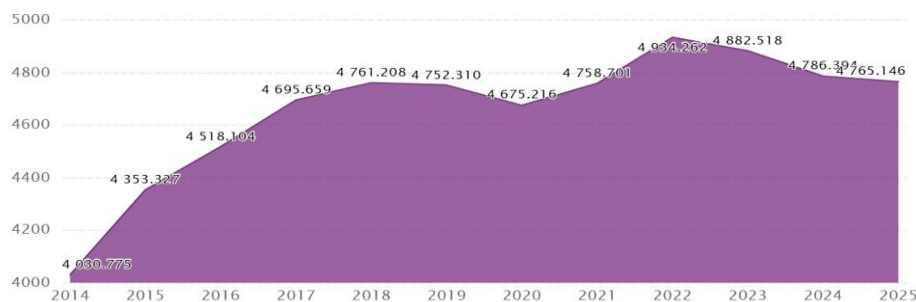


Figure 1. Indonesia's Purchasing Power (Welfare) 2014-2025

Source: <https://www.ceicdata.com/en/indonesia/exchange-rate-forecast-non-oecd-member-annual/id-purchasing-power-parity-national-currency-per-usd>.

The data in Figure 1 above shows that Indonesian purchasing power continues to decline, reaching USD 4,882,518 in 2023 and USD 4,786,394 in 2024. This decline in purchasing power (social welfare) in Indonesia indicates unsustainable economic development [9], [10], [11].

To address these challenges, digital transformation is key to accelerating the implementation of the blue economy. Digitalization, particularly in financial management and business marketing, plays a role in creating a connected business ecosystem between businesses, consumers, the government, and other stakeholders [12]. Through a digital approach, MSMEs can improve operational efficiency, expand markets, and manage their businesses transparently and in a data-driven way. A study by Fatimah et al. [13] shows that digital integration can increase MSME business efficiency by up to 37% and expand market access more than four times compared to conventional methods.

Besides improving efficiency, digitalization also offers new perspectives in financial management and profit management, as well as the empowerment of local communities [14]. However, to date, many coastal MSMEs have not fully utilized digital technology [15].

Barriers such as low digital literacy, limited access to infrastructure, and the lack of platforms tailored to local needs are key obstacles [16]. These issues directly impact MSMEs' low contribution to digital economic growth, particularly in the maritime and coastal sectors.

One area that reflects this condition is Langkat Regency in North Sumatra Province. This region boasts significant marine potential, including mangrove ecosystems, seafood, and coastal plants such as jeruju leaves (*Acanthus ilicifolius*), which are now being developed as a raw material for regional crackers

Table 1. Area of Forest in Langkat Regency

Kecamatan	Luas Kawasan Hutan di Kabupaten Langkat Dirinci Menurut Fungsi Hutan (Ha) (Hektar)											
	SM Langkat Timur Laut			Hutan Lindung			Hutan Produksi Terbatas (HPT)			Hutan Produksi (HP)		
	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015
Bohorok	-	-	-	-	-	-	6811.00	7177.00	7177.17	-	282.00	292.53
Sirapit	-	-	-	-	-	-	-	-	-	-	-	-
Salapian	-	-	-	-	-	-	727.00	1597.00	1596.56	-	-	-
Kutambaru	-	-	-	-	-	-	4280.00	4586.00	4605.69	-	68.00	68.30
Sei Bingai	-	-	-	-	-	-	4770.00	3715.00	3711.04	-	48.00	48.20
Kuala	-	-	-	-	-	-	516.00	470.00	489.73	-	-	-
Selesai	-	-	-	-	-	-	-	-	-	-	-	-
Binjai	-	-	-	-	-	-	-	-	-	-	-	-
Stabat	-	-	-	-	-	-	-	-	-	-	-	-
Wampu	-	-	-	-	-	-	-	-	-	-	-	-
Batang Serangan	-	-	-	-	-	-	5164.00	5851.00	5876.49	-	-	-
Sawit Seberang	-	-	-	-	-	-	-	130.00	140.27	-	-	-
Padang Tualang	-	-	-	-	-	-	-	-	-	-	-	-
Hinai	-	-	-	-	-	-	-	-	-	-	-	-
Secanggang	6118.00	5503.00	5902.00	-	-	-	-	-	-	1989.00	696.00	705.73
Tanjung Pura	3401.00	4017.00	3616.00	-	963.00	996.32	-	-	-	10953.00	4952.00	4950.10
Gebang	-	-	-	-	347.00	380.65	-	-	-	10266.00	4238.00	4248.34
Babalan	-	-	-	-	439.00	472.70	-	-	-	8783.00	244.00	255.49
Sei Lapan	-	-	-	-	58.00	93.40	6790.00	5165.00	5184.79	754.00	73.00	72.50
Brandan Barat	-	-	-	-	247.00	292.41	-	73.00	83.21	5244.00	2404.00	2463.50
Besitang	-	-	-	-	-	-	9327.00	6906.00	6926.06	5264.00	3452.00	3463.20
Pangkalan Susu	-	-	-	-	2047.00	1830.00	3110.00	3713.00	3566.73	6160.00	6139.00	6020.50
Pematang Jaya	-	-	-	-	472.00	504.52	1764.00	993.00	1013.26	9026.00	2516.00	2515.61
Kabupaten Langkat	9519.00	9520.00	9518.00	0.00	4573.00	4570.00	43259.00	40376.00	40371.00	58439.00	25112.00	25104.00

