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The inclusive digital economic infrastructure framework: A system level integration of AI, blockchain, and tokenization for sustainable development

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Abstract

Contemporary poverty is increasingly understood as a multidimensional phenomenon encompassing income deprivation, vulnerability, digital exclusion, and limited participation in emerging economic systems. This paper contributes a system level ICT4D framework that bridges intelligence systems and decentralized value distribution mechanisms, demonstrating how the integration of artificial intelligence (AI), Web3, blockchain, and tokenization can address multidimensional poverty through interoperable socio technical systems. The paper introduces the Inclusive Digital Economic Infrastructure (IDEI), a multi layer framework comprising intelligence, infrastructure, value, and application layers. Drawing on global policy reports, emerging enterprise practices, and multi stakeholder perspectives, the framework provides a structured approach to integrating AI driven decision making with decentralized trust mechanisms and programmable value systems. The study identifies a critical gap in existing literature, where AI and decentralized technologies remain largely disconnected, and proposes a unified architecture for inclusive and sustainable digital economic systems. The IDEI framework contributes to interdisciplinary research at the intersection of digital infrastructure design, artificial intelligence, and inclusive economic development, with direct relevance to the Sustainable Development Goals (SDGs) and the design of inclusive, socio-technical digital systems. The framework also provides a foundation for responsible management education through the integration of emerging technologies, stakeholder engagement, and sustainable development outcomes.

Keywords: Artificial Intelligence, Blockchain, Digital Economy, ICT for Development (ICT4D), Inclusive Digital Infrastructure, Interoperability, Poverty Alleviation, Responsible Management Education, Smart Contracts, Socio-technical Systems, Sustainable Development Goals (SDGs), Tokenization, Web3.

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1. Introduction

The digital economy has expanded rapidly across the globe, transforming economic structures, business models, and pathways for innovation. However, the distribution of its benefits remains uneven. Approximately one-third of the global population lacks reliable access to digital connectivity, limiting participation in economic and social systems and reinforcing structural inequalities [1]. This persistent digital divide has become a defining feature of contemporary inequality, shaping access to education, employment, financial services, and broader socio-economic opportunities [2].

This study directly contributes to SDG 1 (No Poverty), SDG 8 (Decent Work), SDG 10 (Reduced Inequalities), and SDG 17 (Partnerships) by proposing an integrated digital economic infrastructure. Despite the rapid advancement of these technologies, the absence of a unified system-level framework remains a critical barrier to achieving inclusive and sustainable economic systems at scale.

The framework is also aligned with the principles of Responsible Management Education and responds to growing calls for interdisciplinary approaches that integrate technological innovation with sustainability, governance, and social impact.

At the same time, scholarly understanding of poverty has shifted significantly. Poverty is no longer viewed solely through an income-based lens but is increasingly conceptualized as a multidimensional condition that includes vulnerability, exclusion, and lack of agency [3]. Digital exclusion plays a critical role in this transformation, constraining individuals' ability to participate in emergent economic systems and limiting upward mobility.

Artificial Intelligence (AI) has emerged as a transformative technological capability with the potential to enhance decision-making, optimize resource allocation, and accelerate progress toward achieving the SDGs [4]. However, while AI provides powerful analytical and predictive capabilities, it does not inherently address key challenges related to trust, governance, ownership, or equitable value distribution [5].

In contrast, decentralized digital technologies, particularly blockchain, provide mechanisms for transparency, accountability, and trust through verifiable and tamper-resistant records. Tokenization further extends these capabilities by enabling programmable and traceable value exchange [6]. Yet, these decentralized systems lack the advanced intelligence necessary for adaptive decision-making and predictive analysis.

Previous research by Yeung and Lee [7] explored the integration of tokenization and sustainable development, demonstrating the potential of Web3 technologies to support SDGs through improved governance and value distribution. Recent systematic reviews confirm the growing evidence base for Web3-enabled social innovation [8] and studies have demonstrated how tokenization can address transparency and liquidity challenges in carbon markets [9]. However, a critical gap remains. Existing research has largely treated AI and decentralized technologies as separate domains, with limited integration between intelligence systems and value distribution mechanisms. This lack of integration constrains the development of holistic approaches to addressing complex challenges such as poverty and inequality.

