An Integrated Digital Public Infrastructure Framework for Green Finance: Advancing Sustainable MSME Development in Africa

Abstract

Digital Public Infrastructure (DPI) has quickly evolved into a vital undergird of digital transformations and financial inclusion; however, its impact on advancing green finance for MSMEs remains unexplored in Africa. An exploratory study examines the conditions under which a foundation for interoperable digital infrastructure can enable sustainable finance through disclosure of alternative trade credit data to overcome information asymmetry. The study, employing a qualitative multiple-case study design, examines seven African digital ecosystems (Kenya, Nigeria, Ghana, Rwanda, South Africa, and Egypt, and the regional Central African GIMACPAY payment infrastructure) by leveraging secondary data from peer-reviewed literature, policy reports, and institutional publications. The thematic and cross-case analyses demonstrate that interoperable digital payments create consistent transaction histories, which lend themselves to robust credit assessment in turn driving financial inclusion and facilitating MSME access to green financing. While experiences from different national contexts show that there is a variety of implementation routes, they consistently draw attention to the importance of governance, interoperability, and digital financial ecosystems for sustainable investment. Based on these results, this study suggests an integrated conceptual framework about DPI, credible with alternative credit data, sustainable finance, and green finance, which impacts financial inclusion and sustainable development. It also introduces the concept of Regional Digital Public Infrastructure (RDPI), stating that regional interoperable payment infrastructures such as GIMACPAY can scale national DPI by catalyzing cross-border financial integration and laying the digital foundations for institutionalized sustainability financing in a regional context under the African Continental Free Trade Area (AfCFTA). It also adds to the nascent DPI literature by reconceptualizing interoperable digital infrastructure as a critical public good that can drive inclusive, resilient, and climate-resilient growth across Africa, rather than simply as yet another payment innovation.

Keywords: Digital Public Infrastructure; Green Finance; Financial Inclusion; Alternative Credit Data; MSMEs; Regional Digital Public Infrastructure; GIMACPAY, Sustainable Development Africa

1. Introduction

Digital Public Infrastructure (DPI) is emerging as the fundamental backbone of digital transformation and inclusive economic development, consisting of a suite of systems that enable secure, interoperable, and scalable transactions between governments, businesses, and citizens. Whether occasionally described as a landscape consisting of interoperable payment systems, digital identity, and trusted data-sharing frameworks (World Bank 2024; UNDP, 2024; Centre for Digital Public Infrastructure [CDPI] 2024), DPI is also increasingly framed in public-good conversations, closely associated with innovation and enhancing the ability of the state to deliver services to citizens or increase access to financial services. Digital infrastructure interoperability that propels sustainable finance in Africa remains under-explored, even though it has proved to provide such a solution, as evidenced by countries like India (Unified Payments Interface (UPI)), Brazil (Pix), and Estonia (X-Road).

Africa, in turn, can no longer afford to wait for solutions to the climate and development financing crisis. Africa, while accounting for the least amount of global greenhouse gas emissions, estimated to be below 3% globally (AfDB, 2024; UNECA, 2022), is amongst those regions which are currently most exposed and highly dependent on urgent capital investment in renewable energy, climate-adaptive agriculture and industry, and resilient infrastructure. This is, finally, about micro–small and medium enterprises (MSMEs), which account for over 90 percent of businesses and the majority of jobs across Africa (IFC, 2025; African Development Bank, 2017). Unless society takes steps to make policy and market makers more aware of these gaps - the low collateralization, hard-to-assess credit histories, fragmented payment ecosystems, and persistent information

asymmetries that ultimately drive lending decisions-then hundreds of thousands of off-the-beaten-path solutions will be robustly excluded from mainstream green finance.

Recent digital financial services innovations like mobile money, instantaneous payments, and interoperable payment systems provide new opportunities to overcome the structural barriers faced by potential segments of the population that are un(der)banked. However, the interoperable digital ecosystems that enable more seamless transactions also produce repeat, trusted histories of digital transaction behaviors that can serve as alternative credit data and much more. These digital footprints permit lenders to underwrite lent businesses based on their actual (observed, real) financial behavior rather than more traditional collateral or less rich indicators of capacity, helping to alleviate asymmetric information whilst broadening access to the services that finance facilitates. Yet little is known about the intersection between Digital Public Infrastructure and both financial inclusion and green finance; these categories have yet to be analyzed primarily in isolation from one another, and how interoperable digital infrastructure can drive investment towards African MSMEs remains poorly theorized.

