

Original Article

Profit Meets Purpose: How Blockchain is Transforming Sustainable Digital Entrepreneurship in Iringa Municipal, Tanzania

Lusekelo Kibona

Department of Computer Science, Ruaha Catholic University (RCU), Iringa, Tanzania.

Corresponding Author : lusekelo2012@gmail.com

Received: 01 October 2024

Revised: 04 November 2024

Accepted: 21 November 2024

Published: 05 December 2024

Abstract - In recent years, the importance of sustainability in business has gained prominence, driven by increasing consumer awareness and demand for ethically produced goods and services. Entrepreneurs in Iringa Municipal have begun to recognize the potential of blockchain technology to address local challenges such as poverty, unemployment, and resource scarcity. This study explored the transformative potential of blockchain technology in fostering sustainable digital entrepreneurship. It aimed to understand how blockchain contributed to sustainable development and social impact, identified specific benefits for environmental and social sustainability, and examined the creation of sustainable business models through its implementation. Utilizing a mixed-methods approach, the research gathered data from 108 respondents through surveys and interviews. Key findings revealed that blockchain significantly enhanced transparency, accountability, and collaboration among stakeholders while offering opportunities for ethical sourcing and community empowerment. However, challenges such as regulatory hurdles, technological limitations, and financial constraints emerged as barriers to scaling these initiatives. The study concluded by recommending strategic collaborations among stakeholders to maximize blockchain's benefits for sustainable regional development. This research contributed to the growing body of knowledge on the intersection of technology, entrepreneurship, and sustainability, highlighting blockchain's role in shaping a more sustainable future.

Keywords - Blockchain technology, Digital entrepreneurship, Sustainable development, Sustainable business models, Environmental sustainability, Market acceptance, Consumer awareness.

1. Introduction

Blockchain technology and sustainable entrepreneurship represent a significant paradigm shift in how businesses operate, particularly in developing regions such as Iringa Municipal, Tanzania. Blockchain, a decentralized digital ledger system, offers unprecedented transparency and security, enabling entrepreneurs to build trust and credibility with their stakeholders. In the context of sustainable digital entrepreneurship, blockchain facilitates the efficient management of resources. It enhances accountability in supply chains, which is crucial for promoting environmentally and socially responsible business practices. In recent years, the importance of sustainability in business has gained prominence, driven by increasing consumer awareness and demand for ethically produced goods and services. Entrepreneurs in Iringa Municipal have begun to recognize the potential of blockchain technology to address local challenges such as poverty, unemployment, and resource scarcity. By leveraging blockchain, these businesses can optimize operations, reduce waste, and create innovative business models that align profit with purpose. This transformative

approach is reshaping the entrepreneurial landscape, encouraging stakeholder collaboration and fostering a sustainability culture. Sustainable digital entrepreneurship emerged as a concept integrating digital technologies, entrepreneurship, and sustainability principles. It was characterized by digitalization, openness, innovation, flexibility, and value creation [1]. Four types of sustainable digital entrepreneurs were identified: Process-Oriented System Thinkers, Unconventional Strategists, Dynamic Visionary, and Success-Oriented opportunists [2]. These entrepreneurs influenced organizational culture and resilience through six success factors. The transition to digital entrepreneurship brought challenges, including disruption of collaborative networks and socio-technical pressures [3]. However, it also offered benefits such as improved efficiency, economic growth, and support for social stability [4]. Digital accounting, management, and marketing processes played crucial roles in sustainable entrepreneurship, highlighting specific sustainability aspects that, when integrated, led to economic, environmental, and social success [4]. The studies examined various aspects of digital entrepreneurship and



sustainability in Tanzania. Entrepreneurship training positively impacted SME sustainability, with customer service, opportunity identification, and record keeping being crucial skills [5]. Tanzania's emerging digital economy faced challenges such as insufficient network coverage, low internet usage, and lack of consumer protection [6]. Digital leadership was conceptualized with key characteristics grouped into roles, emphasizing the importance of fostering innovation and entrepreneurship [7]. Strategic orientations, including market, entrepreneurial, and learning orientations, were positively related to digitalization, mediating the relationship between these orientations and sustainable competitive advantage for small businesses [8]. These findings highlight the importance of digital skills, infrastructure, leadership, and strategic orientation in promoting sustainable digital entrepreneurship in Tanzania while identifying policy and practice improvement areas. Recent research has examined the challenges and opportunities in creating sustainable digital startups. Studies highlighted the potential of digital technologies to address sustainability issues, such as developing renewable energies and smart cities [9]. However, challenges like e-waste and high energy consumption were also identified. Researchers proposed four archetypes of digital sustainable business models, emphasizing the integration of ecological sustainability into core business logic [10]. A study on Estonian companies revealed that increasing production efficiency and favorable taxation for green products were seen as opportunities while losing competitive advantage and significant investment needs were challenges [11]. In rural contexts, partnerships with stakeholders and customization to meet specific customer needs were found to be key factors in achieving sustainability objectives through digital transformation [12]. These findings provide valuable insights for sustainable digital entrepreneurship.

The digital landscape in Tanzania presents both opportunities and challenges for sustainable startups. While e-government initiatives aim to drive transformation, they face obstacles such as reluctance towards transparency, technological misfortune, and institutional docility [13]. The emerging cybersecurity sector offers prospects in digital technology and government initiatives but struggles with limited digital literacy and inadequate infrastructure [14]. Technology business incubation is gaining traction, though unique challenges persist in this developing country context [15]. In agriculture, digital technologies show promise for sustainable practices, particularly for large-scale farmers. However, smallholder farmers lack comprehensive digital services that address their needs throughout the farming cycle [16]. To foster sustainable digital startups, Tanzania must overcome these challenges while leveraging opportunities in cybersecurity, e-government, business incubation, and agricultural technology sectors. Blockchain technology emerged as a promising tool for addressing environmental and social challenges in digital entrepreneurship. It offered reliability, transparency, decentralization, and accessibility for

social ventures [17]. Blockchain applications facilitated sustainable development through renewable energy adoption and emissions reduction [18]. Digital innovations, including blockchain, helped tackle climate change and promote sustainable development by enabling entrepreneurial organizations to address societal challenges [19]. Blockchain solutions were proposed for secure green energy trading, efficient tracking of CO2 reduction, and ESG compliance [18]. The technology's user-centric paradigm presented opportunities for social impact [20]. However, challenges remained in implementing blockchain for social good, including stakeholder engagement and regulatory compliance [17]. Overall, blockchain technology demonstrated the potential to drive positive societal impact through digital sustainability initiatives in entrepreneurship.

In Tanzania, Blockchain technology has emerged as a potential solution to various challenges, including environmental and social issues in digital entrepreneurship. Research has shown that blockchain can enhance security, transparency, and efficiency in sectors such as healthcare, land registration, and banking [21]. In education, blockchain-based systems have been proposed to address certificate verification challenges, combating forgery and improving credibility [22]. Social entrepreneurship in Tanzania has played a crucial role in addressing social problems, though it faces challenges like poor infrastructure and funding issues [23]. Recent studies have demonstrated that digital technologies, including blockchain, the Internet of Things, and Big Data Analytics, positively impact sustainable supply chain performance in public procurement entities when supported by appropriate legal frameworks [24]. These findings suggest blockchain technology can significantly address environmental and social challenges in Tanzania's digital entrepreneurship landscape.

Blockchain technology demonstrated significant potential for enhancing sustainability in supply chains. It offered improved transparency, traceability, and efficiency in supply chain management [25, 26]. The decentralized and immutable nature of blockchain enabled organizations to address environmental and ethical concerns throughout the supply chain [26]. Studies highlighted blockchain's capacity to improve sustainability performance in areas such as environmental protection, social equity, and governance efficiency [25]. However, researchers identified adoption barriers, including inter-organizational, intra-organizational, technical, and external challenges [27]. Case studies in agriculture and manufactured goods showcased blockchain's potential to promote sustainable sourcing from origin to consumers [28]. While blockchain showed promise for boosting supply chain sustainability, ensuring accurate and verifiable data input from all stakeholders remained challenging [28]. Blockchain technology was considered a promising tool for addressing global supply chain management problems and sustainability goals [27]. Recent studies explored how blockchain technology enabled

Sustainable Business Models (SBMs) and practices. Blockchain's transparency, security, and immutability enhanced traceability and reduced transaction costs in supply chains, particularly in the agri-food sector [29]. The research identified four main areas where blockchain supported SBMs: smart energy management, climate change mitigation, waste management, and sustainable production [30]. The technology fostered inclusivity and long-term community benefits, even in traditional sectors [31]. Case studies demonstrated blockchain's potential to drive financial and social sustainability by facilitating the widespread distribution of benefits [31, 32]. Additionally, blockchain-based SBMs aligned with the United Nations Sustainable Development Goals, offering empirical evidence of successful implementations [30]. These findings suggested that blockchain technology enabled and supported new sustainable business practices across various industries.