While ICT4D research has explored AI and blockchain separately, few studies have examined their integration within a unified system-level architecture [5, 8, 10]. This paper addresses this gap by proposing the IDEI framework. In doing so, the study contributes to the Responsible Management Education and ICT4D literature by examining how emerging technologies can be integrated into system-level designs for inclusive development.

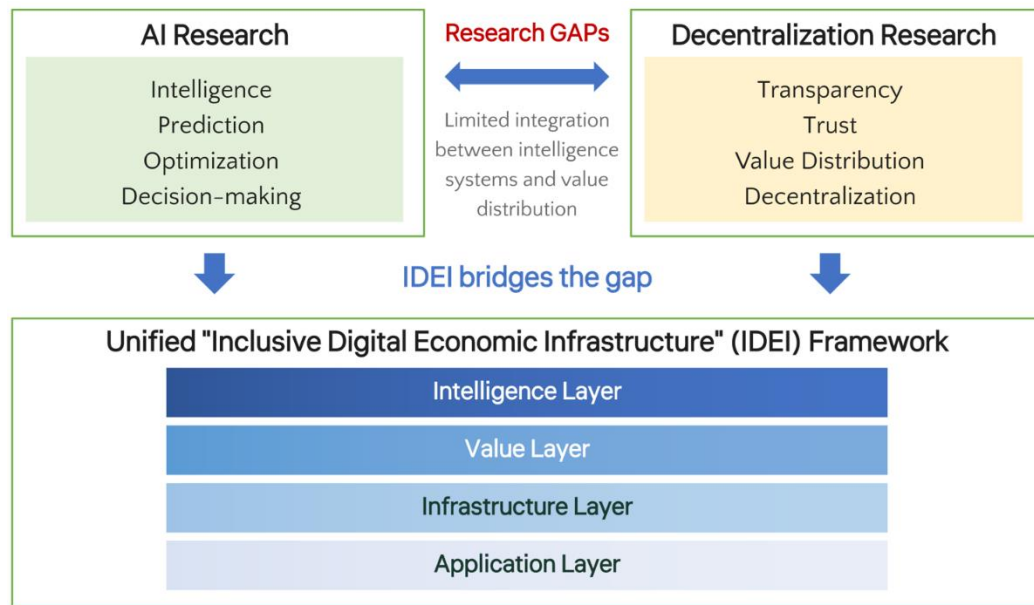


Figure 1.
Research gap between AI and decentralized systems and the proposed IDEI framework.
Source: The Inclusive Digital Economic Infrastructure (IDEI) Framework.

To address this gap, the present study introduces the Inclusive Digital Economic Infrastructure (IDEI) framework, a system-level model that integrates AI, decentralized infrastructure, and tokenization to enable inclusive and sustainable economic systems.

Unlike existing approaches that treat AI and decentralized systems as separate domains, the IDEI framework explicitly integrates intelligence, infrastructure, and value distribution within a unified system architecture.

2. Literature Review

2.1. Digital Inclusion and Inequality

Digital transformation is widely recognized as a key driver of economic growth and innovation. However, its benefits are distributed unevenly across regions and populations. While digital technologies can enhance productivity and create new economic opportunities, they can also exacerbate inequalities when access to infrastructure, connectivity, and digital skills is uneven [3].

Empirical research demonstrates that disparities in digital access persist across countries, with bandwidth distribution remaining highly skewed [2]. These findings underscore the importance of inclusive digital frameworks that go beyond infrastructure provision to address participation, capability development, and value distribution [5]. The World Bank's framework on Digital Public Infrastructure (DPI) highlights how foundational systems can enable inclusive development [11]. In this context, the IDEI framework may be interpreted as a complementary layer to emerging Digital Public Infrastructure initiatives by integrating intelligence, governance, and value distribution mechanisms.

2.2. Artificial Intelligence for Sustainable Development

AI plays a critical role in advancing sustainable development through its ability to process large datasets, generate insights, and optimize complex systems. Vinuesa, et al. [4] demonstrate that AI can support many SDG targets while also posing risks if not governed responsibly.