Utilizing qualitative multiple-case analysis of Kenya, Nigeria, Ghana, Rwanda, Egypt, and South Africa along with the CEMAC modular GIMACPAY ecosystem, this paper addresses this gap. This study compares a number of these diverse Digital Public Infrastructure initiatives to analyze the institutional mechanisms that enable them, and explains how interoperable digital payments, digital identity, and trusted data-sharing frameworks connect financial inclusion, alternative credit data generation, and green finance. Based on Information Asymmetry Theory, the study develops an *integrative conceptual framework*, positioning Digital Public Infrastructure as the institutional link between financial inclusion and sustainable investing. Finally, the paper enhances knowledge by proposing that Regional Digital Public Infrastructure (RDPI), such as those with interoperable regional payment infrastructures including but not limited to GIMACPAY, can reduce cross-border financial fragmentation, support African Continental Free Trade Area (AfCFTA) implementation, and reinforce cross-border financial inclusion in an inclusive and sustainable manner across Africa while enabling productive value chains and increasing access to climate finance across the continent.

Given these gaps, the current study responds to the following three research questions: (1) How does Digital Public Infrastructure contribute towards alleviating green finance access for African MSMEs? (2) In what ways do interoperable payment systems and alternative credit data relieve constraints to sustainable investment finance? (3) What lessons for inclusive, climate-resilient development in Africa can be gleaned from these examples of Digital Public Infrastructure? In conclusion, the paper contributes conceptually, empirically, and in policy terms to the emergent literature at the intersection of Digital Public Infrastructure, financial inclusion, and green finance by illustrating how such regional interoperable infrastructures can help advance the sustainable development agenda in Africa.

2. Literature Review

2.1 Digital Public Infrastructure and Inclusive Economic Development

In recent years, Digital Public Infrastructure (DPI) has become a key component of digital transformation strategies across the globe to enable governments and private sector actors to deliver secure, interoperable, and scalable digital services. These digital " bricks and mortar," like a digital Identity (ID), an interoperable payment system, and secure data exchange, provide important foundations for innovation and access to high-speed internet infrastructure (World Bank 2024), which facilitates the provision of public services in an effective manner; it also allows stakeholders with diverse economic profiles to participate fully in today's increasingly digitized world. In the same way, UNDP (2024) defines DPI as a public good or an environment for accelerating the Sustainable Development Goals (SDGs); when multiple users gain access, transaction costs also decrease, which avoids duplicating institutional resources and is more affordable. According to the Centre for Digital Public Infrastructure (CDPI, 2024), successful DPI relies not just on technology but also on governance and interoperability standards, legal systems and institutional coordination to guarantee security, trust and scalability

If examined globally, examples abound of how DPI has completely changed financial ecosystems. An example of publicly-funded interoperability is India, which doubled the volume of digital transactions by promoting interoperable digital identity and state-owned instant payment infrastructure, encouraging innovative business models in banking and fintech (World Bank, 2024). The instant real-time interoperability of Brazil's Pix was another very effective way to reduce the price for retail payments and increase financial inclusion across the socio-economic segments (BIS, 2023). This clearly demonstrates that DPI is an enabling infrastructure rather than a standalone application; instead, it creates the pipeline whereby inclusive digital services can be offered more efficiently by government, financial institutions and private innovators.

In the past decade, DPI gained unique traction throughout Africa on account of the expansion of cell connectivity and digital fiscal services, along with linked authorities-led electronic transformation options. Examples of the countries that have made significant investments in core DPI components (e.g., digital identity systems, interoperable payment infrastructures and digital government platforms) to harness synergies, improve public service delivery, expand financial inclusion or reduce market fragmentation include Kenya, Ghana, Rwanda, Nigeria, South Africa and Egypt (World Bank 2020; 2024; Centre for Digital Public Infrastructure [CDPI] 2024). The initiatives highlight that interoperability in digital ecosystems can improve economic participation, institutional efficiency and innovation across the public and private sectors.