Blockchain technology demonstrated the potential for enhancing sustainability in digital entrepreneurship and startups. It offered transparency, security, and efficiency in various sectors, enabling the removal of intermediaries and promoting sustainable practices [33]. The technology facilitated tracking and verification of sustainable practices, supporting the transition to a low-carbon economy [34]. Blockchain applications reduced bureaucracy and incentivised environmentally friendly behavior [35]. However, concerns were raised regarding the energy consumption of certain blockchain networks, particularly Bitcoin, which posed sustainability challenges [34]. Despite these concerns, no limiting factors or carrying capacity issues were evident in the blockchain system [35]. Developing less energy-intensive alternatives for block validation was suggested as a potential solution to address environmental concerns and further promote sustainability in blockchain applications [35].

Blockchain technology offers significant potential for enhancing sustainability and efficiency in various sectors in Tanzania, including healthcare, land registration, banking, and public procurement [21]. Its implementation could improve security and transparency and reduce fraud [21]. In digital entrepreneurship, blockchain and other technologies like Internet of Things and Big Data Analytics positively impacted sustainable supply chain performance in public entities [24]. However, adopting blockchain in Tanzania faced challenges, including low awareness among procurement professionals, with 74.7% unaware of its applications in supply chain operations [36]. Technical issues and lack of understanding were major obstacles [36]. To address these challenges and promote sustainability in digital entrepreneurship, entrepreneurship training was found to be crucial for SME sustainability, though high costs limited access to such training [5]. The statement of the problem addressed by this study stems from the growing need to align digital entrepreneurship with sustainable development goals in Iringa Municipal through the use of blockchain technology. While

blockchain has the potential to foster transparency, accountability, and efficiency, its application in promoting environmental and social sustainability among local digital startups remains underexplored. This study investigates how blockchain technology can contribute to sustainable development by addressing critical questions: How can blockchain be integrated to support social impact in the region? What specific environmental and social benefits can it offer? Furthermore, local entrepreneurs face challenges in creating sustainable business models due to limited resources, awareness, and technical know-how. The study will also examine the opportunities and obstacles in scaling blockchain-driven sustainable entrepreneurship in Iringa Municipal, aiming to provide solutions that balance business growth with sustainability efforts.

The gap in this study was identified in the limited research on how blockchain technology had been applied to foster sustainable digital entrepreneurship, specifically in the local context of Iringa Municipal. Although blockchain's potential to revolutionize industries globally was recognized, previous studies had overlooked mainly its impact on creating sustainable business models that integrated environmental and social considerations. Additionally, there was a lack of exploration into the specific benefits of blockchain in promoting sustainability within smaller, emerging regions like Iringa. This study aimed to fill that gap by examining how blockchain technology contributed to sustainable development in local digital startups while also addressing the unique challenges and opportunities for scaling these businesses in Iringa Municipal.

This study aims to explore blockchain technology's transformative role in promoting sustainable digital entrepreneurship within Iringa Municipal. Specifically, the study examines how blockchain can contribute to sustainable development and social impact by fostering transparency, efficiency, and accountability among local digital startups. It seeks to identify the specific environmental and social benefits blockchain can offer entrepreneurs, evaluate how this technology can be leveraged to create sustainable business models and address the challenges and opportunities for scaling these efforts in the region.

The main contribution of this study is its in-depth analysis of how blockchain technology can serve as a powerful tool for fostering sustainable digital entrepreneurship in Iringa Municipal. By investigating the intersection of blockchain and sustainability, the study provides valuable insights into how local entrepreneurs can integrate blockchain to create transparent, socially responsible, and environmentally sustainable business models. Additionally, the study addresses the challenges and opportunities specific to scaling these ventures, offering a framework for stakeholders to leverage blockchain in driving long-term sustainable development while balancing economic goals with social impact.

2. Methodology

The study's methodology involved a mixed-methods approach, combining quantitative and qualitative research techniques to gain comprehensive insights into the role of blockchain technology in fostering sustainable digital entrepreneurship in Iringa Municipal. The sample size for this study consisted of 108 participants, including local entrepreneurs, blockchain experts, and stakeholders from various sectors involved in digital startups. Quantitative data were collected through structured questionnaires distributed to the participants, which included closed-ended questions designed to assess their understanding of blockchain technology, its benefits for sustainability, and the challenges faced in implementing these practices. The questionnaires were administered both online and in-person to ensure a diverse range of responses. In addition to the quantitative approach, qualitative data were gathered through semi-structured interviews with selected entrepreneurs who had implemented blockchain solutions in their businesses.

These interviews aimed to explore participants' experiences and perspectives on how blockchain technology could enhance sustainable practices and create social impact within their startups. The qualitative data provided depth and context to the quantitative findings, allowing for a more nuanced understanding of the intersection between blockchain and sustainable entrepreneurship in the region. Data analysis involved statistical techniques for the quantitative data, such as descriptive statistics to summarize the responses and thematic analysis for the qualitative data to identify key themes and insights that emerged from the interviews. This comprehensive methodology ensured that the study captured a holistic view of the challenges and opportunities of integrating blockchain technology into sustainable digital entrepreneurship in Iringa Municipal with statistical evidence and in-depth personal insights.

3. Results and Discussion

The results and discussion section of the study provided an in-depth examination of the data collected from a sample size of 108 participants involved in sustainable digital entrepreneurship in Iringa Municipal. The study's findings were categorized based on the research questions, exploring how blockchain technology contributed to sustainable development, the specific environmental and social benefits, and the challenges and opportunities encountered by the entrepreneurs. The data revealed the transformative impact of blockchain on business models, with many participants acknowledging its role in enhancing transparency and accountability in their ventures. The discussion further contextualized these findings, drawing connections between the unique regional dynamics in Iringa and broader trends in sustainable entrepreneurship. The study offered insights into how blockchain technology reshaped digital entrepreneurship for sustainability in the area through participant responses and data analysis.

3.1. Blockchain's Contribution to Sustainable Development and Social Impact

The study focused on blockchain's potential to drive sustainable development and social impact, examining key aspects such as transparency and traceability in supply chains, fair trade and ethical sourcing, community development, and environmental sustainability. The findings demonstrated that blockchain had played a pivotal role in enhancing transparency, making it easier to trace the origins of products, particularly in supply chains. Respondents also reflected on how blockchain technology supported ethical sourcing, ensuring fair trade practices. Additionally, blockchain empowered local communities by fostering development initiatives and contributed to environmental sustainability by promoting resource conservation and reducing carbon footprints.

3.1.1. Transparency and Traceability in Supply Chains

As per Table 1, the study accentuated the significance of blockchain technology in enhancing transparency and traceability within supply chains. Among the 108 respondents, 20 individuals, or 18.5%, perceived that blockchain had a low impact on improving these aspects. These participants often mentioned that blockchain could potentially increase transparency, but it had not yet been fully adopted or implemented in many supply chains, limiting its effectiveness. One respondent shared:

"...I have seen the idea of transparency being touted, but in practice, it is still more of a promise than a reality in many sectors..."

However, 40 respondents, representing 37%, reported that blockchain moderately impacted improving transparency and traceability. They recognized that blockchain had begun to influence supply chains, especially in tracking products, but it had yet to be fully utilized across the board. One participant commented:

"...blockchain has definitely improved the traceability of some products, especially in food and agriculture, but its application remains inconsistent across different industries..."