AI systems operate based on predefined objectives and data inputs. Without appropriate governance mechanisms, AI may reinforce existing inequalities or introduce risks related to bias, exclusion, and accountability. Consequently, AI must be embedded within frameworks that ensure transparency, fairness, and inclusiveness [5, 10].

2.3. Decentralized Infrastructure and Tokenization

Decentralized technologies, particularly blockchain, provide mechanisms for transparent, secure, and verifiable data management. These systems enable interactions without reliance on centralized intermediaries, thereby enhancing accountability and trust in digital transactions [12].

Recent studies have examined the role of decentralized systems in supporting community development and inclusive economic structures [13]. By reducing dependence on centralized institutions, such systems contribute to improved governance and transparency, particularly in environments where institutional trust is limited.

Tokenization extends these capabilities by enabling the digital representation and exchange of value across assets and applications. Through programmable transactions and reduced transaction costs, tokenization lowers barriers to participation and facilitates more inclusive economic activity [6, 14]. Practitioner perspectives further highlight the potential of tokenized systems to enhance liquidity and expand financial accessibility [15, 16].

Institutional research reinforces these developments. Digital technologies are estimated to support a significant proportion of SDG targets [17] while blockchain-based pilot initiatives have demonstrated real-time verification of development outcomes [18].

Emerging applications further illustrate the transformative potential of these technologies. Decentralized finance (DeFi) initiatives have shown capacity to reduce poverty by lowering remittance costs and expanding access to financial services [19]. Self-sovereign identity (SSI) frameworks are being deployed to improve aid distribution by granting individuals control over their digital credentials [20]. Central bank digital currencies (CBDCs) are also being explored to enhance the delivery of social safety nets and government transfers [21].

Moreover, blockchain-based governance models, including Decentralized Autonomous Organisations (DAOs), are increasingly aligned with international standards such as ISO 26000 and the SDGs, supporting institutional transparency and multi-stakeholder accountability [22].

Beyond financial applications, tokenization is extending into industrial domains. Recent studies demonstrate how non-fungible token (NFT) structures can be applied to operations and supply chain management, enabling verification of physical assets and enhancing traceability across value chains [23]. Recent research on real-world asset (RWA) tokenisation further highlights the importance of connecting tokenized infrastructures with underlying financial and physical assets, thereby extending the practical relevance of tokenization beyond purely digital environments [24].

2.4. Research Gap

Despite extensive research, AI-driven intelligence systems and decentralized value infrastructures remain largely disconnected. This fragmentation limits the development of integrated solutions for complex socio-economic challenges. The IDEI framework addresses this gap by integrating intelligence, infrastructure, and value distribution within a unified system-level architecture for inclusive development.

This gap is particularly salient in the ICT4D, Responsible Management Education, and sustainable development literature, where there is growing interest in understanding how emerging technologies such as AI, blockchain, and tokenization can be harnessed for inclusive and sustainable development [8, 11].

3. Methodology

This study adopts a conceptual framework synthesis approach, which systematically integrates existing concepts from diverse literatures to develop a new theoretical model. The IDEI framework was developed through three core processes.

First, a structured review of peer-reviewed literature (2018–2026) and global policy reports was conducted, focusing on digital inclusion, AI governance, blockchain systems, and tokenization. Keywords included “AI for SDGs”, “blockchain poverty”, “tokenization development”, and “digital economic infrastructure”. Databases included Scopus, Web of Science, and Google Scholar, complemented by hand-searching of UN and World Bank publications.

Second, insights were derived from the author’s participation in international multi-stakeholder dialogues on AI and sustainable development (Hong Kong, 2025–2026), which brought together academics, policymakers, and industry practitioners.

Third, case-based observations from real-world implementations – including humanitarian blockchain systems (World Food Programme’s Building Blocks) and tokenized engagement platforms – were incorporated to ground the framework in practical application.

The resulting IDEI framework is conceptual and prescriptive, intended for empirical validation in future research. No primary data were collected; therefore, ethical approval was not required. This approach aligns with system-level design methodologies commonly used in interdisciplinary ICT and digital infrastructure research [11, 12].

4. The IDEI Framework

The IDEI framework represents a system-level integration of intelligence, infrastructure, and value components, designed to address structural inefficiencies in existing digital and economic systems.

