

The Linkage Between Blue Economy and Digital Tourism: Platform-Based Monetization Strategies for Marine Ecosystems

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ABSTRACT

The integration of the blue economy and digital tourism has become a key driver of sustainable development in coastal regions. This study examines the interlinkage between these two concepts and explores platform-based monetization strategies for marine ecosystems. To quantitatively analyze the relationship between digital technology adoption, platform monetization efficiency, and the sustainability of marine ecosystems within the framework of the blue economy and digital tourism. This research employed a quantitative approach using Structural Equation Modeling (SEM) on 85 marine tourism destinations in Indonesia selected through purposive sampling. Data were collected through online surveys of tourism destination managers and secondary digital platform data spanning 2022–2024. The structural model demonstrated that digital technology adoption significantly influences monetization efficiency ($\beta = 0.742$, $p < 0.001$), which in turn positively impacts ecosystem sustainability ($\beta = 0.631$, $p < 0.001$). Digital platforms increased average revenue by 45–78% and operational efficiency by 32–56% across marine tourism destinations. Platform-based monetization strategies have proven effective in integrating the blue economy with digital tourism, though adequate infrastructure and skilled human resources remain prerequisites.

Keywords : blue economy, digital tourism, platform monetization, marine ecosystems, digital technology

INTRODUCTION

The blue economy has emerged as a paradigm of sustainable development, defined as the sustainable utilization of marine resources for economic growth, job creation, and ecosystem preservation (Lee et al., 2020; Choudhary et al., 2021). This concept encompasses multiple maritime sectors such as fisheries, marine tourism, marine transportation, and renewable energy (Nabi & Hayat, 2025). By simultaneously promoting economic progress and conservation, the blue economy has become central to achieving the United Nations' Sustainable Development Goals (Aprizal et al., 2025; Narwal et al., 2024).

Parallel to this, digital tourism has undergone rapid transformation, driven by the adoption of online platforms, artificial intelligence (AI), blockchain, and digital twin technologies. These innovations enhance visitor experience, streamline operational efficiency, and improve marketing strategies within the tourism sector (Liu et al., 2023; Ha, 2024). For instance, blockchain can improve transparency in transactions, while digital twin applications allow real-time monitoring of marine ecosystems to balance conservation with tourism development (Pranita et al., 2023; Bhati et al., 2025).



The integration of the blue economy with digital tourism creates new opportunities for platform-based monetization strategies. Digital marketplaces, reservation applications, and online payment ecosystems have become crucial instruments for unlocking the economic potential of marine ecosystems (Iranita et al., 2024; Wang et al., 2024). Xu et al. (2024) demonstrated that fintech and digitalization significantly contributed to the growth of global tourism destinations, while Wang et al. (2024) emphasized the role of collaborative digital platforms in integrating the marine economy with the digital economy. Similarly, technologies such as Virtual Reality (VR), the Internet of Things (IoT), and Geographic Information Systems (GIS) have been shown to enhance innovation and performance in marine tourism (Lee et al., 2024).

Digitalization also contributes directly to sustainability outcomes. Wu et al. (2023) and Tang (2023) highlighted that the digital economy strengthens the efficient management of marine resources and promotes resilient tourism industries. Fang et al. (2024) further confirmed that digital technologies have a significant positive impact on sustainable development in China's coastal regions. However, scholars have raised concerns regarding potential socio-environmental inequalities if digital monetization strategies are not inclusive (Germond-Duret, 2022; Phelan et al., 2020).

Despite its potential, the adoption of digital monetization strategies faces structural barriers. Mujanah et al. (2024) identified limited human resource capacity as a major challenge to the development of blue economy-based digital tourism. Similarly, Karuppiah et al. (2025) highlighted systemic barriers in emerging economies, including infrastructure gaps and resistance to technological adoption. These findings suggest that while digitalization is transformative, the transition towards a sustainable blue economy requires careful policy design and multi-stakeholder collaboration.

