

---

*Original Article*

# Digital Dimension of Blue Economy in Zanzibar

**Dr. Addi Juma Faki**

Zanzibar Planning Commission

---

**Abstract**

The Blue Economy (BE) has emerged as a central pillar of Zanzibar's development agenda, underpinned by strong political commitment, comprehensive policy frameworks, and dedicated institutional arrangements since 2020. Despite this momentum, evidence suggests that the translation of BE promise into inclusive and sustainable socio-economic outcomes remains challenging, particularly for artisanal fishers, seaweed farmers, women, and youth. Using a systematic literature review (SLR) approach, the study synthesizes peer-reviewed studies, policy documents, and grey literature published between 2015 -2025 focusing on the roles of information and communication technologies (ICTs), Internet of Things (IoT), and blockchain technologies in enhancing governance, livelihoods, sustainability, and resilience in the BE discourse. The review also underpinned by Socio-Technical Systems (STS) theory. The findings show that while digital technologies hold significant potential to improve fisheries monitoring, market access, traceability, climate adaptation, and institutional transparency, their adoption in Zanzibar remains fragmented and uneven. Key constraints include weak institutional integration, limited digital infrastructure, low digital literacy, inadequate financing mechanisms, and persistent socio-economic inequalities. The paper argues that Zanzibar's digital Blue Economy transition sits at the intersection of opportunity and constraint. Realizing its transformative potential requires moving beyond techno-centric approaches toward integrated, inclusive, and context-sensitive digital strategies that align technology with governance reform, capacity building, and sustainable financing. The study contributes empirically to the limited Zanzibar-specific literature and theoretically by extending STS theory to the analysis of digitalization in marine and coastal economies, offering policy-relevant insights for Small Island Developing States pursuing digitally enabled Blue Economy pathways.

Article  
History

Received:  
09.01.2026

Accepted:  
20.01.2026

Published:  
31.01.2026

---

**Keywords**

*Blue Economy, Digitalization, Internet of Things, Blockchain, Socio-Technical Systems (STS) Theory.*

---

## 1. Introduction

The Blue Economy (BE) has become a central pillar of Zanzibar's development strategy, as reflected in the Zanzibar Blue Economy Policy (2022), Zanzibar Development Plan (ZADEP 2021-2026), Vision 2050, and dedicated institutional arrangements including Ministry responsible for blue economy in particular. Globally, the BE is framed as an integrated development paradigm that promotes economic growth, environmental sustainability, and social inclusion through the sustainable use of ocean and coastal resources (Hafidh et al, 2021). In Zanzibar, BE policy frameworks are strongly aligned with international and regional instruments such as the United Nations Convention on the Law of the Sea (UNCLOS), the African Integrated Maritime Strategy (AIMS 2050), and the Lomé Charter, emphasizing sustainable resource use, maritime security, and ecosystem protection (Hafidh et al, 2021) and SDGs (SDG 14(Life below water and DG 8: Decent Work and Economic Growth among many others).

Since assuming office in 2020, the President of Zanzibar has placed the Blue Economy at the center of the islands' socio-economic transformation agenda. Presidential statements and development priorities have consistently framed the ocean economy as a strategic pathway for employment creation, youth and women's empowerment, industrialization, and sustainable livelihoods, particularly for coastal communities. This high-level political commitment has reinforced the prominence of the Blue Economy within national planning frameworks and accelerated the creation of institutional structures dedicated to its coordination and implementation (Hafidh et al, 2021; Semboja & Hafidh, 2022).

Despite this strong political and policy commitment, empirical literature reveals that the translation of Blue Economy ambitions into tangible socio-economic outcomes remains limited. Studies focusing on Zanzibar's core BE sectors—particularly artisanal fisheries and seaweed farming—consistently identify structural constraints, including limited access to capital, weak market systems, low technological adoption, inadequate infrastructure, and vulnerability to climate and non-climate stressors (Makame & Salum, 2021; Muumin et al., 2023; Ali et al., 2023). These constraints have contributed to persistently low productivity and limited livelihood gains among coastal communities, raising concerns about the inclusiveness and effectiveness of BE implementation.

Although BE policy frameworks stress integration and stakeholder participation, evidence shows that the involvement of artisanal fishers, seaweed farmers, and women remains largely consultative rather than decision-making (Mwanyoka et al., 2025). Salum (2023) further argues that Zanzibar's BE functions as a development agenda, environmental governance tool, and political discourse, where policy narratives often mask power relations and implementation challenges. By contrast, earlier policy-focused studies assume that political will and institutional coherence automatically ensure implementation, overlooking governance practices and political economy dynamics (Hafidh et al, 2021; Semboja & Hafidh, 2022).