However, the rollout of DPIs remains inconsistent across the continent. The digital ecosystem also remains constrained, although levels of dependability and maturity might differ, by differences in institutional capacity, regulatory maturity, digital infrastructure, governance arrangements and cross-border interoperability. While several studies have investigated DPI's role in facilitating digital government, digital financial inclusion and payment system development, little research has focused on the potential of DPI to facilitate green finance and sustainable investment. In particular, little has been done in terms of how interoperable digital infrastructures produce alternative credit data, and thus less information asymmetry that can moreover enhance the assessment of creditworthiness of underserved MSMEs and help unlock financing for environmentally sustainable economic activities. Closing this gap is particularly important for understanding how Digital Public Infrastructure can move from being merely a digital service delivery platform to a broader strategic enabler of sustainable and inclusive economic development.

2.2 Financial Inclusion, Alternative Credit Data, and Green Finance

Financial inclusion is increasingly considered a necessary condition for sustainable economic development, as it allows businesses and individuals access to affordable financial products and services. As per the World Bank (2022), financial inclusion with access to savings, payments, insurance, and credit helps boost entrepreneurship, empower households, and reduce poverty. But access to finance for African MSMEs is still constrained by a lack of collateral, poor financial records, and high information asymmetries between borrowers and lenders (CGAP, 2023). These structural barriers are especially severe in the financing of green investment projects, which tend to have long payback periods and higher perceived risk.

Green finance covers financial products and investments that are intended to develop functional assets supporting environmentally sustainable activities, ranging from renewable energy and climate-smart agriculture to sustainable transportation and resource-efficient production (OECD, 2023). Even though international pledges for climate finance have grown significantly in recent years, African MSMEs receive just a fraction of the funding that might be available due to poor risk assessment processes and underdeveloped financial markets (African Development Bank, 2023). As a result, there is increasing interest in utilizing digital technologies in order to alleviate financing constraints and enhance access to climate finance for those who need it the most. This is where non-traditional or alternative credit data comes into the picture as a potential way out of this conundrum. Now, instead of drawing on just historical financial statements or other physical collateral, lenders are relying more and more on alternative behavioral datasets to determine the ability to repay loans, such as transaction histories (World Bank, 2022), mobile money usage, or payments for utilities and merchant payment flows. By relying less on static measures of a borrower's finances and more on real-time alternative datasets, these solutions effectively reduce information asymmetries. Prior work led by Suri

& Jack (2016) showed that the mobile money ecosystem created major gains in household resilience and financial inclusion, while new studies find that data from digital payments may provide MSME lending opportunities and allow green finance to be offered at lower perceived risk of underserved borrowers (CGAP, 2023; OECD, 2023).

To date, in spite of these advances, previous studies have examined financial inclusion, digital finance and green finance separately. There are only a handful of studies that explicitly investigate the extent to which Digital Public Infrastructure acts as the institutional infrastructure that consistently produces verified alternative credit data for sustained investment actions.

2.3 Interoperable Payment Systems as Digital Public Infrastructure

Correlatively, interoperable payment systems are one of the most emergent and most economically impactful aspects of Digital Public Infrastructure. Interoperability makes it possible for banks, mobile money operators, fintechs, payment service providers and governments to swap payments freely under common technical standards and governance frameworks. As per the Bank for International Settlements (2023), interoperable instant payment systems enhance competition, lower transaction costs, increase efficiency and bolster financial inclusion by breaking down private payment silos.

We have seen in many cases across a number of African nations the advantages that interoperable payment infrastructure can provide. Ghana Interbank Payment and Settlement Systems (GhIPSS) connects banks, mobile money providers and government institutions with real-time payment services. The Nigeria Inter-Bank Settlement System (NIBSS), the issuer for instant payments in Nigeria, has also undertaken efforts on a similar footing as it expanded instant payment over the last decade while enabling innovation across financial institutions and other fintech players. Rwanda's National Digital Payment System: A case where coordinated regulatory leadership and interoperability were shortcuts to Digital payment uptake and better access for underserved communities (World Bank 2024; AFI, 2023). In addition to enhancing payment efficiency, interoperable systems also create quality transaction data which can facilitate digital credit and risk assessment as well as develop new financial products. With its interoperable transactions, every single one adds to the credibility of a digital financial history which solidifies lenders' ability to assess borrowers on their habits rather than on physical assets. The mature interoperable payment ecosystems increasingly command strategic assets for financial inclusion, public service delivery, and sustainable economic development.