In summary, existing literature demonstrates that both the blue economy and digital tourism independently contribute to sustainable development. Yet, comprehensive quantitative analyses of their causal relationship particularly the role of digital technology adoption and platform-based monetization in ensuring marine ecosystem sustainability—remain scarce. Addressing this gap, this study employs Structural Equation Modeling (SEM) to examine the interlinkages between digital technology adoption, platform monetization efficiency, and marine ecosystem sustainability across Indonesia's marine tourism destinations.

The economic transformation brought by digital platforms extends beyond traditional tourism boundaries, creating new models of value creation within marine ecosystems. Martínez-Vázquez et al. (2021) highlighted that the blue economy faces significant challenges in terms of financing and technological integration, particularly in developing countries where traditional funding mechanisms may be insufficient. This challenge is further compounded by the need for innovative financing mechanisms that can support both technological advancement and environmental conservation (Tirumala & Tiwari, 2020). The emergence of digital platforms offers a potential solution by creating diversified revenue streams that can fund both tourism operations and conservation initiatives, thereby addressing the dual challenge of economic sustainability and environmental protection. Furthermore, the integration of community-based approaches within digitally-enhanced marine tourism presents opportunities for more inclusive and sustainable development models. Praptiwi et al. (2021) demonstrated that tourism-based alternative livelihoods for small island communities can effectively support the transition towards a blue economy, particularly when combined with appropriate technological tools. This community-centric approach aligns with the broader goals of sustainable development, as it ensures that the benefits of digital transformation are distributed more equitably among local stakeholders. Mani and Lamçe (2023) further

emphasized that the convergence of blue economy principles with digital marketing strategies worldwide represents a significant trend that requires careful analysis and strategic implementation to maximize its potential benefits.

METHODS

This study employed a quantitative, cross-sectional design using Structural Equation Modeling (SEM) to analyze the causal relationship between digital technology adoption, platform monetization efficiency, and marine ecosystem sustainability. The research population consisted of marine tourism destinations in Indonesia that had implemented digital platforms, with purposive sampling applied to select 100 destinations based on specific criteria. After data screening, 85 destinations provided valid responses, representing an 85 percent response rate and covering regions such as Bali, Java, Sumatra, Sulawesi, and Eastern Indonesia. Data were collected through online surveys distributed to destination managers using a seven-point Likert scale, validated through expert review and pilot testing, as well as secondary performance reports from digital platforms spanning 2022–2024.

The constructs measured in this study comprised three latent variables. Digital Technology Adoption (DTA) was indicated by the utilization of online platforms, blockchain, artificial intelligence, and digital twin technologies (Pranita et al., 2023; Bhati et al., 2025). Platform Monetization Efficiency (PME) was reflected in indicators such as revenue growth, operational efficiency, and market expansion (Iranita et al., 2024; Liu & Huang, 2025). Marine Ecosystem Sustainability (MES) was evaluated through conservation efforts, resource management, and ecological impact (Elston et al., 2024; Li & Zhang, 2025). Data analysis was conducted using SmartPLS 4.0, which involved assessing measurement validity and reliability, testing structural relationships, examining mediation effects, and applying bootstrapping with 5,000 subsamples to ensure the robustness of statistical estimates.

RESULTS AND DISCUSSION

Respondent and Data Characteristics

Out of 100 distributed questionnaires, 85 complete responses were obtained. The destinations exhibited diverse digital adoption strategies: 58% relied on marketplace platforms such as Traveloka and Tiket.com, 27% operated proprietary applications, and 15% combined both approaches. This distribution reflects varied levels of technological maturity across Indonesian marine tourism destinations.

Measurement Model Evaluation

Reliability and validity tests indicated strong psychometric properties of the constructs:

Table 1. Reliability and validity tests

Construct	Cronbach's Alpha	Composite Reliability	AVE
Digital Technology Adoption	0.847	0.892	0.674
Platform Monetization Efficiency	0.823	0.886	0.661
Marine Ecosystem Sustainability	0.791	0.867	0.621

The AVE values (>0.50) and CR values (>0.80) confirmed convergent validity and internal consistency. Fornell–Larcker tests further supported discriminant validity, with each construct's AVE square root exceeding inter-construct correlations.