Within this governance and political context, digitalization is increasingly recognized as a potential enabler of Blue Economy transformation. Globally, digital technologies—including ICT platforms, mobile applications, Geographic Information Systems (GIS), remote sensing, Internet of Things (IoT), artificial intelligence (AI), and blockchain—have been shown to enhance fisheries monitoring, marine spatial planning, transparency, traceability, and market access (Cedrilla et al., 2024; Chandravanshi, 2025). In fisheries and aquaculture, blockchain-based systems are particularly noted for their role in addressing illegal, unreported, and unregulated (IUU) fishing and improving supply-chain governance (Chandravanshi, 2025).

However, Zanzibar-specific evidence on the practical adoption and governance of digital technologies remains limited and fragmented. Studies suggest that digital uptake in Blue Economy sectors is constrained by digital divides, low digital literacy, limited infrastructure, weak financial systems, and inadequate institutional capacity (Nassir et al., 2023; Jape, 2024). Research on education and human capital further reveals low public awareness of the BE concept and insufficient integration of ICT- and BE-related competencies within higher learning institutions, limiting innovation and adaptive capacity (Mitula, 2023; Abdalla et al., 2023). Consequently, the strong political promise of the Blue Economy, including presidential commitments since 2020, has yet to be matched by inclusive, evidence-driven, and digitally enabled implementation on the ground. The paper is underpinned by Socio-Technical Systems Theory to address digital dimension of blue economy to make the sector fruitful to incumbent communities and national at large.

## **2. Literature Review**

### ***A. Information and Communication Technologies (ICTs) in the Blue Economy***

A growing body of empirical literature demonstrates that information and communication technologies (ICTs) play a foundational role in enhancing the efficiency, transparency, and sustainability of Blue Economy (BE) activities. ICT-based tools such as Geographic Information Systems (GIS), remote sensing, satellite imaging, mobile technologies, and database management systems are widely applied to support marine spatial planning, fisheries monitoring, and stock assessment. A systematic review of information systems research in Pacific fisheries and aquaculture shows that these technologies improve governance and sustainability outcomes by providing spatially and temporally precise data on fish stocks, fishing effort, and ecosystem health, thereby enabling more informed and timely decision-making (Cedrilla et al., 2024).

Despite these benefits, empirical evidence indicates that ICT adoption is strongly conditioned by institutional capacity and socio-economic context. Cedrilla et al. (2024) observe that much of the existing literature remains technologically driven, with limited attention to governance arrangements, organizational readiness, and livelihood realities that shape adoption outcomes. This limitation is particularly salient for Zanzibar, where fisheries governance is constrained by fragmented institutions, weak monitoring capacity, and limited integration of digital systems into regulatory practice. While ICT tools such as electronic licensing, digital catch reporting, and spatial

planning platforms could strengthen fisheries governance in Zanzibar, there is limited empirical evidence on their effective implementation at the local level.

Beyond governance, ICTs are empirically linked to livelihood improvement in small-scale fisheries. An applied economics review focusing on fishing households in Indonesia finds that mobile phones, digital marketing platforms, and online information systems can increase fishers' income by expanding market access, reducing dependence on intermediaries, and improving price transparency (Hilal et al., 2024). However, the study also shows that these benefits are unevenly distributed due to low digital literacy, inadequate infrastructure, and persistent digital divides in coastal communities. These findings are highly relevant for Zanzibar, where artisanal fisheries dominate and where structural inequalities limit equitable access to ICT-enabled opportunities.

At the regional policy level, African Blue Economy frameworks increasingly recognize innovation and technology as enablers of sustainable development. Nevertheless, empirical assessments reveal that digitalization is often treated implicitly rather than operationalized as a core governance pillar. An analysis of Blue Economy implementation in the South West Indian Ocean region highlights persistent gaps between policy ambition and practical outcomes, citing weak institutional coordination, limited monitoring capacity, and inadequate investment in enabling ICT infrastructure (Bolaky, 2020). For Zanzibar, this suggests that ICTs hold significant promise, but their impact depends on deliberate integration into governance reforms, institutional strengthening, and capacity-building strategies.

### ***B. Internet of Things (IoT) and Smart Systems in the Blue Economy***

The Internet of Things (IoT) represents a more advanced and dynamic dimension of digitalization within the Blue Economy, enabling real-time data collection, automation, and predictive analytics across fisheries, aquaculture, and marine environmental management. Empirical and review-based studies demonstrate that IoT-enabled sensors, automated feeding systems, water-quality monitors, and data analytics platforms can significantly enhance productivity, resource efficiency, and environmental performance in aquaculture systems by reducing human subjectivity and enabling data-driven management (Biazi & Marques, 2023).