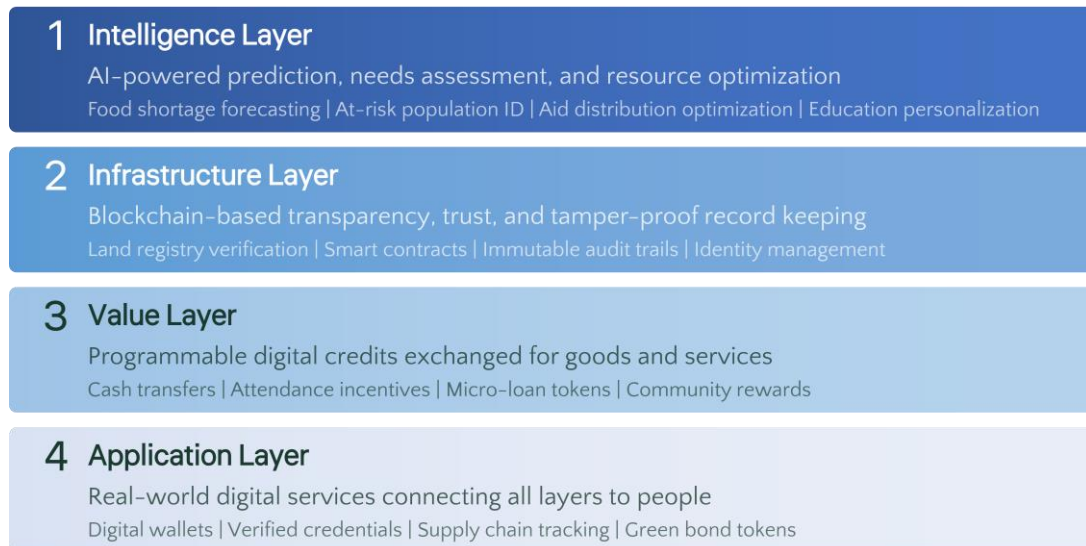


Figure 2.
Inclusive Digital Economic Infrastructure (IDEI) framework as a layered socio-technical system architecture.

The framework consists of four interdependent layers that collectively integrate intelligence, trust, and value flows within a unified economic system.

In addition to its economic implications, the IDEI framework can be interpreted as a socio-technical system architecture and design framework, where AI, decentralized infrastructure, and tokenized value layers interact through coordinated design mechanisms.

4.1. Intelligence Layer (AI-Driven)

The Intelligence Layer is powered by artificial intelligence technologies that enable predictive analytics, needs assessment, and optimization of resource allocation. AI models process real-time and historical data from decentralized sources to identify patterns, forecast outcomes, and detect anomalies.

Within the IDEI framework, AI operates under governance constraints defined by smart contracts and regulatory guidelines, ensuring that algorithmic decisions remain aligned with ethical and policy standards. In poverty alleviation contexts, AI can predict food insecurity hotspots, optimize resource distribution, and adjust financial risk models dynamically.

4.2. Infrastructure Layer (Decentralized Ledger)

The Infrastructure Layer consists of decentralized systems, including blockchain and distributed ledgers, that provide transparency, immutability, and trust. Transactions, identity credentials, and governance activities are recorded in tamper-resistant systems accessible to authorized participants.

This reduces dependence on centralized institutions and enhances accountability, particularly in environments where institutional trust is limited [13]. Smart contracts in this layer automate the execution of agreements when predefined conditions are satisfied. The governance dimension of decentralized infrastructure is also consistent with broader principles of accountability, transparency, and stakeholder engagement reflected in international sustainability frameworks such as ISO 26000.

4.3. Value Layer (Tokenization)

The Value Layer enables the digital representation and exchange of economic value through tokenization. Assets such as financial resources, carbon credits, educational credentials, and community investments are represented as digital tokens that are divisible, transferable, and programmable.

Tokenization allows conditional transfers, micro-investment opportunities, and inclusive participation in economic activities. It lowers entry barriers and enhances efficiency in value distribution systems.

4.4. Application Layer (SDG-Aligned Use Cases)

The Application Layer translates the combined capabilities of AI, decentralized infrastructure, and tokenization into real-world use cases aligned with the SDGs.