Source : <https://langkatkab.bps.go.id/indicator/60/103/1/luas-kawasan-hutan-di-kabupaten-langkat-dirinci-menurut-fungsi-hutan-ha-.html>

According to data from Statistics Indonesia (BPS) for Langkat Regency (2023), there are more than 4,200 small businesses in the maritime sector, but the majority lack integrated digital financial management systems or market access.

This research builds on previous studies demonstrating the importance of integrating financial information systems and digital platforms to strengthen the capacity of small businesses. Financial information systems help MSMEs prepare accurate reports, improve accountability, and support decision-making [17], [18]. Highlight the role of e-commerce as an effective marketing medium for expanding the reach of local products [19]. Sitorus et al. [16] indicate that adapting digital technology in the context of coastal MSMEs still requires support for system design tailored to local needs.

Given these challenges and opportunities, this research aims to design and develop the "Jeruju Digital" platform, a technology-based information system that integrates small-business financial management and e-commerce services. This platform is expected to be a strategic solution to encourage efficiency, transparency, and sustainability of coastal small businesses within the framework of implementing a blue economy in Langkat Regency

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2. METHODS

This research uses a research and development (R&D) approach because the primary focus of this study is to design and develop a digital application system that meets user needs and tests its effectiveness in the field. The R&D approach is considered appropriate for producing applied technology products based on local contexts [20], [21].

The system development model used is the Waterfall Model, a sequential software development model that includes the following stages: analysis, design, implementation, testing, and evaluation. This model is suitable for developing specific systems and has a clear requirements flow from the outset [22], [23].

The research was conducted in the coastal area of Langkat Regency, North Sumatra Province, which offers potential for businesses based on processing marine products and mangrove plants, particularly jeruju leaves (*Acanthus ilicifolius*). The focus was on Jaring Halus Village, Secanggang District, as this area is a center for MSMEs processing jeruju leaf crackers. The research was conducted from February to July 2025.

The research subjects were micro and small business owners processing jeruju leaves, village officials, and MSME assistants in coastal areas. The research object was the digital platform “Jeruju Digital”, which was developed to integrate two main functions: 1) A Simple Financial Management System, including daily transaction recording features, basic financial report preparation (profit and loss, cash flow, and balance sheet); and 2) E-Commerce Features, including product catalogs, shopping carts, ordering, and simple QR or transfer-based payment integration. Data were collected through four main techniques, namely: 1) Direct field observation, to identify existing business conditions, work systems, and financial recording issues. This technique was carried out in a participatory manner and aimed to gain contextual understanding [24]; 2) Semi-structured interviews, conducted with business owners and village assistants to explore system feature needs and technology implementation challenges [25]; 3) Documentation study, including reviewing business records, manual reports (if available), and production data as material for system design; and 4) System validation questionnaire, used in the trial phase to evaluate the performance and usability of the system based on user perceptions [26].