In contrast, a significant 48 respondents, or 44.5%, felt that blockchain greatly impacted transparency and traceability in supply chains. These individuals shared experiences of how blockchain technology had revolutionized their ability to trace the origins of products, particularly in industries focused on ethical sourcing and sustainability. One respondent explained:

"...using blockchain, we can now trace every product from its source to the final consumer, and this level of transparency has built a new layer of trust with our customers." Another echoed this sentiment: "Before blockchain, we could only hope our suppliers were ethical, but now we can verify every step of the supply chain..."

Table 1. The blockchain's contribution to sustainable development and social impact

Sub-indicator	Low Impact (%)	Moderate Impact (%)	High Impact (%)
Transparency and traceability in supply chains	20 (18.5%)	40 (37%)	48 (44.5%)
Fair trade and ethical sourcing	15 (14%)	35 (32.5%)	58 (53.5%)
Community development and empowerment	25 (23%)	45 (42%)	38 (35%)
Environmental sustainability	12 (11%)	36 (33.5%)	60 (55.5%)

These findings illustrated the varying degrees of blockchain's impact on supply chain transparency and traceability, with most respondents recognizing its growing influence but acknowledging that there is still room for broader adoption and refinement.

3.1.2. Fair Trade and Ethical sourcing

The study findings revealed that blockchain technology has had varying levels of impact on fair trade and ethical sourcing practices. According to table 1, among the 108 respondents, 15 individuals, or 14%, reported that blockchain had a low impact on fair trade and ethical sourcing. These respondents expressed skepticism about the practical use of blockchain in driving ethical practices within supply chains. One participant noted:

"...blockchain seems like a good idea, but I have not seen it really change how businesses source their products. It is more like a concept that has not yet been fully realized..."

This comment reflected concerns that the technology's application in ethical sourcing was not yet widespread or impactful in their immediate environments. Conversely, 35 respondents, or 32.5%, believed blockchain had a moderate impact. These participants acknowledged that blockchain has begun influencing how goods are sourced by increasing transparency and allowing consumers to verify product origins. One interviewee mentioned:

"... we have seen some improvements in how blockchain helps trace products back to their source. It is making it easier to ensure that suppliers follow fair trade principles, but it is still not something every business is adopting..."

This response pointed to a growing but uneven application of blockchain, with its impact felt in certain sectors but not universally. A significant majority of respondents, 58 individuals, or 53.5%, stated that blockchain greatly impacted fair trade and ethical sourcing. These respondents shared positive experiences of how blockchain helped ensure transparency in their supply chains, leading to more ethical business practices. One respondent highlighted:

"...Blockchain has made a huge difference. We can now track our products from start to finish, ensuring that everything is sourced ethically. This not only builds trust with customers but also helps us maintain fair trade certifications." Another participant added, "The ability to verify that products are ethically sourced gives us a

competitive edge, and customers appreciate the transparency that blockchain provides..."

This high-impact group emphasized the growing importance of blockchain in ensuring ethical sourcing, promoting fair trade, and building consumer trust. The technology was praised for its ability to provide concrete proof of ethical practices, which benefits businesses and helps protect vulnerable communities and workers involved in the supply chain. These findings suggested that while blockchain's role in fair trade and ethical sourcing is still evolving, it holds substantial promise for driving positive changes in global trade practices.

3.1.3. Community Development and Empowerment

In the study on blockchain's contribution to community development and empowerment, the respondents, as shown in Table 1, expressed varying perspectives on the impact of blockchain technology. Among the 108 participants, 25 individuals (23%) believed blockchain had a low impact on community development and empowerment. These respondents felt that while blockchain had potential, its benefits were not fully realized in local communities. One participant noted:

"...blockchain sounds promising, but we have not seen much in terms of real, tangible changes for the community. It is still very abstract, and the benefits seem far off..."

This group raised concerns about the accessibility and applicability of blockchain in addressing grassroots issues, with the technology still perceived as distant from everyday community challenges. On the other hand, 45 respondents (42%) believed that blockchain had a moderate impact on community development. These individuals recognized some benefits, especially in terms of transparency and accountability in local projects, but felt that its full potential had yet to be unlocked. One respondent remarked:

"...Blockchain has helped us track funds and ensure they are used properly for community projects, but it is still in the early stages. We need more education and infrastructure to make it more impactful..."

This group pointed out that while blockchain was helping to improve governance and reduce corruption in community-based projects, there were still significant barriers, including a lack of understanding and limited technological infrastructure that needed to be addressed for broader empowerment.

A smaller yet notable group of 38 respondents (35%) reported that blockchain greatly impacted community development and empowerment. These individuals shared success stories of how blockchain had been used to facilitate community-driven initiatives, from crowdfunding local projects to providing transparency in resource allocation. One interviewee stated:

“...blockchain has empowered our community by giving us control over our resources. We have been able to use it to track donations and make sure that funds are spent properly. It’s a game changer.” Another participant added, *“We have seen real empowerment through blockchain because it holds everyone accountable. Whether in agriculture or small business development, it has given us the tools to take ownership of our future...”*

This high-impact group highlighted the transformative potential of blockchain when applied effectively, noting that it fosters accountability, trust, and local ownership of development initiatives. The data reflected that while blockchain’s role in community development and empowerment is still in its early stages, it holds substantial potential for driving positive changes. The key to realizing its full impact lies in improving education and infrastructure and encouraging greater community involvement in adopting the technology.

3.1.4. Environmental Sustainability

In the study, the respondents, as per Table 1, provided diverse insights regarding blockchain’s contribution to environmental sustainability. Out of 108 participants, 12 individuals (11%) expressed that blockchain had a low impact on environmental sustainability efforts in the region. These respondents were skeptical about the real-world effects of blockchain on environmental issues, citing its complex technical nature and the limited visible outcomes. One participant remarked:

“... we have heard that blockchain can help with sustainability, but honestly, I have not seen any direct results yet. It seems more like a buzzword than something we can use to protect our environment...”

This response reflected the challenges of translating blockchain’s theoretical benefits into practical, measurable environmental impacts, particularly in regions where technological infrastructure might still develop. On the other hand, 36 respondents (33.5%) acknowledged that blockchain had a moderate impact on environmental sustainability, recognizing the technology’s potential and highlighting the current limitations.

These participants viewed blockchain as a promising tool for reducing environmental damage, particularly through transparency in supply chains and resource conservation, but

noted that more widespread adoption and integration were needed. One respondent stated:

“...blockchain is definitely helping us monitor resources better and reduce waste, especially in industries like agriculture. But the technology is still new, and not everyone uses it, so the impact has not been as big as it could be...”

Another participant added:

“... we have seen some positive changes, especially in tracking environmental data and ensuring accountability in resource use, but it is not yet at the level where it is making a huge difference...”

This group acknowledged that while blockchain had started contributing to sustainability, its potential remained untapped. A majority of the respondents, 60 individuals (55.5%), believed that blockchain greatly impacted environmental sustainability, particularly in areas such as reducing carbon footprints and promoting resource conservation.

These respondents emphasized how blockchain had been effectively applied to track emissions, verify sustainable practices, and ensure environmental transparency in various industries. One enthusiastic

interviewee shared:

“...blockchain has revolutionized how we approach sustainability. It has allowed us to trace our products’ origin, reduce waste, and lower our carbon footprint. This level of accountability has been a game-changer for us...”

Another participant noted:

“...what I love about blockchain is how it forces companies to be transparent about their environmental impact. It is no longer just about profits; companies now have to show that they are responsible stewards of the environment...”

This group highlighted the significant strides in leveraging blockchain to improve environmental sustainability, particularly in industries where tracking resource use and reducing waste were critical. The findings indicated that while blockchain’s impact on environmental sustainability varied among respondents, a strong consensus emerged around its potential.

The technology’s ability to promote transparency, accountability, and resource conservation was evident. However, broader adoption and enhanced infrastructure were key factors to realizing its full potential in fostering sustainable practices across industries.