Applications include financial inclusion services, tokenized education credentials, transparent supply chains, climate-related financing, ESG reporting systems, self-sovereign identity frameworks, and decentralized governance models.

The integration of all layers enables systems that are efficient, transparent, equitable, and collaborative.

5. Tokenized Poverty Alleviation Workflow



Key Evidence:

WFP Building Blocks (2017-2020): Blockchain cash transfers to 106,000 Syrian refugees in Jordan — eliminated 98% of bank fees

UNDP & Stellar (2025): 46 pilot-ready solutions across 3 continents — proving last-mile digital payment viability

Figure 3.

IDEI Implementation: Tokenized poverty alleviation workflow.

Source: World Food Programme [25] and UNDP & Stellar Development Foundation [26]. The Inclusive Digital Economic Infrastructure (IDEI) Framework.

The following workflow illustrates a practical application of the IDEI framework through a conditional transfer system consisting of eight steps:

1. AI-based needs assessment identifies eligible beneficiaries.
2. Smart contract deployment defines conditional rules.
3. Token issuance distributes digital assets to recipients.
4. Compliance monitoring verifies conditions using external data.
5. Condition verification determines eligibility for redemption.
6. Token redemption enables use for approved goods or services.
7. Blockchain recording ensures transparency and auditability.
8. AI impact evaluation informs continuous system improvement.

This integrated workflow enhances efficiency, reduces fraud, lowers costs, and enables adaptive targeting in development programs.

6. Mapping SDGs to IDEI Layers

IDEI Layer	Example Application
Intelligence (AI)	AI forecasts food insecurity before harvest failure, enabling preemptive aid
Infrastructure (Blockchain)	Land registry on immutable ledger reduces corruption and property disputes
Value (Tokenization)	School attendance tokens for conditional cash transfers — verified on-chain
Application (Integrated)	Tokenized green bonds with AI-verified carbon credits for climate finance

Figure 4.

Representative applications of the IDEI framework across SDG domains.

Source: The Inclusive Digital Economic Infrastructure (IDEI) Framework.

Table 1.

IDEI Layers Mapping to the Sustainable Development Goals.(SDG Coverage: SDG 1, 2, 3, 4, 8, 9, 10, 12, 13, 16 & 17).

IDEI Layer	Primary SDGs	Mechanism	Example
Intelligence	SDG 1, 2, 3 (No Poverty, Zero Hunger, Health)	Predictive analytics	Food security forecasting
Infrastructure	SDG 9, 16 (Infrastructure, Peace & Justice)	Transparent governance	Blockchain land registry
Value	SDG 1, 8, 10 (No Poverty, Work, Reduced Inequalities)	Programmable value	Conditional transfers
Application	SDG 4, 12, 13, 17 (Education, Consumption, Climate, Partnerships)	Integrated solutions	Tokenized green finance

Each layer contributes to achieving multiple SDGs, with the most significant impact arising from their integration. The combination of all four layers enables comprehensive SDG progress – with the most transformative outcomes arising from full integration rather than any single technology.

7. Case-Based Insights

Digital engagement platforms. Platforms that issue tokens for pro-social actions (e.g., recycling, volunteering) have been deployed by social enterprises in several regions. The iSHANG Web3-as-a-Service platform illustrates how organisations can launch token-based engagement campaigns, including loyalty programmes and impact tracking [27]. This example is included for illustrative purposes to demonstrate practical applications of tokenized engagement systems.

Blockchain-based humanitarian cash transfers. The World Food Programme’s Building Blocks project (2017–2020) used blockchain to authenticate cash transfers for Syrian refugees in Jordan, reducing bank fees and fraud while giving recipients direct control [25]. Similarly, a UNDP & Stellar Development Foundation [26] demonstrated conditional transfers linked to school attendance and healthcare visits, showing how tokenization can improve aid effectiveness [26].

These cases illustrate the practical feasibility of the IDEI framework’s core mechanisms – transparency, conditionality, and reduced administrative overhead – in real-world development contexts.

8. Discussion

8.1. Policy Implications

The IDEI framework has implications for policymakers seeking to develop inclusive digital ecosystems. Policymakers should invest in digital infrastructure, promote digital literacy, and establish supportive regulatory frameworks that encourage innovation while ensuring equitable participation. The framework can be viewed as complementary to emerging Digital Public Infrastructure (DPI) initiatives by integrating intelligence, governance, and value distribution mechanisms.