The system development technique follows the Waterfall model stages, as shown in Figure 2 below

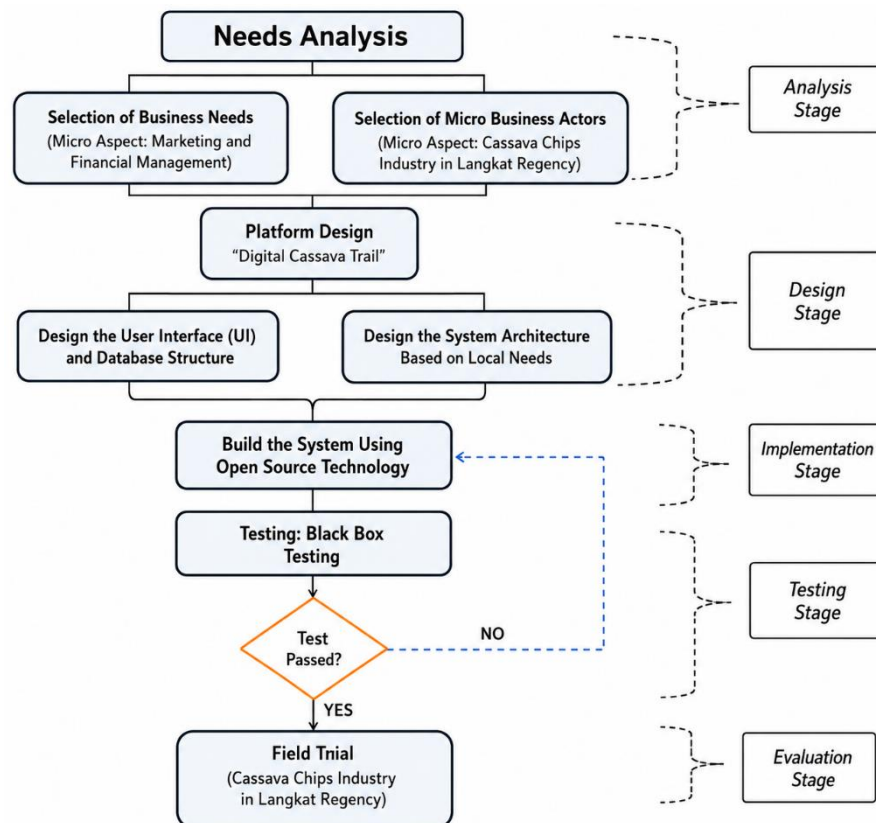


Figure 2. Stages of Development of the “Jeruju Digital” Platform

Data were analyzed using a combination of descriptive, qualitative, and simple quantitative approaches. Qualitative data were obtained from interviews and observations, which were analyzed thematically to identify patterns in user needs and the context of system implementation [27]. Quantitative data were obtained from a questionnaire validated using a 5-point Likert scale with the following measurement indicators: 1) Ease of use (usability); 2) Suitability of features to business needs; 3) Aesthetics and comfort of display; 4) Time and process efficiency; and 5) Overall user satisfaction.

The developed “Jeruju Digital” platform can be said to be functionally successful and suitable for use by coastal MSMEs if it meets the following assessment categories.

Table 1. Assessment Score Categories and Interpretations

No	Average Score	Assessment Categories	Brief Interpretation
1	4.21 – 5.00	Very good	The system is very satisfying and effective
2	3.41 – 4.20	Good	The system is working properly
3	2.61 – 3.40	Pretty good	The system is quite functional, but needs improvement
4	1.81 – 2.60	Not good	The system still has many shortcomings
5	1.00 – 1.80	Not good	The system is not suitable for use

Source: Sugiono 2019

3. RESULTS AND DISCUSSION

This research resulted in a digital platform, "Jeruju Digital," that integrates a business financial management system and e-commerce features for coastal MSMEs processing jeruju leaves in Langkat Regency. The platform was developed using a waterfall approach through five main stages: analysis, design, implementation, testing, and evaluation. Each stage produces relevant outputs that can be explained as follows :

3.1 Result

1. Needs Analysis Stage

At this stage, observations and interviews were conducted with 10 micro-entrepreneurs processing jeruju leaves in Jaring Halus Village, Langkat Regency. The analysis showed that: 1) The majority of entrepreneurs do not have an organized financial recording system; 2) The sales process still relies on conventional methods (offline and manual); and 3) There is an urgent need for an application that is easy to use, lightweight, and available in simple local Indonesian.