Table 2. Showing the benefits of blockchain for environmental and social sustainability

Sub-indicator	Not Beneficial (%)	Somewhat Beneficial (%)	Beneficial (%)
Reduced fraud and corruption	18 (17%)	42 (39%)	48 (44%)
Improved accountability and transparency	10 (9%)	30 (28%)	68 (63%)
Enhanced trust and reputation	12 (11%)	40 (37%)	56 (52%)
Facilitation of collaborative initiatives	15 (14%)	35 (32.5%)	58 (53.5%)

3.2. Benefits of Blockchain for Environmental and Social Sustainability

The analysis of blockchain's benefits for environmental and social sustainability focused on its ability to address key sector challenges. Respondents shared insights on how the technology reduced fraud and corruption, improved accountability and transparency, enhanced trust and reputation, and facilitated collaborative initiatives. These contributions were viewed as critical in promoting ethical practices, fostering trust between stakeholders, and enabling coordinated efforts for sustainability. Through blockchain's transparency and decentralized nature, participants believed it had a transformative effect, particularly in areas where transparency and collaboration were essential for achieving sustainability goals.

3.2.1. Reduced Fraud and Corruption

As in Table 2, the study revealed insightful respondents' perspectives on how blockchain technology helped reduce fraud and corruption in environmental and social sustainability efforts. Of the 108 participants, 18 respondents (17%) stated that blockchain had not been beneficial in addressing fraud and corruption. These participants shared experiences where blockchain's potential had not been fully realized, or implementation challenges had diluted its effectiveness. One respondent explained:

“...While blockchain has the potential to bring transparency, we have not seen a significant reduction in corruption in our sector because it has not been implemented at scale yet. Without broader adoption, its impact remains limited...”

On the other hand, 42 respondents (39%) found blockchain to be somewhat beneficial. These individuals recognized that while the technology showed promise, there were still limitations in its current use cases. As one interviewee noted:

“...Blockchain helps track transactions and ensures there is less room for fraud. But it is still early days. In some areas, traditional systems are still being used alongside blockchain, which means there is room for corruption to slip through the cracks...”

A significant 48 respondents (44%) saw blockchain as highly beneficial in reducing fraud and corruption. These individuals spoke highly of the technology's ability to create immutable records, making fraudulent activities nearly

impossible. One respondent shared:

“...Since the introduction of blockchain in our supply chain, we have seen a drastic decrease in fraudulent activities. Its traceability and transparency mean no one can alter records without leaving a digital footprint. It has completely transformed how we manage ethical sourcing...”

These findings underlined blockchain's varying levels of perceived effectiveness in combating fraud and corruption, with a majority acknowledging its role as a powerful tool for promoting accountability and transparency.

3.2.2. Improved Accountability and Transparency

In examining the benefits of blockchain for improving accountability and transparency in environmental and social sustainability, the majority of respondents, as per Table 2, reported positive outcomes, though their experiences varied in scope. Of the 108 respondents, only 10 (9%) found that blockchain did not foster greater transparency or accountability in their projects. These respondents cited issues such as the complexity of blockchain technology and its slow adoption across sectors. One respondent commented:

“...While blockchain theoretically should improve transparency, we have not fully integrated it into our operations. There is still a reliance on traditional systems that undermines its potential...”

However, 30 respondents (28%) found blockchain somewhat beneficial, acknowledging its value but pointing to a need for better implementation. These participants noted that blockchain could improve accountability, but challenges such as training and system integration limited its effectiveness. One interviewee shared:

“...Blockchain brings a level of transparency that we did not have before, but we are still in the early stages of adoption. Sometimes, getting everyone on board is hard, especially those unfamiliar with the technology...”

This sentiment reflects the growing awareness of blockchain's capabilities and highlights the need for more comprehensive training and infrastructural support. Most notably, 68 respondents (63%) stated that blockchain had greatly increased accountability and transparency in their environmental and social initiatives. These individuals emphasized how blockchain's immutable ledger technology created a trustworthy system for tracking transactions and



ensuring all stakeholders were held accountable. One respondent praised this aspect, stating:

“...With blockchain, we have seen a huge improvement in accountability. Every transaction and decision is traceable, which has reduced the chances of corruption or mismanagement. It has been a game changer for us, especially in maintaining transparency with our partners and the communities we work with...”

This feedback illustrated blockchain’s substantial role in enhancing accountability and transparency, especially when effectively integrated into organizational operations. The findings accentuated that, while some challenges remained, blockchain was widely viewed as a powerful tool in advancing sustainable and transparent practices.

3.2.3. Enhanced Trust and Reputation

In exploring the role of blockchain in enhancing trust and reputation in environmental and social sustainability projects, the findings, as illustrated in Table 2, revealed a spectrum of opinions from the respondents. Out of 108 respondents, 12 (11%) reported that blockchain had not been beneficial in building trust or improving the reputation of their projects. These participants often noted that the technology was still in its early stages of adoption and that its complexity sometimes hindered widespread understanding, limiting its impact. One respondent mentioned:

“... We have heard a lot about how blockchain can improve trust, but it has not made a noticeable difference. It is hard to convince others to trust a system they do not fully understand or see in action...”

This response reflected a challenge in gaining the confidence of stakeholders unfamiliar with blockchain technology, especially in more traditional sectors. A larger portion of respondents, 40 (37%), found that blockchain had been somewhat beneficial in fostering trust and enhancing their projects’ reputations. These respondents appreciated blockchain’s transparency but felt there were still hurdles to fully realizing its potential. One participant shared:

“...Blockchain has improved transparency, which helps build trust, but it is not a magic solution. It takes time to get people on board and ensure all systems function smoothly. We have seen some positive changes, but work must be done...”

This feedback indicated that while the technology was making strides in increasing trust, broader adoption and better integration into business processes were needed to unlock its full benefits. On the other hand, the majority of respondents, 56 (52%), believed that blockchain had greatly enhanced trust and reputation. These participants emphasized how blockchain’s immutable ledger and decentralized nature offered unparalleled transparency, fostering stakeholder trust.

One respondent noted:

“...Blockchain has been a game changer for us. With everything recorded on a decentralized system, our partners and clients can see that we operate with integrity. It has really boosted our reputation and helped us gain more trust from the community...”

Another added:

“...The fact that every transaction is traceable and secure has given us much credibility. We no longer have to rely on third parties, and people trust that what they see is exactly what happened...”

This positive feedback highlights blockchain’s significant impact on establishing trust and improving reputations, particularly when applied effectively in transparent, decentralized ecosystems. The responses suggested that while blockchain’s benefits in enhancing trust and reputation were clear, achieving widespread understanding and seamless integration remained critical for its broader adoption and success in sustainability initiatives.

3.2.4. Facilitation of Collaborative Initiatives

In examining the benefits of blockchain technology for facilitating collaborative initiatives in environmental and social sustainability, respondents, as per Table 2, expressed a range of perspectives that illustrated the transformative potential of this technology. Among the 108 participants, 15 (14%) indicated that blockchain did not facilitate collaboration. These respondents often highlighted concerns regarding the complexity of blockchain systems, which they felt created barriers to entry. One interviewee articulated this challenge, stating:

“...While using blockchain for collaboration sounded promising, the technical aspects were too daunting for many of our partners. It became a hurdle instead of a help. We struggled to engage everyone when the technology seemed too complicated...”

This viewpoint emphasizes a critical aspect of technology adoption: the necessity for accessible and comprehensible systems that can engage all stakeholders effectively. In contrast, a more substantial group of respondents, comprising 35 (32.5%), perceived blockchain as somewhat beneficial for collaborative efforts. These participants acknowledged that while blockchain offered tools for improved collaboration, its effectiveness was often contingent upon the familiarity and willingness among stakeholders to engage with the technology. One respondent shared:

“... we have had some success using blockchain for collaboration, especially when our partners were open to learning about it. It enabled us to share information more

efficiently, but we still faced resistance from those not ready to embrace such a new approach...

This comment reflected a common theme where the potential of blockchain was recognized but limited by varying levels of technological readiness and understanding among collaborators. The most favorable opinion came from most respondents, with 58 (53.5%) acknowledging blockchain as highly beneficial in facilitating collaborative initiatives.

These respondents emphasized that the transparency and immutability provided by blockchain significantly enhanced trust among stakeholders, thereby promoting more effective partnerships. One participant remarked:

"...blockchain changed the way we work together. Knowing that all contributions are securely recorded makes everyone more willing to collaborate. It has allowed us to build initiatives we could not have achieved alone..."

Another participant added:

"...the collaborative potential is immense. By using smart contracts, we could automate processes that once took a lot of negotiation, making it easier for multiple parties to engage and contribute meaningfully..."