However, most of the current literature is concentrated on domestic interoperability, while less has been addressed to regional interoperable payment infrastructures that enable cross-border commerce, regional financial integration, and long-term investment. This is an essential gap for research, particularly in Africa's Regional Economic Communities where trading and investing across borders continues to be obstructed by fragmented payments.

2.4 Research Gap and Conceptual Contribution

There is strong evidence from the literature that Digital Public Infrastructure enhances financial inclusion, alternative credit data enables better assessment of credit risks, and green finance facilitates sustainable development. But these streams of research have mostly developed independently from one another. Existing studies often do not elaborate on how digitization using interoperable digital infrastructures produces both reliable financial data and green investments for MSMEs in a sustainable way. Moreover, the majority of empirical evidence is for national initiatives, with much less knowledge on regional Digital Public Infrastructure that could facilitate corresponding cross-border financial inclusion and sustainable finance.

This study fills this gap by combining Digital Public Infrastructure, financial inclusion, information asymmetry, alternative credit data, and green finance into a single analytical framework. It differs from prior work by proposing Regional Digital Public Infrastructure (RDPI) and serving the GIMACPAY ecosystem of the Central African Economic and Monetary Community (CEMAC) as an empirical instance of how regional

interoperable payment infrastructures can increase financial inclusion, develop trusted digital transaction histories, enable cross-border commerce, and widen access to sustainable finance. By connecting national and regional levels of analysis, the study also adds new insights regarding how interoperable digital ecosystems can help Africa accelerate its green and inclusive economic transformation.

3. Conceptual and Theoretical Framework

The theoretical foundation of this research is based on Information Asymmetry Theory (Akerlof, 1970) and draws from Financial Intermediation Theory (Diamond, 1984) and the Technology-Organization-Environment (TOE) Framework (Tornatzky & Fleischer, 1990). Collectively, these theories postulate the role of DPI in closing information asymmetries and improving financial intermediation, while also providing an enabling institutional setting conducive to inclusive green finance (i.e., other salient factors). The Theory of Information Asymmetry explains how financial markets may function inefficiently when one party has more information than another before entering into an agreement (Akerlof, 1970). Particularly for African MSMEs, this dilemma is amplified as lenders frequently have less access to verifiable financial records, leading to challenges in discerning between low-risk and high-risk applicants. As a result, formal finance remains out of reach for many potentially viable enterprises, especially those working with renewable energy and climate-smart agriculture or other environmentally sustainable activities where established coalitions from the government and private sectors have contributed infrastructure, and where such support remains limited. This information asymmetry is one of the largest systemic barriers to scaling up green finance across developing economies.