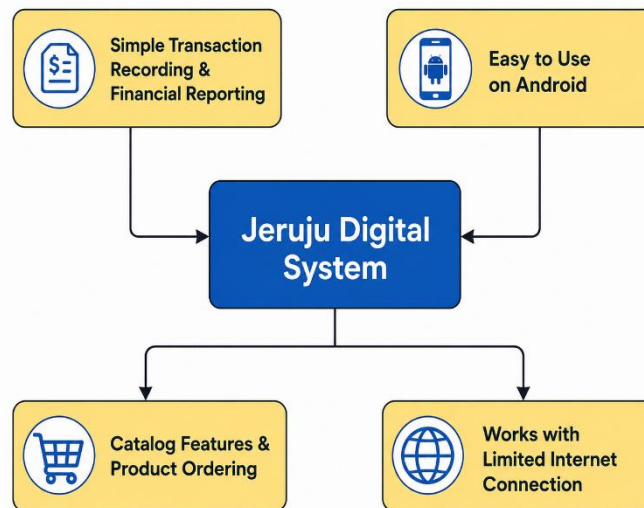


Figure 3. System Requirements Flowchart (Use Case)

2. System Design Stage

Based on the analysis results, the interface and database structure were designed. The system was designed using a modular interface for two main functions: 1) Finance Module: transaction input, profit and loss statements, cash flow statements, and a simple balance sheet; and 2) E-Commerce Module: product upload, order entry, transaction status, and printing transaction receipts

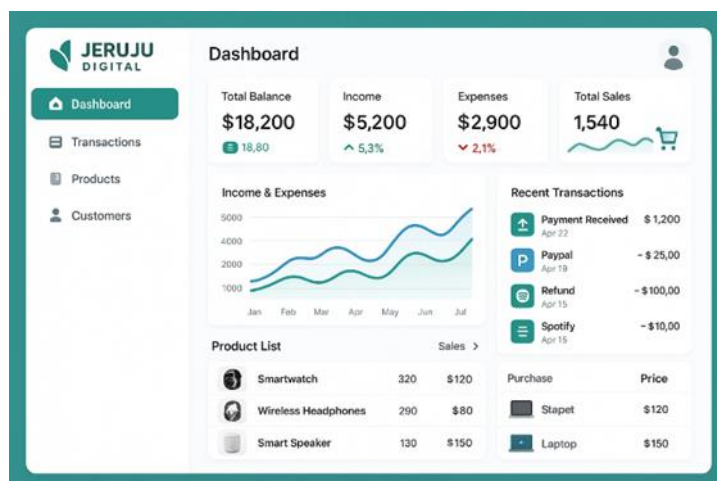


Figure 4. Jeruju Digital Dashboard Interface Design

3. System Implementation Stage

The platform was developed using open-source technologies: Laravel (backend), MySQL (database), and Bootstrap 5 (interface). The application is hosted locally and can be run responsively on desktop and mobile devices

4. System Testing Stage (Black Box Testing)

Testing was conducted using black-box methods across 15 main system functions. The results are shown in Table 2 below :

Table 2. Functional Test Results of Digital Jeruju (Black Box)

No	Features Tested	Testing Status	Information
1	User Login & Access Rights	Succeed	As expected
2	Sales Transaction Input	Succeed	No bugs
3	Input Expenditure Transactions	Succeed	Validation went well
4	Print Profit and Loss Report	Succeed	Standard format
5	Print Cash Flow and Balance Sheet	Succeed	Automatically categorized
6	Upload & Edit Products	Succeed	Maximum 2MB per image
7	Online Order Simulation	Succeed	Notification sent
8	Print Proof of Transaction	Succeed	PDF auto-generate
9	Responsiveness on Mobile	Succeed	Mobile-friendly design