These insights highlight the transformative role that blockchain can play in fostering cooperation across various sectors, effectively creating a more interconnected and collaborative framework for addressing sustainability challenges. The feedback from respondents illustrates that while there are barriers to overcome, facilitating collaborative initiatives through blockchain is viewed positively, particularly as stakeholders' understanding and engagement with the technology grow.

3.3. Blockchain-Enabled Sustainable Business Models

In exploring blockchain-enabled sustainable business models, respondents acknowledged the technology's capacity to reshape traditional practices in various ways. They highlighted decentralized marketplaces and platforms, significantly improving accessibility for smaller producers and allowing them to engage directly with consumers without intermediary reliance. This shift fostered a more equitable market and encouraged the tokenization of assets and services, democratizing ownership and increasing liquidity. Additionally, participants emphasized the rise of a shared economy and collaborative consumption, noting how these concepts optimized resource use and enhanced community participation. Furthermore, they recognized social impact bonds and crowdfunding as effective methods for financing sustainable projects, effectively mobilizing capital to generate both financial returns and positive social outcomes.

Table 3. The blockchain-enabled sustainable business models

Sub-indicator	Insignificant (%)	Moderate (%)	Significant (%)
Decentralized marketplaces and platforms	20 (18.5%)	45 (42%)	43 (39.5%)
Tokenization of assets and services	25 (23%)	30 (28%)	53 (49%)
Shared economy and collaborative consumption	15 (14%)	40 (37%)	53 (49%)
Social impact bonds and crowdfunding	18 (17%)	25 (23%)	65 (60%)

3.3.1. Decentralized Marketplaces and Platforms

In the context of blockchain-enabled sustainable business models, the concept of decentralized marketplaces and platforms, as per Table 3, emerged as a critical area of interest among respondents. A significant portion, comprising 43 individuals (39.5%), perceived these platforms as significantly impacting market accessibility for small-scale producers. They expressed that blockchain technology facilitated direct interactions between buyers and sellers, reducing reliance on intermediaries. One respondent shared their experience, saying:

"...using blockchain allowed us to connect directly with customers, cutting out the middlemen who often took a hefty share of our profits. This change empowered us and increased our earnings..."

However, not all participants viewed this transformation as overwhelmingly positive. Approximately 20 respondents (18.5%) felt that decentralized marketplaces had an insignificant impact, citing concerns about the technology's

accessibility and the potential for market saturation. A participant articulated this concern, noting:

"...while the idea sounds great, many people in our community still struggle with basic tech literacy. It feels like a leap too far for us, and I worry that without proper support, these platforms might not help everyone as intended..."

In contrast, 45 respondents (42%) acknowledged a moderate impact, recognizing such models' potential benefits while highlighting the need for education and infrastructure to support widespread adoption. One of them remarked:

"...the potential is there, but we need workshops and training for people to understand how to use these platforms effectively. Otherwise, we might just be creating a new kind of exclusivity..."

This varied perspective illustrated the complexities surrounding the implementation of decentralized marketplaces, emphasizing that while the opportunities

presented by blockchain are promising, significant barriers still need to be addressed for their full potential to be realized.

3.3.2. Tokenization of Assets and Services

In the context of tokenising assets and services, respondents, as in Table 3, reflected on its impact on sustainable business models, showcasing a spectrum of opinions. A group of 25 respondents (23%) regarded the influence of tokenization as insignificant. Many in this category highlighted their concerns about the complexity of the technology and its accessibility to small entrepreneurs. One respondent noted:

“...for most small business owners, tokenization seems like a far-off concept. They focus more on day-to-day operations than understanding how their assets could be tokenized. Without proper guidance, it remains an abstract idea...”

This response underlined a perceived gap between the potential of tokenization and the practical realities many local businesses face. In contrast, 30 respondents (28%) considered tokenization to have a moderate impact. These participants acknowledged some benefits of tokenization, particularly in increasing liquidity and creating new funding opportunities. One interviewee explained:

“...tokenization can indeed open doors for businesses to access previously out of reach funds. However, many still require education on how to leverage these opportunities effectively. It is a matter of building trust in the system...”

This perspective illustrated a recognition of tokenization's potential, tempered by the realities of needing broader knowledge and trust in the technology. Most respondents, 53 (49%), believed that tokenization of assets and services significantly contributed to sustainable business models. They highlighted its transformative potential in redefining ownership and enabling fractional investment. One enthusiastic participant shared:

“...tokenization allows us to break down barriers. Imagine investing in a fraction of a solar energy project or a community farm. It democratizes access to investment opportunities, promoting sustainability and community development...”

This view demonstrated a robust belief in tokenization's ability to foster more inclusive economic models and support environmentally conscious initiatives.

Despite the existing barriers to full implementation, the responses reflected a growing awareness of tokenization's significance, with many recognizing its potential to drive innovation and sustainability in the local economy. Participants expressed hope that with further education and

support, more entrepreneurs would harness the advantages of tokenization, leading to more sustainable business practices in Iringa Municipal.

3.3.3. Shared Economy and Collaborative Consumption

In exploring the impact of the shared economy and collaborative consumption on sustainable business models, the study illustrated in Table 3 revealed varied perspectives among respondents regarding its significance. A total of 15 respondents (14%) viewed the shared economy as insignificant in the context of blockchain applications. Many of these participants expressed skepticism about the effectiveness of collaborative consumption, noting that traditional economic practices were still deeply entrenched in the local culture. One respondent shared:

“...In Iringa, people are used to their ways of doing business. The idea of sharing resources or services with strangers feels foreign to many. It is hard to change mindsets that have been in place for generations...”

On the other hand, a more substantial portion of respondents, 40 (37%), recognized a moderate impact of the shared economy on local business practices. These individuals acknowledged the potential benefits of collaborative consumption but pointed out significant challenges in implementation. One participant articulated this viewpoint, stating:

“...I see the value in sharing platforms; they could lead to more efficient use of resources and reduce waste. However, building trust among users is still a long way to go. People need to feel secure when sharing their assets with others...”

This opinion emphasized the necessity for education and community engagement to facilitate the acceptance of shared economy models. The largest group of respondents, 53 (49%), believed that the shared economy and collaborative consumption significantly contributed to sustainable business models. They highlighted how blockchain technology could enhance trust and transparency in these transactions, thus encouraging participation. One enthusiastic respondent noted:

“...the potential of a shared economy is immense! We can track transactions with blockchain and ensure everyone gets a fair deal. This technology could transform how we think about ownership and resource management in our community...”

This belief highlighted the transformative potential of the shared economy, particularly when coupled with blockchain's ability to foster transparency and accountability. The insights gathered from the respondents illustrated a growing awareness of the shared economy's significance, with many recognizing its potential to drive innovation and sustainability in Iringa Municipal. However, it was clear that fostering a collaborative

mindset would require continued education, trust-building, and community engagement to realize the full benefits of these emerging business models.

3.3.4. Social Impact Bonds and Crowdfunding

In the study's exploration of social impact bonds and crowdfunding as mechanisms enabled by blockchain for sustainable business models, respondents, as per table 3, clearly understood their potential significance. Of the participants, 18 (17%) considered social impact bonds and crowdfunding insignificant. These individuals often cited concerns regarding the effectiveness of these models in the local context. One respondent reflected:

“...In Iringa, we have a history of skepticism toward financial innovations. People are often unsure how funds will be utilized, especially when it involves new concepts like social impact bonds. The trust simply is not there yet...”

This skepticism highlighted a need for improved communication and transparency in promoting such initiatives. In contrast, 25 (23%) respondents acknowledged a moderate impact of social impact on bonds and crowdfunding. These participants recognized the potential for these tools to attract funding for local projects but expressed reservations about their implementation. As one participant stated:

“...crowdfunding could help us raise money for community projects, but we need to educate people on how it works. Many are still unfamiliar with the concept, and without proper understanding, they might not feel comfortable participating...”