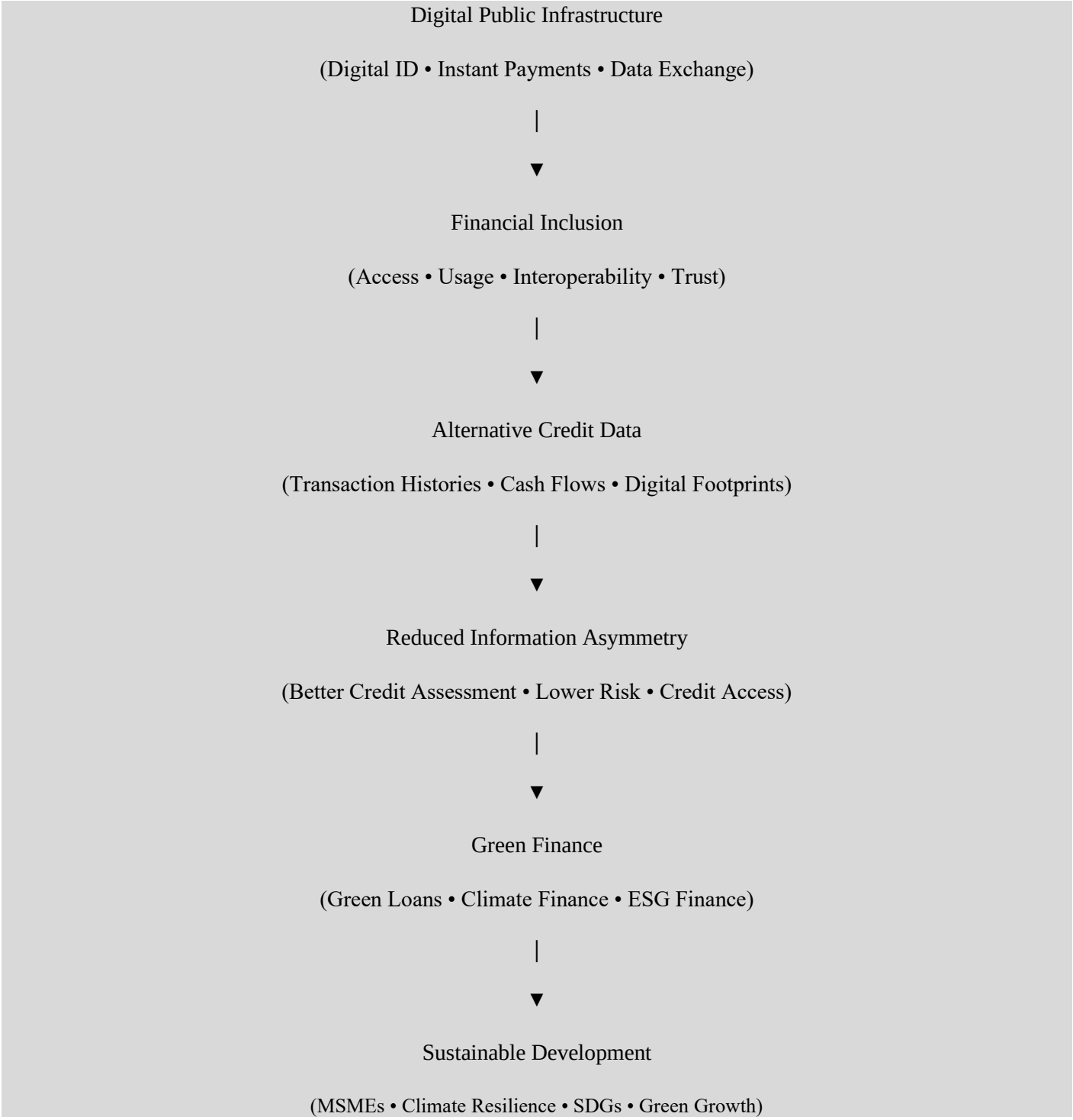
But DPI disrupts this system by creating trusted transaction data in real time from interoperable payment systems and secure data-sharing frameworks built on equitable digital identity. It would be useful to build a verifiable digital financial footprint based on every digital payment, merchant transaction, government transfer, or utility payment as alternative credit data. These behavioral datasets provide a continuous observable signal of the economic activity of financial institution clients, reducing reliance on historical financial accounts and collateral (World Bank, 2024; CGAP, 2023). In doing so, DPI tackles the fundamental information asymmetry that continues to limit lending to underserved MSMEs. Financial Intermediation Theory also explains how the availability of high-quality information allows financial institutions to act more effectively. According to Diamond (1984), financial institutions are present because information costs are lower, and they can be employed more effectively than if all participants were in the market alone. Digital Public Infrastructure reduces monitoring costs, provides information about expected credit risk, and allows lenders to design financial products for the needs of underserved enterprises by providing standardized and interoperable transaction data. This enables wider access to sustainable finance and contributes to the overall efficiency of financial markets.

Lastly, it is important to include an institutional perspective on DPI adoption through the Technology–Organization–Environment (TOE) Framework (Tornatzky & Fleischer, 1990). The framework indicates that technological innovation is not purely dependent on technical capabilities, but also on organizational preparedness and a conducive regulatory environment. As a result, successful Digital Public Infrastructure builds on interoperable technical standards and designs supported by effective governance, regulation, and collaboration among governments, central banks, financial institutions, and fintech firms at the cutting edge of development, unlocking the potential to deliver. These complementary institutional conditions that determine whether interoperable digital ecosystems can scale up and achieve inclusive economic outcomes.