While much of the empirical evidence originates from large-scale commercial aquaculture systems, the underlying principles of IoT—continuous monitoring, early warning, and adaptive management—are increasingly applicable to small-scale and modular systems. In Zanzibar, where seaweed farming and emerging aquaculture initiatives are integral to the Blue Economy, IoT technologies could help manage climate-related risks, improve product quality, and stabilize production in the face of environmental variability. However, adoption remains uneven due to high costs, unreliable energy supply, limited technical skills, and weak institutional support structures (Chandravanshi, 2025).

Environmental and climate change literature further underscores the importance of IoT-enabled systems for climate adaptation in marine economies. Fisheries and aquaculture are increasingly vulnerable to climate variability, sea-level rise, temperature changes, and extreme weather events, all of which threaten productivity and coastal livelihoods (Rahman et al., 2022). Despite this, much of the empirical literature emphasizes adaptation strategies without explicitly examining the role of digital tools such as real-time environmental monitoring, early warning systems, and climate forecasting models. This omission represents a significant gap, particularly for climate-sensitive island economies like Zanzibar, where timely data and predictive analytics are essential for adaptive fisheries management.

Overall, the literature suggests that IoT technologies offer substantial potential to enhance resilience and sustainability in the Blue Economy. However, their effectiveness in Zanzibar depends on context-sensitive design, institutional readiness, human capital development, and alignment with local livelihood systems rather than the mere availability of technology.

### ***C. Blockchain Technologies and Digital Traceability in the Blue Economy***

Blockchain technologies have emerged in the empirical literature as a powerful digital tool for enhancing transparency, traceability, and accountability within fisheries and marine value chains. Studies show that blockchain-based systems can address illegal, unreported, and unregulated (IUU) fishing by enabling tamper-proof

recording of catch data, vessel movements, and supply-chain transactions, thereby strengthening governance and market trust (Chandravanshi, 2025). By improving traceability from harvest to market, blockchain technologies can enhance access to premium markets and support sustainability certification.

However, empirical evidence also highlights significant barriers to blockchain adoption, particularly in developing and small-island contexts. High implementation costs, limited digital infrastructure, weak institutional coordination, and socio-economic inequalities constrain uptake among small-scale producers (Chandravanshi, 2025). These challenges are pronounced in Zanzibar, where artisanal fisheries dominate and where financial systems remain underdeveloped. Empirical evidence from Zanzibar shows heavy reliance on self-financing and limited effectiveness of formal loan mechanisms, suggesting that blockchain adoption cannot be separated from broader financial inclusion and institutional reform efforts (Nassir et al., 2023).

Critical regional perspectives caution against viewing blockchain as a stand-alone solution to governance challenges. Moolna and Thompson (2018), in their analysis of Seychelles and the wider East African region, argue that Blue Economy discourse is often dominated by political rhetoric that obscures governance failures, weak enforcement, and limited stakeholder inclusion. They emphasize that digital tools – including blockchain – can only contribute meaningfully to sustainability if embedded within robust institutions, participatory governance structures, and transparent regulatory frameworks. For Zanzibar, this implies that blockchain systems must complement, rather than substitute, institutional capacity and community participation.

#### ***D. Synthesis of Gaps and Implications for Zanzibar***

Across ICTs, IoT, and blockchain technologies, the empirical literature converges on the view that digitalization offers significant opportunities to enhance efficiency, transparency, resilience, and inclusivity within the Blue Economy. However, it also consistently demonstrates that digital transformation is not a purely technical process but one deeply shaped by governance quality, institutional capacity, human capital, and socio-economic conditions. Studies from Zanzibar further reveal limited public understanding of the Blue Economy (Mitula, 2023) and inadequate ICT- and BE-aligned curricula in higher learning institutions (Abdalla et al., 2023), highlighting critical human capital constraints that undermine digital uptake.

Collectively, the literature indicates that while the Blue Economy is firmly embedded in Zanzibar's development vision, its translation into inclusive and sustainable livelihood outcomes remains limited. Digitalization emerges as a potentially transformative but insufficiently examined dimension of this agenda. Zanzibar-specific research remains fragmented, often techno-centric, and largely silent on how digital tools interact with local institutions, power relations, and livelihood dynamics. Consequently, there is a clear need for context-specific, empirically grounded research that situates digitalization within Zanzibar's governance and political economy realities, bridging the gap between policy promise and lived experience in the island's Blue Economy.

### **3. Methodology**

#### ***A. Research Design***

This study adopted a desk review research design using a systematic literature review (SLR) approach. A desk review was considered appropriate given the study's objective of synthesizing existing empirical, conceptual, and policy-oriented literature on the digital dimension of the Blue Economy, with a specific focus on Zanzibar. The SLR approach enabled a transparent, replicable, and structured synthesis of evidence across diverse sources, including peer-reviewed journal articles, policy reports, and institutional publications.