The effectiveness of inclusive digital infrastructure depends not only on technological capabilities, but also on stakeholder participation, institutional trust, and governance arrangements that support long-term adoption and social impact.

8.2. Business Implications

The IDEI framework also has implications for businesses and social enterprises. Organizations can leverage AI, blockchain, and tokenization to develop inclusive value creation models, improve transparency, and create innovative mechanisms for stakeholder engagement and impact measurement.

8.3. Responsible Management Education

The IDEI framework has implications for responsible management education. As AI, blockchain, and tokenization become increasingly integrated into economic systems, future leaders will require interdisciplinary competencies that combine technological literacy with sustainability, governance, stakeholder engagement, and ethical decision-making. The framework therefore provides a foundation for integrating emerging digital technologies into SDG- and ESG-oriented responsible management education and leadership development.

The IDEI framework also has implications for the design of technical systems, as it highlights the need for interoperable, privacy-preserving, and human-centred digital infrastructures [11, 12]. These insights are particularly relevant for the design of digital systems within the cs.CY domain, where the interaction between technology and society is central.

The IDEI framework may also serve as a practical learning model for integrating AI, Web3, ESG, and SDG considerations into experiential and project-based learning environments.

9. Conclusion

This study proposes the IDEI framework as a comprehensive system integrating AI and decentralized infrastructure for sustainable development. By bridging intelligence, trust, and value distribution, it provides a structured approach to addressing complex socio-economic challenges.

The framework provides a foundation for future research, policy innovation, responsible management education, and practical implementation in inclusive digital economies. As a conceptual model, the IDEI framework requires empirical validation through future case-based and quantitative studies.

The IDEI framework contributes to interdisciplinary research at the intersection of digital infrastructure design, artificial intelligence, and inclusive economic systems, with direct relevance to the Sustainable Development Goals (SDGs) and Web3-enabled development. Future research should focus on empirical validation across education, finance, humanitarian assistance, and sustainable supply-chain applications.