Structural Model Results

The SEM analysis produced strong explanatory power:

- **Platform Monetization Efficiency (PME):** $R^2 = 0.551$
- **Marine Ecosystem Sustainability (MES):** $R^2 = 0.473$

All hypotheses were supported ($p < 0.001$):

Table 2. Structural model results

Hipotesis	Path Analysis	T-Statistics	P-Values	Kesimpulan
H1: ATD → EMP	0.742	18.346	0.000***	Accepted
H2: EMP → KEK	0.631	12.847	0.000***	Accepted
H3: ATD → KEK	0.289	4.921	0.000***	Accepted

*** $p < 0.001$

Mediation analysis revealed that PME **partially mediated** the effect of DTA on MES (VAF = 61.8%).

Quantitative Impact of Digital Platforms

Findings confirmed significant economic and ecological impacts:

- **Revenue Increase:** 45–78% growth across destinations adopting digital platforms.
- **Operational Efficiency:** Improvements ranging 32–56%.
- **Market Expansion:** Tourist reach expanded by 65–120% through online channels.
- **Ecosystem Conservation:** IoT and digital twin adoption improved monitoring effectiveness by up to 40%.

Findings confirmed significant economic and ecological impacts. Destinations adopting digital platforms experienced revenue growth of 45–78%, operational efficiency improvements ranging from 32–56%, market expansion of 65–120% through online channels, and enhanced ecosystem monitoring effectiveness by up to 40% with the adoption of IoT and digital twins.

To better illustrate these findings, Figure 1 presents the quantitative impacts of digital platform adoption across the four performance dimensions—revenue generation, operational efficiency, market expansion, and ecosystem conservation. The figure highlights not only the range of improvements achieved but also the relative magnitude of change across different aspects of marine tourism management.

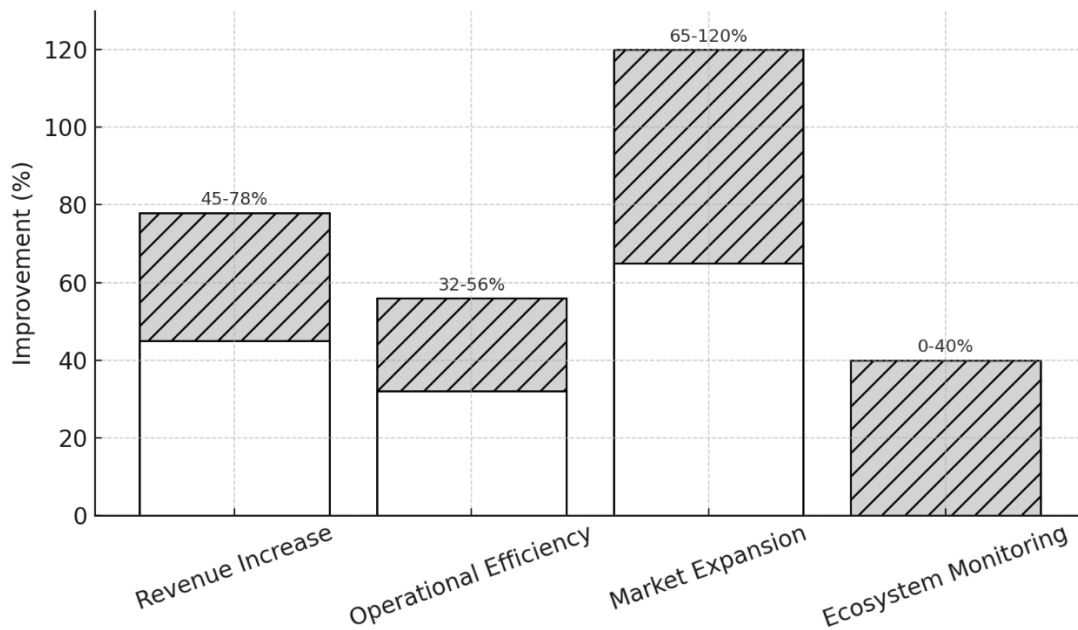


Figure 1. Quantitative impact of digital platforms on marine tourism destinations