#### ***B. Literature Search Strategy***

A systematic search strategy was employed to identify relevant literature. Academic databases including Scopus, Web of Science, Google Scholar, ScienceDirect, and SpringerLink were consulted. In addition, grey literature from reputable international and regional organizations was reviewed to capture policy and implementation perspectives. These included publications from the United Nations (UN), FAO, World Bank, African Union, Observer Research Foundation, and Zanzibar Government institutions.

The search was conducted using combinations of keywords and Boolean operators such as:

- “Blue Economy” AND “digitalization”

- “ICT” AND “fisheries” AND “Blue Economy”
- “IoT” AND “aquaculture”
- “Blockchain” AND “fisheries”
- “Digital technology” AND “marine governance”
- “Blue Economy” AND “Zanzibar”

To ensure relevance, literature published between 2015 and 2025 was prioritized, reflecting recent developments in digital technologies and Blue Economy discourse.

### ***C. Inclusion and Exclusion Criteria***

Clear inclusion and exclusion criteria were applied to ensure consistency and relevance.

#### ***(a) Inclusion criteria***

- Peer-reviewed journal articles, systematic reviews, and empirical studies
- Policy briefs, technical reports, and institutional publications from credible organizations
- Studies addressing ICTs, IoT, blockchain, or digital innovation in fisheries, aquaculture, marine governance, or coastal livelihoods
- Literature with relevance to developing countries, Small Island Developing States (SIDS), or East African coastal contexts.

#### ***(b) Exclusion criteria: 0777 420088***

- Non-English publications
- Studies lacking relevance to marine or coastal sectors
- Opinion pieces without empirical or analytical grounding
- Duplicated studies or outdated sources superseded by more recent evidence.

### ***D. Study Selection Process***

The study selection process followed a structured screening procedure consistent with PRISMA guidelines for systematic reviews. Initially, titles and abstracts were screened to remove irrelevant studies. Full-text screening was then conducted to assess alignment with the study objectives and inclusion criteria. Disagreements during screening were resolved through iterative review and refinement of selection criteria.

### ***E. Data Extraction and Analysis***

Relevant data were extracted using a structured review matrix capturing key information, including:

- Author(s) and year of publication
- Study context and geographical focus
- Research design and methodology
- Type of digital technology examined (ICT, IoT, blockchain)
- Key findings related to governance, livelihoods, sustainability, and institutional capacity
- Identified limitations and research gaps

The extracted data were analyzed using thematic synthesis, allowing patterns and relationships across studies to be identified and compared. Themes were organized around the digital dimensions of the Blue Economy—ICTs, IoT, and blockchain—and cross-cutting issues such as governance, inclusion, human capital, climate resilience, and policy implementation.

### ***F. Analytical Framework***

The analysis was guided by a socio-technical systems perspective, which recognizes that digital technologies interact with institutional, political, and socio-economic structures rather than operating in isolation. This framework enabled critical examination of how digital tools influence, and are influenced by, governance arrangements, human capital, financial systems, and power relations within the Blue Economy.

In addition, the review was informed by the Sustainable Development Goals (SDGs) framework, particularly SDGs 14, and 8 among many others to assess how digitalization contributes to inclusive growth, environmental sustainability, and institutional effectiveness in Zanzibar’s Blue Economy.

### ***G. Quality Assessment***

To enhance rigor, the quality of selected studies was assessed based on clarity of research objectives, methodological transparency, relevance to the study focus, and credibility of data sources. Greater analytical weight was given to peer-reviewed and empirically grounded studies, while conceptual and policy-oriented documents were used to contextualize findings.

### ***H. Ethical Considerations***

As a desk review study relying exclusively on secondary data, this research did not involve human participants and therefore did not require ethical clearance. Nevertheless, ethical standards were maintained through proper citation, accurate representation of findings, and acknowledgment of all original sources.

### ***I. Limitations of the Methodology***

While the desk review and SLR approach provide comprehensive synthesis of existing knowledge, they are limited by the availability and quality of existing studies. Zanzibar-specific empirical evidence on digitalization in the Blue Economy remains limited, and findings are therefore partly inferred from comparable contexts. Future studies incorporating primary data collection would help validate and deepen these insights.

## **4. Discussion of the Findings**

This study's findings reinforce and extend existing empirical literature on the digital dimension of the Blue Economy by demonstrating that while digital technologies—particularly ICTs, IoT, and blockchain—hold substantial transformative potential, their effectiveness in Zanzibar is constrained by institutional, socio-economic, and governance-related factors. Consistent with global and regional studies, the findings suggest that digitalization in the Blue Economy is not a purely technical intervention but a socio-institutional process that requires coordinated governance, human capital development, and inclusive policy design.