References

- [1] World Economic Forum, *How AI can enhance digital inclusion and fight inequality*. Geneva: WEF, 2025.
- [2] M. Hilbert, "The bad news is that the digital access divide is here to stay: Domestically installed bandwidths among 172 countries for 1986–2014," *Telecommunications Policy*, vol. 40, no. 6, pp. 567–581, 2016. <https://doi.org/10.1016/j.telpol.2016.01.006>
- [3] World Bank, *World development report 2021: Data for better lives*. Washington, DC: World Bank, 2021.
- [4] R. Vinuesa *et al.*, "The role of artificial intelligence in achieving the Sustainable Development Goals," *Nature Communications*, vol. 11, no. 1, p. 233, 2020. <https://doi.org/10.1038/s41467-019-14108-y>
- [5] G. George, R. K. Merrill, and S. J. D. Schillebeeckx, "Digital transformation and the new logic of inclusion," *Academy of Management Discoveries*, vol. 7, no. 4, pp. 461–465, 2021.
- [6] Y. Chen and C. Bellavitis, "Blockchain disruption and decentralized finance: The rise of decentralized business models," *Journal of Business Venturing Insights*, vol. 13, p. e00151, 2020. <https://doi.org/10.1016/j.jbvi.2019.e00151>
- [7] S. Yeung and S. Lee, "Talent development for integration Web 3.0/NFT/SDG into UNSDGs," *Journal of Economics and Technology Research*, vol. 4, no. 2, pp. 1–7, 2023. <https://doi.org/10.22158/jetr.v4n2p1>
- [8] R. K. R. Kummitha, "Grand challenges, corporate legitimacy, and community integration: An integrative smart technology model," *R&D Management*, vol. 54, no. 4, pp. 775–790, 2024. <https://doi.org/10.1111/radm.12591>
- [9] C. Mueller and L. Kling, "Tokenising the voluntary carbon credit market: Harnessing opportunities for sustainable development. UPLOpen," 2025. <https://uplopen.com/chapters/e/10.1515/9783111706719-001>
- [10] I. Calzada, "Decentralizing AI economics for poverty alleviation: Web3 social innovation systems in the global south," *AI*, vol. 6, no. 12, p. 309, 2025. <https://doi.org/10.3390/ai6120309>
- [11] J. Clark, G. Marin, O. P. Ardic Alper, and G. A. Galicia Rabadan, "Digital public infrastructure and development: A world bank group approach - Digital Transformation," 2025. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099031025172027713>
- [12] UNCTAD, *Blockchain for sustainable development: Opportunities and challenges for developing countries*. Geneva: United Nations, 2021.
- [13] B. Bourbon and R. Murimi, "Decentralization, blockchains, and the development of smart communities in economically challenging environments," *Ledger*, vol. 9, pp. 30–50, 2024. <https://doi.org/10.5195/ledger.2024.302>
- [14] S. Arenaza and S. Navajas, *Tokenization and development: Framework and insights deck*. Washington, DC: IDB, 2025.
- [15] S. Lee, "The next frontier of financial sector: Asset tokenization. Medium," 2020. <https://medium.com/@coinstreet/the-next-frontier-of-financial-sector-i-asset-tokenization-2a757a9bdc37>
- [16] S. Lee, "The next frontier of financial markets: RWA or RWB tokenization. Medium," 2021. <https://medium.com/@coinstreet/the-next-frontier-of-financial-markets-ii-a-or-b-rwa-or-rwb-tokenization-7580255d35ff>
- [17] UNDP, "#Web3for2030: How can web3 help achieve the Sustainable Development Goals? New York: United Nations Development Programme," 2022. <https://www.undp.org/publications/web3for2030-how-can-web3-help-achieve-sustainable-development-goals>
- [18] Blockchain.News, "World bank issues poverty reduction bonds on Polygon, leveraging real time impact verification," 2025. <https://blockchain.news/PostAMP?id=world-bank-issues-poverty-reduction-bonds-on-polygonleveraging-real-time-impact-verification>
- [19] Crypto Breaking News, "DeFi group proposes \$30B initiative to reduce global poverty. Industry report," 2025. <https://www.cryptobreaking.com/defi-group-proposes-30b-initiative/>. [Accessed June 2026]
- [20] M. Saffari and Y. Qu, "A framework for self-sovereign identity-based digital aid distribution," *IEEE Transactions on Engineering Management*, vol. 72, pp. 1–15, 2025.
- [21] D. Nikitin, J. Schmalholz, and C. Bloch, "Can retail central bank digital currencies improve the delivery of social safety nets? (IMF Working Paper No. WP/25/211). International Monetary Fund," 2025. <https://www.imf.org/en/publications/wp/issues/2025/10/24/can-central-bank-digital-currencies-improve-the-delivery-of-social-safety-nets-568447?cid=em-COM-123-50803>
- [22] L. Haque, "Mapping ISO 26000 to DAO governance & the sustainable development goals. BlockStand Report," 2025. https://blockstand.eu/blockstand/uploads/2025/05/Final-Blockstand-Report-March-2025_Mapping-ISO-26000-to-DAO-Governance-UN-SDGs.pdf
- [23] P. Helo and Y. Hao, "Blockchain for sustainable supply chains: Ensuring transparency and accountability in SDG 12," *International Journal of Production Research*, vol. 63, no. 4, pp. 1123–1145, 2025.
- [24] G. Vella, L. Pennella, and M. C. Ballandies, "A taxonomy of real-world asset tokenization for blockchain-based financial infrastructure," *arXiv preprint arXiv:2606.08534*, 2026. <https://doi.org/10.48550/arXiv.2606.08534>
- [25] World Food Programme, "Building blocks: Blockchain for humanitarian assistance. Rome: WFP," 2020. <https://innovation.wfp.org/project/building-blocks>
- [26] UNDP & Stellar Development Foundation, "Digital payments that work under real constraints: Three UNDP SDG Blockchain Accelerator pilots show what last mile readiness actually looks like," 2025. <https://innovation.eurasia.undp.org/digital-payments-that-work-under-real-constraints/>
- [27] iSHANG, "Case studies: Web3 as a service for tokenized engagement. Company case study," 2025. <https://new.ishang.com/#/case-studies>