This response underlined the importance of outreach and education to foster acceptance and participation in crowdfunding efforts. The most significant response came from 65 participants (60%), who viewed social impact bonds and crowdfunding as having a considerable positive impact on sustainable business models. They emphasized how these financial instruments could mobilize resources for social good while fostering community involvement. One enthusiastic respondent explained:

“...social impact bonds are revolutionary! They allow us to fund projects that address critical issues like education and healthcare in Iringa. With blockchain ensuring transparency, we can track how funds are spent, which builds trust among investors and the community...”

This optimism illustrated a strong belief in the power of blockchain to enhance accountability and engagement in funding initiatives. The findings from the interviews revealed a range of perceptions regarding social impact bonds and crowdfunding. While skepticism remained among a minority, a growing recognition of their potential for fostering sustainable development and social impact was evident among

a significant portion of respondents. Continued efforts to build trust and educate the community about these financial mechanisms will be essential in realizing their full potential in Iringa Municipal.

3.4. Challenges and Opportunities for Scaling Sustainable Digital Entrepreneurship

In analyzing the challenges and opportunities for scaling sustainable digital entrepreneurship, respondents identified several significant barriers that had previously impeded growth in Iringa Municipal. Regulatory hurdles and policy barriers emerged as major obstacles, with many entrepreneurs expressing frustration over complex regulations that limited innovation and operational flexibility.

Technological limitations further complicated matters, as startups often struggled to obtain the necessary infrastructure to support their expansion efforts. The region's lack of talent and expertise presented additional challenges, making it difficult for entrepreneurs to find skilled professionals to drive their initiatives. Financial constraints and difficulties in accessing funding were also highlighted, with many participants noting the limited investment avenues available to support their projects. Finally, market acceptance and consumer awareness were crucial for the success of digital ventures, as educating the local population about the benefits of digital solutions was essential for fostering acceptance and driving growth in the entrepreneurial landscape.

3.4.1. Regulatory Hurdles and Policy Barriers

In the study, respondents highlighted various regulatory hurdles and policy barriers that impacted their efforts to scale sustainable digital entrepreneurship in Iringa Municipal. According to Figure 1, out of the 108 participants, 27 indicated that they faced minor challenges related to regulatory compliance. These respondents noted that while the challenges were present, they were manageable and did not significantly impede their operations. One entrepreneur remarked:

“...we had some hurdles, but they were mostly minor issues that we could navigate with the right legal advice. It required some effort, but we managed to adapt...”

Conversely, a larger group of 49 respondents reported encountering moderate challenges that posed significant obstacles to their business practices. They expressed frustrations with inconsistent regulatory frameworks and the absence of supportive policies tailored to blockchain technologies. One participant stated:

“...the lack of clear regulations around blockchain forced us into a reactive position. We often had to alter our business model to stay compliant, which delayed our growth...”

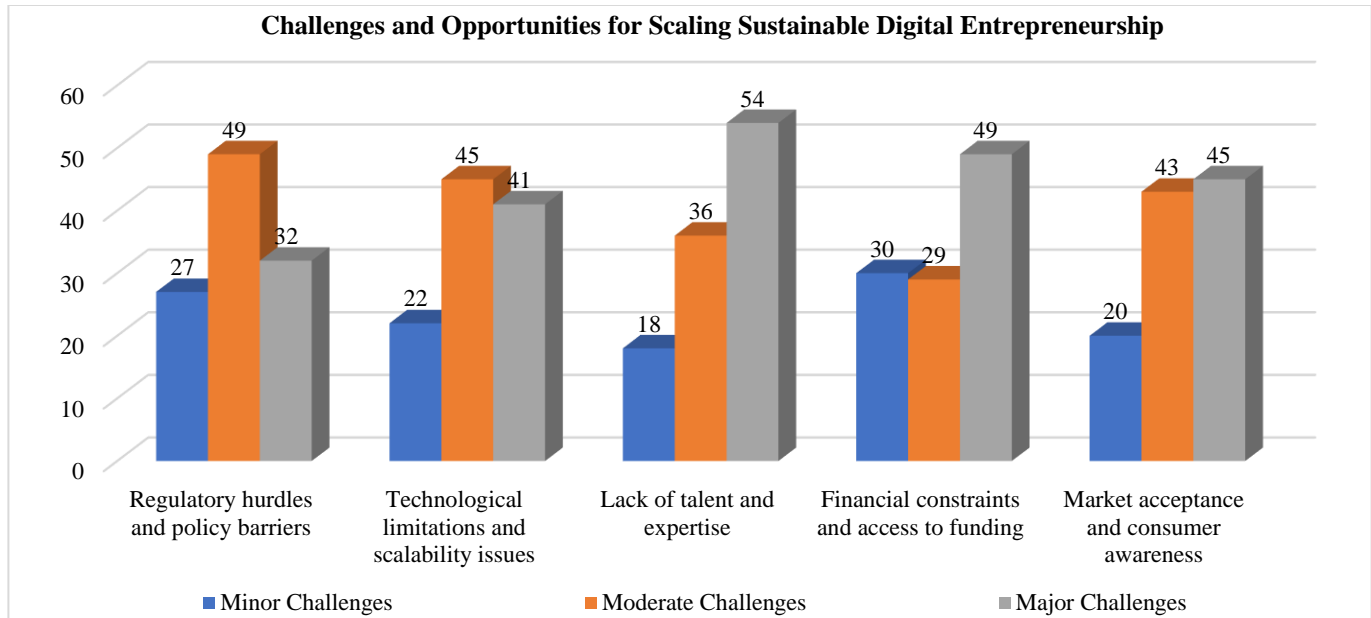


Fig. 1 The challenges and opportunities for scaling sustainable digital entrepreneurship

This comment echoed many interviews, emphasizing a common struggle among entrepreneurs in adapting to fluctuating regulations. Moreover, 32 respondents articulated that they faced major challenges from regulatory frameworks stifling innovation. They described situations where unclear guidelines led to confusion and hesitation from potential investors. One entrepreneur articulated the gravity of the situation by saying:

“...without a clear regulatory landscape, it is hard to convince investors that we are a viable option. They worry about future legal repercussions, which holds us back from scaling...”

This feedback heightened the critical need for policymakers to develop comprehensive regulations that support innovation while ensuring consumer protection. The insights gathered from the respondents illuminated a pressing need for collaborative efforts between entrepreneurs and regulatory bodies to create an environment conducive to sustainable digital entrepreneurship in the region.

3.4.2. Technological limitations and Scalability Issues

In the study, respondents, as in Figure 1, expressed varied experiences regarding technological limitations and scalability issues that hindered their pursuit of sustainable digital entrepreneurship through blockchain technology. Among the participants, 22 identified only minor challenges, suggesting that while they faced some technological constraints, these did not significantly impede their operations. One respondent stated:

“...we encountered some limitations with the current technology, but they were more inconvenient than barriers.

Our team was able to work around them effectively...”

This observation illustrated an adaptability within certain startups, allowing them to innovate despite minor technological hurdles. Conversely, a larger group of respondents, 45, reported experiencing moderate challenges associated with technology and scalability. These individuals highlighted concerns such as integrating blockchain with existing systems and needing specialized knowledge to leverage blockchain effectively. A participant noted:

“...while we recognized the potential of blockchain, we often struggled to integrate it with our existing processes. It required a steep learning curve that diverted our focus from growth...”

This viewpoint pointed to a common challenge within the ecosystem: the need for better education and training regarding blockchain technologies to ensure that entrepreneurs could fully capitalize on their benefits. Additionally, 41 respondents articulated that they faced major challenges related to technological limitations. They raised significant concerns about the scalability of blockchain solutions, particularly in the context of their business models. One entrepreneur emphasized:

“...the technology often felt like it was lagging behind our needs. We wanted to scale quickly, but the blockchain solutions available to us could not handle the volume we needed, which became a huge bottleneck...”

This feedback highlighted the critical need for technological advancements and support systems that could facilitate scalability for digital entrepreneurs.



The collective insights from the respondents indicated a pressing demand for innovation in blockchain technology and related infrastructures, emphasizing that overcoming these challenges was essential for fostering a thriving entrepreneurial environment in Iringa Municipal.

3.4.3. Lack of Talent and Expertise

In the study, the lack of talent and expertise, as in figure 1, emerged as a significant challenge for respondents pursuing sustainable digital entrepreneurship. Among the participants, 18 indicated that they faced only minor challenges in this area, suggesting that their teams were sufficiently skilled to navigate the complexities of blockchain technology. One respondent remarked:

“...we had a small but dedicated team that understood the basics of blockchain. We managed to get by, even if we were not experts...”