### ***A. Digital Technologies as Enablers of Efficiency and Governance***

The findings align with prior empirical evidence showing that ICT-based systems enhance efficiency, transparency, and decision-making in fisheries and marine governance. Similar to observations by Catedrilla et al. (2024), the results indicate that digital tools such as mobile platforms, GIS, and digital databases have the potential to improve fisheries monitoring, spatial planning, and information flows in Zanzibar. However, echoing the same literature, the study reveals that these technologies remain underutilized due to weak institutional integration and limited operational capacity. This confirms that technological availability alone does not guarantee improved governance outcomes, particularly in small island contexts where regulatory enforcement and coordination are limited.

### ***B. Uneven Adoption and the Role of Institutional Capacity***

The findings further corroborate evidence from Chandravanshi (2025), which emphasizes uneven adoption of advanced digital technologies such as IoT and blockchain due to high costs, infrastructure gaps, and institutional weaknesses. In Zanzibar, digital tools are often introduced in pilot or project-based formats without sustained institutional support, leading to fragmented implementation. This pattern reinforces the argument that digitalization must be embedded within well-governed and context-sensitive digital ecosystems rather than treated as a stand-alone technical solution. The findings thus support a shift away from techno-centric narratives toward institutional and governance-focused approaches in Blue Economy digitalization.

### ***C. Livelihood Impacts and Digital Inequalities***

Consistent with the applied economics literature, particularly Hilal et al. (2024), the findings indicate that digital platforms can improve market access and income opportunities for coastal communities by reducing information asymmetries and reliance on intermediaries. However, the Zanzibar case demonstrates that these benefits are unevenly distributed. Artisanal fishers, women seaweed farmers, and youth with limited digital literacy or access to devices are less able to benefit from digital innovations. This supports broader empirical observations that digitalization can inadvertently reinforce existing socio-economic inequalities unless deliberate inclusion mechanisms are put in place.

#### ***D. Governance Gaps Between Policy and Practice***

The findings resonate strongly with regional policy analyses that identify persistent gaps between Blue Economy policy ambitions and implementation outcomes (Bolaky, 2020). Although Zanzibar's development vision emphasizes innovation and the Blue Economy, digital tools are rarely operationalized as core governance instruments. This disconnect mirrors the critique advanced by Moolna and Thompson (2018), who argue that Blue Economy discourse in East Africa is often dominated by political rhetoric that obscures underlying governance failures. The findings suggest that digital technologies could help bridge this gap, but only if integrated into participatory governance structures and supported by regulatory reforms.

#### ***E. Human Capital Constraints and Skills Mismatch***

Human capital limitations emerge as a critical constraint shaping the effectiveness of digitalization in Zanzibar's Blue Economy. The findings align with Mitula (2023) and Abdalla et al. (2023), who report limited public understanding of the Blue Economy and inadequate ICT- and BE-aligned curricula in higher education institutions. This skills mismatch undermines the adoption and sustainability of digital technologies and challenges assumptions in the literature that digital uptake will occur rapidly once technologies are introduced. The findings thus highlight the need to align education reforms, vocational training, and capacity-building initiatives with digital governance and industry needs.

#### ***F. Climate Change, Resilience, and Missed Digital Opportunities***

The findings also underscore a critical gap in the integration of digital technologies into climate adaptation strategies within the Blue Economy. While climate risks to fisheries and aquaculture are well documented (Rahman et al., 2022), digital tools such as early warning systems, IoT-based environmental monitoring, and predictive analytics remain underexplored and underutilized in Zanzibar. This confirms broader critiques in the literature that climate adaptation strategies often neglect the operational role of digital technologies, despite their potential to enhance resilience in climate-sensitive island economies.

#### ***G. Implications for Zanzibar's Blue Economy Transformation***

Taken together, the findings suggest that Zanzibar's digital Blue Economy transition sits at the intersection of opportunity and constraint. Digital technologies can enhance governance efficiency, market access, and sustainability, but their transformative impact depends on institutional coherence, inclusive governance, human capital development, and financial accessibility. The findings therefore support a systems-based perspective in which ICTs, IoT, and blockchain are integrated with policy reforms, education systems, and livelihood strategies rather than implemented in isolation.

Digitalization represents a strategic but underutilized pathway for advancing Zanzibar's Blue Economy. Bridging the gap between policy promise and lived experience requires moving beyond technology-focused interventions toward inclusive, institutionally embedded, and empirically informed digital strategies that prioritize small-scale actors, youth employment, and ecological resilience.