The graphical representation in Figure 1 reveals several critical insights regarding the differential impacts of digital platform adoption across marine tourism performance metrics. The most pronounced improvements are observed in market expansion capabilities, where destinations experienced growth ranging from 65% to 120%, indicating that digital platforms serve as powerful tools for reaching new tourist segments and geographical markets. This substantial market expansion can be attributed to the global reach of online platforms and the enhanced visibility they provide to previously lesser-known marine destinations. The revenue generation improvements, ranging from 45% to 78%, demonstrate significant economic benefits, though the variation suggests that success depends on factors such as platform selection, digital marketing strategies, and local tourism assets.

Discussion

Digital Technology Adoption and Monetization Efficiency

Results underscore the critical role of digital technologies in enhancing revenue and operational efficiency. These findings align with Tang (2022), who emphasized that the digital economy drives high-quality tourism growth. Likewise, blockchain-based applications improve transaction transparency and stakeholder trust (Pranita et al., 2023), while digital twins optimize marine ecosystem management (Bhati et al., 2025).

Monetization Efficiency and Ecosystem Sustainability

The significant positive effect of monetization efficiency on ecosystem sustainability confirms earlier work by Fang et al. (2024) and Li & Zhang (2025). Digital platforms not only increase financial returns but also enable efficient resource monitoring through IoT and GIS (Lee et al., 2024). This dual economic–ecological impact strengthens the case for platform integration in marine tourism.

Mediation Effects in the Blue Economy–Tourism Nexus

The partial mediation role of monetization efficiency demonstrates that **digital adoption indirectly enhances sustainability via improved financial performance.**

This aligns with Tang (2023), who argued that digitalization bolsters tourism resilience by diversifying income streams and optimizing efficiency. Huang et al. (2025) further emphasized that well-configured digital pathways amplify tourism sector resilience.

Implementation Challenges

Despite positive outcomes, significant challenges persist across multiple dimensions of digital platform implementation in marine tourism. Limited digital skills among human resources (Mujanah et al., 2024) and systemic infrastructure gaps (Karuppiyah et al., 2025) restrict broader adoption, particularly in remote coastal areas where internet connectivity and technical support remain inadequate. The financing mechanisms for digital transformation also pose considerable barriers, as traditional funding models may not adequately support the integration of advanced technologies with conservation objectives (Martínez-Vázquez et al., 2021). This financing gap becomes particularly pronounced in developing economies where capital constraints limit the ability of tourism destinations to invest in comprehensive digital infrastructure.

Policy and Managerial Implications

The findings highlight strategic imperatives for policy-makers and industry leaders:

- **Infrastructure Investment:** Strengthening digital infrastructure in coastal regions.
- **Capacity Building:** Training programs for tourism managers and local communities.
- **Stakeholder Collaboration:** Multi-actor partnerships between government, industry, and local communities.
- **Sustainability Standards:** Development of regulatory frameworks ensuring balance between digital growth and ecological protection.

Community Engagement and Social Sustainability

The success of digital platform integration heavily depends on meaningful community participation and benefit-sharing mechanisms. Praptiwi et al. (2021) emphasized that sustainable tourism development requires the active involvement of local communities, ensuring that digital transformation creates alternative livelihoods rather than displacing traditional economic activities. This finding is particularly relevant for Indonesia's diverse marine tourism destinations, where local communities often possess valuable traditional ecological knowledge that can enhance digital monitoring systems. Moreover, without equitable distribution, monetization risks exacerbating socio-environmental inequalities (Phelan et al., 2020; Germond-Duret, 2022). The digital divide between urban and rural coastal communities can create disparities in access to digital platforms, potentially concentrating benefits among already privileged destinations while marginalizing smaller, less-connected communities.