5. User Evaluation Phase (Field Trial)

The trial was conducted with 20 MSMEs for two weeks. The evaluation used a 5-point Likert scale questionnaire covering five key indicators

Table 3. User Evaluation Results of the Jeruju Digital System

No	Evaluation Indicators	Average Score	Interpretation
1	Ease of use of the system (usability)	4.60	Very good
2	Suitability of features to business needs	4.45	Good
3	Clarity of display & interface navigation	4.55	Very good
4	Efficiency in recording & reporting	4.40	Good
5	Overall user satisfaction	4.50	Very good

The average overall score was 4.50, which indicates that the system was highly accepted and suitable for use by the target MSMEs

3.2 Discussion.

The central finding of this study, that "Jeruju Digital" achieved a perfect functional test rate across all assessed system components and an overall user satisfaction score of 4.50 on a five-point scale, provides compelling evidence that integrated digital platforms can be effectively designed and deployed within the operational realities of coastal micro and small enterprises. This result is particularly significant in the context of Indonesia's maritime sector, where digitalization efforts have historically struggled to penetrate communities characterized by low technological familiarity and infrastructure limitations. The platform's dual-module architecture, combining financial management with e-commerce functionality, directly addressed the twin deficits identified during the needs analysis stage: the absence of organized financial recordkeeping and reliance on purely offline, manual sales channels. Rather than treating these as separate problems requiring separate interventions, "Jeruju Digital" addressed them as structurally interconnected dimensions of the same underlying challenge, namely the institutional informality that constrains the growth potential of coastal MSEs.

The high ease-of-use score of 4.60 warrants analytical attention beyond surface-level satisfaction measurement. This result reflects a deliberate design philosophy centered on local linguistic accessibility, interface simplicity, and mobile responsiveness, principles that are not merely aesthetic preferences but functional prerequisites in settings where digital literacy remains uneven. The theoretical basis for this approach is well established in the human-computer interaction literature, where the Technology Acceptance Model posits that perceived ease of use is a primary determinant of adoption behavior. In the coastal MSE context, where cognitive load must be minimized and trust in digital tools is still being cultivated, achieving near-maximum usability scores suggests that the participatory design process, grounded in direct observation and semi-structured interviews with target users, produced an interface that meaningfully resonated with users' cognitive schemas and business routines. This finding reinforces the argument that technology-for-development initiatives fail not primarily because of technical inadequacy but because of misalignment between system design assumptions and the lived realities of intended users.

The financial management module's capacity to generate profit-and-loss statements, cash flow summaries, and simplified balance sheets, functions previously inaccessible to the study's respondents, carries implications that extend beyond operational convenience. Financial transparency and structured recordkeeping are prerequisites for MSEs seeking access to formal credit, government assistance programs, and cooperative membership, each of which is central to the national Blue Economy Action Plan 2023-2045. Prior research on MSE formalization in developing economies has consistently demonstrated that informal bookkeeping constitutes a structural barrier to upward mobility within value chains, not merely because lenders require documentation, but because entrepreneurs themselves lack the informational foundation to make evidence-based decisions regarding pricing, investment, and cost management. The capacity of "Jeruju Digital" to automate basic

financial categorization, as demonstrated through the black-box testing of cash flow and balance sheet auto-generation, directly addresses this informational asymmetry and represents a meaningful step toward the financial inclusion objectives articulated in Indonesia's broader digital economy agenda.