Looking within the lens of Socio-Technical Systems (STS) theory, it becomes clear that digitalization is not a purely technical intervention; rather, it is a socio-institutional process that requires alignment between technological tools, human capacity, governance structures, and socio-economic conditions. While ICTs, mobile platforms, GIS, and digital databases could enhance efficiency, transparency, and decision-making in fisheries and marine governance, their adoption in Zanzibar remains limited due to weak institutional integration, fragmented project-based implementation, and inadequate operational capacity. Similarly, IoT applications and blockchain systems show promise in improving productivity, traceability, and climate resilience, but uneven adoption, high costs, and limited human capital hinder their widespread impact. These dynamics illustrate a key principle of STS: technology alone cannot deliver sustainable outcomes without simultaneous attention to the social and organizational systems in which it operates. Furthermore, digitalization in Zanzibar's Blue Economy intersects closely with livelihoods, equity, and resilience. Benefits from digital platforms are unevenly distributed, with artisanal fishers, women seaweed farmers, and youth often excluded due to low digital literacy, limited access to devices, and socio-economic barriers. Human capital limitations, including inadequate ICT- and Blue Economy-aligned curricula, further constrain the adoption and sustainability of digital tools. Climate-related challenges, such as variability in fisheries

and aquaculture systems, underscore the need for IoT-enabled monitoring and predictive analytics, yet these remain underutilized due to institutional and infrastructural gaps. Through the STS lens, these findings underscore that Zanzibar's digital Blue Economy transition is a complex socio-technical process: realizing its potential requires co-optimization of technology, human capacity, governance, and socio-economic inclusion, ensuring that efficiency, sustainability, and equity are achieved simultaneously.

## **5. Contribution**

### ***A. Contribution to Knowledge***

Empirically, this study advances knowledge on the digital dimension of the Blue Economy in Zanzibar, a context where research remains limited. By synthesizing existing literature and contextualizing it to Zanzibar, the study provides evidence on how ICTs, IoT, and blockchain can enhance governance, efficiency, market access, and climate resilience in fisheries, aquaculture, and marine resource management. Importantly, it highlights the socio-economic and institutional constraints such as digital divides, human capital gaps, weak governance, and infrastructural limitations that mediate the effectiveness of digital tools. This knowledge contributes to a more nuanced understanding of how digitalization interacts with local socio-institutional realities, extending beyond techno-centric narratives and offering empirical insights for policymakers, practitioners, and researchers in Small Island Developing States (SIDS).

### ***B. Theoretical Contribution***

The study also makes a theoretical contribution by applying the Socio-Technical Systems (STS) theory to the Blue Economy and digitalization context. While STS has traditionally been applied in industrial, healthcare, and ICT settings, this study demonstrates its relevance in marine and coastal economies, particularly for analyzing the interaction between digital technologies, human actors, and institutional structures. By framing ICTs, IoT, and blockchain as socio-technical interventions rather than isolated tools, the study advances theoretical understanding of digital transformation in complex, multi-actor systems. It shows that effective digitalization in the Blue Economy requires co-optimization of technology, governance, and human capacity, reinforcing STS principles and extending them to a novel domain of environmental and livelihood-focused economic development.

## **6. Conclusion**

This study set out to examine the digital dimension of the Blue Economy in Zanzibar, with particular attention to the roles of ICTs, IoT, and blockchain in enhancing governance, livelihoods, and sustainability. Drawing on empirical and review-based literature, the study concludes that digitalization holds significant potential to transform Zanzibar's Blue Economy from a resource-dependent model toward a more knowledge-driven, transparent, and resilient development pathway. Digital technologies can improve fisheries monitoring, market access, traceability, and climate resilience, thereby contributing to sustainable livelihoods, youth employment, and environmental stewardship.

However, the findings also reveal that the digital transformation of the Blue Economy in Zanzibar remains fragmented and uneven. While policy frameworks increasingly recognize innovation and technology, digitalization is not yet operationalized as a core governance pillar. Institutional fragmentation, weak coordination, limited infrastructure, low digital literacy, and constrained financing mechanisms continue to limit the effectiveness and inclusivity of digital initiatives. As a result, the benefits of digitalization are unevenly distributed, often excluding small-scale fishers, women seaweed farmers, and youth—groups that are central to Zanzibar's Blue Economy.

The study further concludes that digitalization in the Blue Economy is not a purely technical process but a socio-institutional and political one. Without robust institutions, participatory governance structures, and sustained investment in human capital, digital technologies risk reinforcing existing inequalities rather than addressing them. Moreover, the limited integration of digital tools into climate adaptation strategies represents a missed opportunity for enhancing resilience in Zanzibar's climate-sensitive marine sectors. Overall, the study underscores that realizing the transformative potential of the digital Blue Economy in Zanzibar requires moving beyond techno-centric approaches toward integrated, inclusive, and context-sensitive strategies that align technology with governance reform, capacity building, and sustainable financing.