This discernment highlighted that the absence of specialized knowledge was acknowledged but did not significantly hinder their operations. However, a significant portion of the respondents, precisely 36, identified moderate challenges related to the talent gap. These individuals expressed concerns about finding skilled personnel who could effectively implement and manage blockchain solutions. One entrepreneur noted:

“...it was tough to find people who understood blockchain and had practical experience. We often had to spend much time training new hires...”

This insight underlined the importance of fostering education and training programs that could equip individuals with the necessary skills for the blockchain landscape. The most pressing challenges were reported by 54 respondents who identified a major lack of talent and expertise as a significant barrier to their success. Many of these entrepreneurs conveyed frustration over the scarcity of qualified professionals in their local market. One respondent shared:

“...we had ambitious plans for growth, but we realized that we were limited in what we could achieve without the right talent. It felt like we were constantly trying to catch up...”

This statement revealed a critical need for initiatives to develop a skilled workforce capable of supporting sustainable digital entrepreneurship.

The respondents' consensus was clear that addressing the talent gap was essential for individual businesses and fostering a vibrant entrepreneurial ecosystem in Iringa Municipal, ultimately paving the way for more successful blockchain initiatives.

3.4.4. Financial Constraints and Access to Funding

The study consistently highlighted financial constraints and access to funding as significant barriers to scaling sustainable digital entrepreneurship. As indicated in figure 1, among the respondents, 30 indicated that these challenges were minor, suggesting that they had either secured sufficient resources or found innovative ways to work around financial limitations. One participant explained:

“...we relied on community crowdfunding and some local grants, which initially helped us sustain our business. It was not easy, but we made do...”

This approach exemplified how some entrepreneurs leveraged alternative financing models, such as crowdfunding, to overcome the initial funding gaps. On the other hand, 29 respondents reported that financial constraints posed moderate challenges.

These entrepreneurs acknowledged that while they had some access to funding, it was often insufficient for scaling their operations. One interviewee noted:

“...we could get a small loan, but it was not enough to expand how we wanted. Integrating blockchain technology is expensive, and finding investors who understood its long-term value was difficult...”

This remark reflected the difficulty many faced in attracting investors familiar with blockchain, especially in regions where digital entrepreneurship is still developing. The most significant struggles were voiced by 49 respondents, who categorized financial constraints as major challenges. For them, the lack of access to funding was a considerable obstacle to growth. One respondent passionately shared:

“...we had a solid business model, but without adequate funding, we were stuck. Traditional banks did not understand our needs, and venture capital was out of reach...”

This statement echoed the broader issues faced by blockchain-based startups, where traditional financial institutions often lacked the knowledge or willingness to support such ventures.

These respondents frequently expressed frustration at the limitations imposed by local financial systems, with one noting:

“...without the right funding, even the best ideas remain just those ideas...”

The study showed that, unless addressed, financial barriers could hinder the potential of digital entrepreneurs in Iringa Municipal from fully realizing the benefits of blockchain technology.

3.4.5. Market Acceptance and Consumer Awareness

In examining market acceptance and consumer awareness, the study, as per Figure 1, revealed that these factors significantly influenced the scaling of sustainable digital entrepreneurship in the region. Among the respondents, 20 categorized market acceptance as a minor challenge, suggesting they had experienced a relatively smooth introduction of their products and services to consumers. One entrepreneur mentioned:

“...we found that once people understood the benefits of our blockchain solution, they were eager to adopt it. Education was key for us; the more we communicated, the more acceptance we saw...”

This statement illustrated the importance of consumer education in fostering a positive perception of new technologies, highlighting that even minor challenges could be overcome with the right approach. In contrast, 43 respondents viewed market acceptance and consumer awareness as moderate challenges.

These entrepreneurs acknowledged that while there was some level of interest in their products, misconceptions and a lack of understanding about blockchain technology often hindered broader acceptance. One interviewee articulated this concern by saying:

“...there were times when we struggled to explain how our platform worked. People were interested but wary, which slowed down our growth. It felt like we were constantly trying to convince potential customers of the value we offered...”

This statement stressed the critical role that education and outreach played in overcoming barriers to acceptance, as many startups faced the challenge of continuously educating their target market. The most pronounced issues were expressed by 45 respondents, who categorized market acceptance and consumer awareness as major challenges. For them, the lack of consumer knowledge about blockchain technology often resulted in skepticism toward their offerings. One respondent reflected on this by stating:

“...despite having a robust product, we faced significant pushback because people did not trust new technologies. Convincing them to adopt blockchain solutions took longer than we anticipated. Many simply preferred what they already knew...”

This concern about consumer skepticism revealed a common obstacle, where traditional habits and fears about change obstructed the path to market acceptance. The interviews highlighted that without a focused effort on consumer education and building trust, sustainable digital entrepreneurs in Iringa Municipal would likely struggle to realize their full potential, emphasizing the need for

innovative marketing strategies and community engagement initiatives to foster understanding and acceptance.

4. Conclusion and Recommendations

The study on the transformative role of blockchain technology in fostering sustainable digital entrepreneurship in Iringa Municipal demonstrated a multifaceted impact on various aspects of social and economic development. It was clear that respondents acknowledged the potential benefits of blockchain in enhancing transparency, accountability, and trust within business models. Many participants emphasized the importance of decentralized marketplaces and ethical sourcing, aligning with their social impact and environmental sustainability goals. The results indicated that while the perceived benefits of blockchain were significant, challenges remained, particularly in terms of regulatory barriers, technological limitations, and market acceptance. Furthermore, the findings revealed that for sustainable digital entrepreneurship to thrive, it was essential to address the gaps in consumer knowledge and promote awareness of blockchain's advantages. The interplay between technological innovation and community engagement was crucial in overcoming skepticism and fostering trust. The research accentuated the necessity of a collaborative approach that includes stakeholders from various sectors to create an ecosystem that supports the growth of blockchain-enabled businesses while advancing sustainable development goals. By embracing these strategies, Iringa Municipal can position itself as a leader in integrating blockchain technology into its entrepreneurial landscape, benefiting the broader community and contributing to sustainable economic growth. To enhance the impact of blockchain technology on sustainable digital entrepreneurship in Iringa Municipal, it is recommended that stakeholders prioritize collaborative efforts between local governments, private sectors, and educational institutions. Initiatives should focus on building awareness and understanding of blockchain's potential benefits among entrepreneurs and consumers, as this will foster trust and engagement. Furthermore, policymakers are encouraged to create a supportive regulatory framework that addresses existing hurdles, ensuring that innovations flourish without unnecessary constraints. Investing in training and skill development programs will also be crucial to bridge the talent gap and enable individuals to leverage blockchain effectively. By taking these proactive steps, the community can maximize the transformative potential of blockchain technology, driving sustainable development and social impact.

Acknowledgments

I want to thank Juma Mdimu Rugina from Ruaha Catholic University (RUCU) for his support during the preparation of this manuscript and Ruaha Catholic University management and staff for the encouragement they gave us during data collection, analysis and interpretation. Also, I would like to thank my family, especially my kids (Neema, Nelson, Nelvin, Nelvis and Angel Lusekelo Kibona) for always being there when I needed them.