Innovation and Technological Integration Patterns

The adoption patterns observed in this study reflect broader trends in digital innovation within the blue economy sector. Pace et al. (2023) identified several future research and innovation directions for sustainable blue economy development, emphasizing the need for integrated approaches that combine technological

advancement with ecological stewardship. The varying degrees of digital adoption across Indonesian marine tourism destinations—with 58% relying on marketplace platforms, 27% operating proprietary applications, and 15% using hybrid approaches—suggest that successful digital transformation requires flexible, context-specific strategies rather than one-size-fits-all solutions. This diversity in adoption patterns also indicates that destinations may benefit from collaborative networks that allow knowledge sharing and resource pooling, particularly for smaller destinations that may lack the resources to develop sophisticated proprietary systems.

Beyond the direct statistical results, the findings highlight a broader transformation within Indonesia's marine tourism sector, where digital platforms act as both economic enablers and ecological guardians. The significant increase in revenue and operational efficiency suggests that destinations adopting digital innovations are not only more competitive but also better positioned to diversify income streams and withstand external shocks such as economic downturns or global crises. This is consistent with the argument by Lu et al. (2024), who demonstrated that the digital economy strengthens tourism resilience in China, showing that digitalization provides adaptive advantages in volatile environments. Thus, Indonesia's case illustrates how the synergy between blue economy principles and digital tourism can safeguard both livelihoods and ecosystems.

Another critical implication is the role of inclusivity and accessibility in shaping long-term sustainability outcomes. While the SEM analysis confirmed the mediating role of monetization efficiency, the risk of digital divides remains pressing. If access to digital infrastructure is uneven across regions, smaller or less-developed destinations may not achieve the same benefits as those in more advanced provinces like Bali or Java. This echoes the concern raised by Germond-Duret (2022) and Phelan et al. (2020), who warned that digital monetization without inclusivity could exacerbate socio-economic inequalities. Addressing this challenge requires targeted policy interventions, such as subsidized infrastructure development in underrepresented regions and training programs for local communities to improve digital literacy.

Lastly, the integration of advanced technologies such as blockchain, digital twins, and IoT points to a future trajectory where marine ecosystem monitoring and conservation become increasingly data-driven. The evidence that monitoring effectiveness improved by up to 40% through these technologies suggests that they can complement traditional ecological practices by offering real-time insights and predictive analytics. As Elston et al. (2024) and Bhati et al. (2025) emphasized, technological innovation is central to achieving a sustainable blue economy. For Indonesia, embedding these tools into marine tourism governance frameworks could create a more transparent, accountable, and ecologically balanced industry. Future collaborations between government agencies, private digital firms, and local stakeholders will therefore be crucial in ensuring that the digital transformation of tourism aligns with ecological stewardship and long-term sustainability.

CONCLUSIONS

This study empirically confirms the significant interlinkage between the blue economy and digital tourism through platform-based monetization strategies. The structural model revealed that digital technology adoption strongly enhances platform monetization efficiency ($\beta = 0.742, p < 0.001$), which in turn positively influences marine ecosystem sustainability ($\beta = 0.631, p < 0.001$). Moreover, monetization efficiency partially mediates the relationship between technology adoption and sustainability (VAF

= 61.8%), highlighting both direct and indirect pathways. The quantitative evidence further demonstrates that digital platforms substantially improve destination performance: revenues increased by 45–78%, operational efficiency improved by 32–56%, and tourist market reach expanded by up to 120%. At the same time, technologies such as IoT and digital twins contributed to ecosystem conservation efforts, with monitoring effectiveness rising by approximately 40%.

These findings provide compelling evidence that digital platform integration represents a viable pathway for achieving the dual objectives of economic growth and environmental conservation within marine tourism sectors. The study's results suggest that successful implementation requires strategic attention to community engagement, infrastructure development, and capacity building to ensure equitable distribution of benefits across all stakeholders. Future research should focus on longitudinal studies to assess the long-term sustainability impacts and explore how emerging technologies such as artificial intelligence and blockchain can further enhance the synergy between blue economy principles and digital tourism innovation.

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