## Recommendations

Based on the study's conclusions, the following recommendations are proposed for policy, practice, and future research:

### *A. Strengthen Institutional Integration of Digital Technologies*

The Government of Zanzibar should embed digital tools—such as electronic licensing systems, digital catch reporting, and vessel monitoring systems—within formal fisheries and Blue Economy governance frameworks. This requires strengthening institutional coordination among ministries, agencies, and local authorities to ensure that digital systems are interoperable, sustained, and aligned with regulatory enforcement mechanisms.

### *B. Invest in Inclusive Digital Infrastructure and Access*

Targeted investment is needed to expand ICT infrastructure in coastal and island communities, including affordable internet connectivity, reliable energy supply, and access to digital devices. Special attention should be given to reducing digital divides affecting artisanal fishers, women, and youth to ensure that digitalization supports inclusive Blue Economy growth rather than deepening inequality.

### *C. Build Human Capital and Digital Skills for the Blue Economy*

Education and training institutions should integrate Blue Economy–relevant digital skills into curricula at secondary, vocational, and higher education levels. This includes training in ICT applications, data management, IoT systems, and digital entrepreneurship tailored to fisheries, aquaculture, tourism, and marine governance. Capacity-building programs for public officials and community leaders are equally critical to support effective digital governance.

### *D. Promote Context-Sensitive Adoption of IoT and Smart Systems*

IoT applications in fisheries, aquaculture, and environmental monitoring should be designed with Zanzibar's socio-economic and infrastructural realities in mind. Pilot projects should prioritize low-cost, modular, and scalable solutions, accompanied by training and maintenance support, to enhance productivity and climate resilience without imposing unsustainable costs on small-scale producers.

### *E. Integrate Blockchain within Broader Governance and Financial Reforms*

Blockchain-based traceability and monitoring systems should be implemented as part of broader governance and financial inclusion strategies. This includes strengthening regulatory frameworks, improving access to credit and insurance, and supporting cooperatives and producer organizations to collectively adopt and manage digital traceability systems.

### *F. Mainstream Digital Tools into Climate Adaptation Strategies*

Digital technologies such as early warning systems, real-time environmental monitoring, and climate forecasting models should be systematically integrated into Zanzibar's fisheries and Blue Economy climate adaptation plans. This would enhance preparedness, reduce vulnerability, and support adaptive management in the face of climate variability and extreme events.

### *G. Advance Empirically Grounded and Participatory Research*

Future research should move beyond conceptual and techno-centric analyses toward empirical, participatory studies that examine how digital technologies interact with local institutions, power relations, and livelihood dynamics. Longitudinal and mixed-methods research is particularly needed to assess the long-term impacts of digitalization on employment, equity, and sustainability in Zanzibar's Blue Economy.

## 7. References

- [1] Abdalla, A. T., Ibwe, K., Maiseli, B., Muhamed, D., & Alawi, M. (2022, December). Towards ICT-Driven Tanzania Blue Economy: The Role of Higher Learning Institutions in Supporting the Agenda. In International Conference on e-Infrastructure and e-Services for Developing Countries (pp. 487-497). Cham: Springer Nature Switzerland.
- [2] Ali, S. M., Bilame, O., & Ngusa, D. (2023). An assessment of the potentials of artisanal fisheries in spearheading the blue economy transformation in Zanzibar islands. *Global Journal of Agricultural Sciences*, 22(1), 23-35. <https://dx.doi.org/10.4314/gjass.v22i1.4>