References

- [1] Guo Hai, and Yang Zhuen, "From Digital Technology to Digital Entrepreneurship: Connotation, Characteristics and Internal Connection," *Foreign Economics & Management*, vol. 43, no. 09, pp. 3-23, 2021. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [2] Carmen Isensee, Frank Teuteberg, and Kai Michale Griese, "Success Factors of Organizational Resilience: A Qualitative Investigation of Four Types of Sustainable Digital Entrepreneurs," *Management Decision*, vol. 61, no. 5, pp. 1244-1273, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [3] Gedas Baranauskas, and Agota Giedre Raišienė, "Transition to Digital Entrepreneurship with a Quest of Sustainability: Development of a New Conceptual Framework," *Sustainability*, vol. 14, no. 3, pp. 1-13, 2022. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [4] Tetiana Kulinich et al., "Sustainable Entrepreneurship: Analysis of Trends in Digital Accounting, Management, and Marketing in Regional and Global Dimensions," *Dnieper State Academy of Construction and Architecture*, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [5] Mrisho Mbegu Malipula, "SMEs Sustainability Through Entrepreneurship Training in Tanzania," *Journal of Enterprise and Development (JED)*, vol. 5, no. 3, pp. 384-397, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [6] Semboja H. Haji, Beatus S. Silla, and Joseph N. Musuguri, "Tanzania as an Emerging Digital Economy," *Global Scientific Journal*, vol. 5, no. 5, pp. 120-148, 2017. [[Google Scholar](#)] [[Publisher Link](#)]
- [7] Mawazo Mwita Magesa, and Joan Jonathan, "Conceptualizing Digital Leadership Characteristics for Successful Digital Transformation: The Case of Tanzania," *Information Technology for Development*, vol. 28, no. 4, pp. 777-796, 2022. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [8] Ismail Juma Ismail, "I have to Apply this Strategy! Understanding the Mediating Effect of Digitalization on Strategic Orientations and Sustainable Competitive Advantage among Small Enterprises in Tanzania," *Management Matters*, vol. 20, no. 1, pp. 53-73, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [9] Alberico Travassos Rosário, and Joana Carmo Dias, "The New Digital Economy and Sustainability: Challenges and Opportunities," *Sustainability*, vol. 15, no. 14, pp. 1-23, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [10] Timo Phillip Böttcher et al., "Digital Sustainable Business Models: Using Digital Technology to Integrate Ecological Sustainability into the Core of Business Models," *Information Systems Journal*, vol. 34, no. 3, pp. 736-761, 2024. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [11] Aleksandra Kekkonen, Renee Pesor, and Marge Täks, "Stepping Towards the Green Transition: Challenges and Opportunities of Estonian Companies," *Sustainability*, vol. 15, no. 5, pp. 1-27, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [12] Karine Wendelborg Risdalen et al., "Sustainable Digital Transformation for Rural Business-A Case Study of a Norwegian Startup," *2023 International Conference on ICT for Sustainability (ICT4S)*, Rennes, France, pp. 197-206, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [13] Emmanuel Constantine Lupilya, and Kwangho Jung, "E-Government Transformation in Tanzania: Status, Opportunities, and Challenges," *Korean Journal of Policy Studies*, vol. 30, no. 1, pp. 147-184, 2015. [[Google Scholar](#)] [[Publisher Link](#)]
- [14] Erasto Kayumbe, and Lucy Michael, "Cyber Threats: Can Small Businesses in Tanzania Outsmart Cybercriminals," *International Research Journal of Advanced Engineering and Science*, vol. 6, no. 1, pp. 141-144, 2021. [[Google Scholar](#)] [[Publisher Link](#)]
- [15] Godfrey Mwandosya, Mikko Apiola, and Kristiina Lähde, "Building the Innovation Ecosystem in Tanzania: Four Viewpoints to Technology Business Incubation," *2016 International Conference on Engineering, Technology and Innovation/IEEE International Technology Management Conference (ICE/ITMC)*, Trondheim, Norway, pp. 1-9, 2016. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [16] Gilbert E. Mushi, Giovana Di Marzo Serugendo, and Pierre-Yves Burgi, "Digital Technology and Services for Sustainable Agriculture in Tanzania: A Literature Review," *Sustainability*, vol. 14, no. 4, pp. 1-17, 2022. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [17] Giuliano Sansone et al., "Blockchain for Social Good and Stakeholder Engagement: Evidence from a Case Study," *Corporate Social Responsibility and Environmental Management*, vol. 30, no. 5, pp. 2182-2193, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [18] Tony Erwin, and Baozhong Yang, "Green Energy, Emissions, and Blockchain Technology," *Fintech and Sustainability*, pp. 29-51, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [19] Gerard George, Ryan K. Merrill, and Simon J.D. Schillebeeckx, "Digital Sustainability and Entrepreneurship: How Digital Innovations are Helping Tackle Climate Change and Sustainable Development," *Entrepreneurship Theory and Practice*, vol. 45, no. 5, pp. 999-1027, 2021. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [20] Walid Al-Saqaf, and Nicolas Seidler, "Blockchain Technology for Social Impact: Opportunities and Challenges Ahead," *Journal of Cyber Policy*, vol. 2, no. 3, pp. 338-354, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [21] Jesco Mhoja Nkwabi, "A Review of the Significance of Block Chain Technology in Tanzania," *European Journal of Business and Management*, vol. 13, no. 16, pp. 1-5, 2021. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]

- [22] Said Hamisi Said et al., "A Blockchain-based Conceptual Model to Address Educational Certificate Verification Challenges in Tanzania," *Engineering, Technology and Applied Science Research*, vol. 13, no. 5, pp. 11691-11704, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [23] Pelagia A. Mutarubukwa, and Mazana Y. Mazana, "The Role and Process of Social Entrepreneurship in a Developing Country: Case Studies From Dar-Es-Salaam and Mwanza, Tanzania," *Business Economic Development Conference*, 2017. [[Google Scholar](#)] [[Publisher Link](#)]
- [24] Deus N. Shatta, "The Influence of Digital Technologies on Sustainable Supply Chain Performance in Public Procuring Entities: A Moderating Effect of Legal Frameworks," *International Journal of Social Science Research and Review*, vol. 7, no. 6, pp. 43-57, 2024. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [25] Arim Park, and Huan Li, "The Effect of Blockchain Technology on Supply Chain Sustainability Performances," *Sustainability*, vol. 13, no. 4, pp. 1-18, 2021. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [26] Anil Varma et al., "Blockchain Technology for Sustainable Supply Chains: A Comprehensive Review and Future Prospects," *World Journal of Advanced Research and Reviews*, vol. 21, no. 3, pp. 980-994, 2024. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [27] Sara Saberi et al., "Blockchain Technology and its Relationships to Sustainable Supply Chain Management," *International Journal of Production Research*, vol. 57, no. 7, pp. 2117-2135, 2019. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [28] Helga Pavlič Skender, and Petra Adelajda Zaninović, "Perspectives of Blockchain Technology for Sustainable Supply Chains," *Integration of Information Flow for Greening Supply Chain Management*, pp. 77-92, 2020. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [29] Francesco Mercuri, Gaetano Della Corte, and Federica Ricci, "Blockchain Technology and Sustainable Business Models: A Case Study of Devoleum," *Sustainability*, vol. 13, no. 10, pp. 1-14, 2021. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [30] Davide Calandra et al., "The Link Between Sustainable Business Models and Blockchain: A Multiple Case Study Approach," *Business Strategy and the Environment*, vol. 32, no. 4, pp. 1403-1417, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [31] Maurizio Massaro et al., "Crypto-economy and New Sustainable Business Models: Reflections and Projections using a Case Study Analysis," *Corporate Social Responsibility and Environmental Management*, vol. 27, no. 5, pp. 2150-2160, 2020. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [32] Declan Bays, Emma Bennett, and Thomas Finnie, "Using Simulation to Assess the Potential Effectiveness of Implementing Screening at National Borders During International Outbreaks of Influenza, SARS, Ebola Virus Disease and COVID-19," *medRxiv*, pp. 1-14, 2020. [[Google Scholar](#)]
- [33] Aswathy Sreenivasan, and M. Suresh, "Start-up Sustainability: Does Blockchain Adoption Drives Sustainability in Start-ups? A Systematic Literature Reviews," *Management Research Review*, vol. 47, no. 3, pp. 390-405, 2024. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [34] Pritam Rani, Pratima Sharma, and Indrajeet Gupta, "Toward a Greener Future: A Survey on Sustainable Blockchain Applications and Impact," *Journal of Environmental Management*, vol. 354, 2024. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [35] Roberto Leonardo Rana et al., "Blockchain Applications and Sustainability Issues," *Amfiteatru Economic*, vol. 21, no. 13, pp. 861-870, 2019. [[Google Scholar](#)] [[Publisher Link](#)]
- [36] Barnabas Maagi, "Applicability of Blockchain Technology in Improving Efficiency in Supply Chain Operations in Public Procurement in Tanzania," *International Journal of Research in Business and Social Science (2147-4478)*, vol. 12, no. 9, pp. 91-98, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]