The e-commerce module's successful performance in simulated online order processing, transaction receipt generation, and product catalog management positions "Jeruju Digital" within a broader trajectory of digital market integration for peripheral and resource-based communities. Research examining e-commerce adoption among MSMEs in developing economies has documented that the transition from offline to online sales channels consistently yields measurable gains in market reach and revenue diversification. However, these gains are conditional on adequate logistical infrastructure and interoperable digital payments. It is precisely this conditionality that underlines one of the study's most substantive limitations: the absence of integration with mainstream digital payment gateways such as GoPay, OVO, or the QRIS national standard. While the platform's QR-based and transfer-based payment functionality represented a workable interim solution for the trial cohort, broader deployment will require seamless gateway integration to achieve competitive equivalence with established e-commerce ecosystems. This limitation is not incidental but reflects the layered nature of digital infrastructure challenges in coastal Indonesia, where connectivity, financial literacy, and the maturity of the payment ecosystem must advance in concert for platforms such as "Jeruju Digital" to realize their full potential.

Situating these findings within the broader literature on digital transformation for coastal and maritime communities reveals both points of convergence and important contextual distinctions. Studies conducted in analogous settings across Southeast Asia and Sub-Saharan Africa have demonstrated that locally adapted platforms outperform generic digital tools in user retention and sustained behavioral change, a pattern consistent with the present study's user evaluation results. However, the existing literature also cautions that short-term satisfaction measures, while necessary, are insufficient proxies for long-term impact, particularly in contexts where novelty effects may inflate initial responses. The two-week trial period and the sample of 20 respondents, both practical constraints given the study's R&D focus and the geographic concentration of the target community, limit the generalizability of the satisfaction findings and preclude longitudinal assessment of behavioral change in financial recordkeeping practices or actual expansion in sales volume. Future research employing extended deployment periods, randomized comparison groups, and objective outcome metrics such as revenue trajectories and credit access rates would substantially strengthen the evidentiary basis for platform-based digital interventions in similar coastal contexts.

The theoretical contribution of this study lies in demonstrating that the blue economy framework can be operationalized at the micro level, not only through ecological conservation mandates but also through the design of locally embedded digital institutions that address the structural informality of coastal small businesses. Existing blue economy scholarship has predominantly engaged with macroeconomic governance, fisheries management, and environmental policy, with comparatively limited attention to the digital empowerment of the micro-enterprise layer that constitutes the foundation of coastal

livelihood systems. "Jeruju Digital" operationalizes the blue economy's inclusive growth dimension by treating financial transparency and market connectivity as public goods that platform design can help provision, even in resource-constrained environments. From a practical standpoint, the replicability of the platform's architecture, built on open-source technologies including Laravel, MySQL, and Bootstrap 5, means that the model can be adapted to other coastal commodity chains across Indonesia's archipelago without prohibitive development costs, provided that the participatory design methodology is preserved to ensure local contextual fit. The platform's success thus offers not merely a technical prototype but a process model for community-centered digital transformation within Indonesia's maritime sectors.

6. CONCLUSION

This study confirms that integrating digital financial management and e-commerce into a single, locally adapted platform is a viable strategy for empowering coastal MSEs within the blue economy framework. "Jeruju Digital" demonstrates that technology-based solutions, when designed with sensitivity to users' literacy levels, local language preferences, and infrastructure constraints, can effectively bridge the gap between traditional coastal business practices and the modern digital economy. The platform's implications extend beyond Langkat Regency, offering a transferable blueprint for government agencies, NGOs, and digital entrepreneurs to accelerate financial inclusion among maritime MSEs nationwide. By combining simple accounting tools with e-commerce functionality, the platform strengthens both operational efficiency and financial accountability—prerequisites for MSEs seeking access to formal credit and government assistance—directly supporting Indonesia's National Blue Economy Action Plan 2023–2045.

Nevertheless, this study has important limitations, including a trial scope limited to 20 respondents from a single village, the lack of integration with mainstream digital payment gateways such as GoPay, OVO, or QRIS, and reliance on stable internet connectivity, which remains a structural challenge in remote coastal areas. Future research should focus on scaling the platform across multiple coastal districts in Indonesia to validate its replicability, incorporate AI-driven features for automated financial forecasting and business insights, and conduct longitudinal evaluations to measure actual changes in revenue, financial literacy, and market reach over a 12–24-month period. Collaborative engagement with local governments, universities, and fintech actors will be essential to ensure the platform's long-term sustainability and broader contribution to the digital empowerment of Indonesia's coastal communities.

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