- [3] Bolaky, B. I. N. E. S. W. A. R. E. E. (2020). Operationalizing blue economy in Africa: the case of South-West Indian Ocean. ORF Issue Brief, 398(398), 17. ISBN 978-93-90159-95-6
- [4] Chandravanshi, S., Sudan, P., Bihari, K., Venkat, C. S. S., Sandeep, J. B., Yadav, B., Revathi, A., & Pugazhenthii, P. (2025). *Digital innovations in fisheries and aquaculture: A systematic review of technologies, adoption, and socio-economic impacts*. International Journal of Advanced Biochemical Research, 9(9), 336–343. <https://www.doi.org/10.33545/26174693.2025.v9.i9e.5642>
- [5] Doce, L. J. P., Catedrilla, J. M., Vega, C. J. B. D., Limpin, L. L., Ambalong, K. A., & Trillo, J. I. T. (2024). Exploring the nexus between the blue economy and information technologies: A systematic literature review of information systems in Pacific fisheries and aquaculture. Journal of Engineering, Environment, and Agriculture Research, 3(1), 46–54. <https://doi.org/10.34002/jeeear.v3i1.67>
- [6] Dogeje, F. (2026). Empowering coastal economies: Gendered insights into women’s participation in seaweed aquaculture in Zanzibar. Marine Policy, 183, 106900. <https://doi.org/10.1016/j.marpol.2025.106900>
- [7] Dogeje, F., Msuya, F. E., Ngaruko, D., & Mohamed, A. S. (2025). Blue economy dynamics: does women’s participation in seaweed aquaculture influence their income levels? Empirical evidence from Zanzibar. Aquaculture International, 33(1), 27. East Africa. Keele University Institute for Sustainable Futures Discussion Paper, 1.
- [8] Hafidh, M. H. A., Salum, S. M., & Ali, M. A. Shariff. (2021). Zanzibar And the establishment of blue economy strategies. Arabian Journal of Business and Management Review (Kuwait Chapter), 10(1), 10-15. SSN: 2617-3018
- [9] Hilal, S., Bafadal, H., & Yulitasari, L. (2025). Blue Economy Optimization of Fishing Families in the Digital Era: An Applied Economics Approach. iEcol Islamic Economics Journal, 3(1), 157-172. <https://doi.org/10.33545/26174693.2025.v9.i9e.5642>
- [10] Jape, K. K. (2024). Exploring the role of social media platforms as a catalyst in Zanzibar’s blue economy development. International Journal of Novel Research in Marketing Management and Economics, 11(1), 120–132. <https://doi.org/10.5281/zenodo.10730997>
- [11] Khatib, M. M. (2025). Women’s Inclusion in the Blue Economy in Zanzibar. Tanzania Journal of Development Studies, 23(1), 81-104. <https://dx.doi.org/10.56279/NJIY8787/TJDS.v23i1.5>
- [12] Makame, O. M., & Salum, L. A. (2021). Vulnerability of Fishing and Fisheries Sector to Climate Change and Non-climate Risks as Perceived by Fishermen in Zanzibar Coastal Villages. Carnets de Recherche’s de l’océan Indien, Mutations et transitions dans l’océan Indien, 7, pp.165-183. [ff10.26171/carnets-oi\\_0711ff](https://doi.org/10.26171/carnets-oi_0711ff). [ffhal-03603618](https://doi.org/10.26171/carnets-oi_0711ff)
- [13] Mitula, M. G. (2023). A Study on the Importance of the Blue Economy Education to all Citizens of Zanzibar. The Journal of Maritime Science and Technology (JMST), 1(1), 21-26. <https://journal.dmi.ac.tz>
- [14] Moolna, A., & Thompson, B. S. (2018). The blue economy approach for sustainability in Seychelles &
- [15] Mussa, W. M., Jing, Z., Machochoki, A. S., & Bakari, S. J. (2021). *Towards growth of the blue economy in Zanzibar: Potentials and challenges*. International Journal of Scientific Advances, 2(3), 11–18. <https://doi.org/10.51542/ijscia.v2i3.13>
- [16] Mwaijande, F., & Rashidi, Y. R. (2025). Application of Social Life Cycle Assessment on Seaweed Farming Blue Economy in Zanzibar-Tanzania by 2025. <https://doi.org/10.21203/rs.3.rs-7241144/v1>
- [17] Nassir, M. N., Abdallah, Z. M., & Hafidh, H. A. (2022). Insight into the Utilization of the Blue Sources of Funds in Fisheries Investment as a Key Sector in Blue Economy in Zanzibar. Asian Journal of Fisheries and Aquatic Research, 9(3), 112-125. DOI: 10.9734/AJFAR/2022/v17i230401
- [18] Onyango, M. J. (2025). Effectiveness of Digital Technology in Enhancing Blue Tourism Sustainability in Tanzania. Journal of Management, and Development Research, 2(1), 1 10. <https://doi.org/10.69739/jmdr.v2i1.191>.
- [19] Rahman, A., Kanon, K. F., Islam, M. J., Mojumdar, S., Ashik, A. A., & Molla, M. H. R. (2022). Impacts of climate change on aquaculture and fisheries: an integrated approach for adaptation and mitigation. Journal of Biological Studies, 5(1), 171-188. <https://doi.org/10.62400/jbs.v5i1.6623>
- [20] Said, S. S. (2023). Blue Economy Discourses for Effective Ocean Governance: A Case of Zanzibar (Master's thesis, University of Dodoma (Tanzania))
- [21] Verma, S., & Sharma, M. Role of Digitalization in a Sustainable Blue Economy. International Journal of Teaching, Learning and Education, 4(3), 618013. <https://dx.doi.org/10.22161/ijtle.4.3.5>