Based upon these theoretical underpinnings, this research presents an Integrated DPI–Green Finance Framework (Figure 1). The framework posits that by enabling Interoperable Payments, digital identity, and trusted data exchange, Digital Public Infrastructure generates new high-quality alternative credit data to overcome information asymmetry, improve financial inclusion and credit allocation, and boost Green Finance access for MSMEs. Building on existing theory, this framework demonstrates how interoperable regional payment infrastructures such as GIMACPAY can not only bring national-level development benefits but also

integrate these benefits beyond borders through cross-border payments, regional financial integration, and sustainable investment across Africa.

Figure 1: Proposed Integrated Digital Public Infrastructure–Green Finance Framework



4. Methodology

4.1 Research Philosophy and Design of Research

This study follows the interpretivism research philosophy, which is suitable for exploring complex institutional forces since DPI connects theories of financial inclusion and green finance across countries in Africa. Interpretivist orientation, however, has broader implications: it is not concerned with hypothesis

testing or causal inference like positivist approaches, but rather it seeks to make sense of the relationships, institutional setup, and governance mechanisms of a phenomenon as well as contextual aspects that are relevant in explaining real-world situations (Creswell & Creswell, 2023). The relationship between DPI and green finance is an emerging area of research; therefore, a qualitative exploratory approach was deemed appropriate.

This research is conducted within the framework of a qualitative multiple-case study design, as explicated by Yin (2018). Multi-case studies allow researchers to explore and compare similarities and differences between contemporaneous phenomena in their natural settings. The suitability of this model derives partly from the diversity in terms of Digital Public Infrastructure maturation, regulatory trends, financial inclusion and digital payment ecosystems across many African countries. Analysis of multiple national initiatives within a regional GIMACPAY ecosystem gives deeper analytical insights than an individual country case study for statistical generalizations.

4.2 Sampling Strategy

Adopting a purposive sampling strategy, identified information-rich cases that can together meet the goals of the research (Patton, 2015). Qualitative purposive sampling does not seek statistical representativeness but rather cases with high explanatory power and practical importance. Seven cases were selected: Kenya, Nigeria, Ghana, Rwanda, South Africa and Egypt; and one regional payment ecosystem: GIMACPAY, in the context of six member states of CEMAC (Central African Economic and Monetary Community). These cases were selected to reflect a range of digital financial maturity levels and existing use cases, while showcasing different approaches towards interoperable payment systems, digital identity, financial inclusion and sustainable finance.

The inclusion criteria were:

- Nationally or regionally recognized Digital Public Infrastructure
- Functional interoperable payment systems or well-developed digital financial ecosystems;
- The presence of documentation demonstrating commitments or initiatives for financial inclusion enabled by digital,
- Green finance or sustainable financing initiatives for MSMEs;
- Public academic/institutional evidence from across 2018 - 2025.

Choosing cases from different African Regions also enhances the transferability of findings by providing institutional, regulatory, and technological diversity while identifying common mechanisms linking DPI to green finance.

4.3 Data Collection

This study uses only secondary qualitative data via a systematic review of academic and institutional literature. Due to its synthesis of evidence obtained from diverse credible data sources with preservation of context-rich evidence, document analysis is regarded as an appropriate qualitative method for policy framework studies, institutional practice, and pathways on digital transformation initiatives (Bowen, 2009).

It was conducted from March to June 2026 by accessing the literature through Scopus, Web of Science, Google Scholar, ScienceDirect, and SpringerLink databases. Publications were gathered from a variety of institutions directly involved with Digital Public Infrastructure, financial inclusion and sustainable finance, including the World Bank, the IFC (International Finance Corporation), AfDB (African Development Bank), UNDP (United Nations Development Programme), CGAP(Consultative Group to Assist the Poor), CDPI(Centre for Digital Public Infrastructure, BIS(Bank for International Settlements (G20 stakeholders), Organisation for Economic Co-operation and Development (OECD), United Nations Economic Commission for Africa

(UNECA), FSD Africa (Financial Sector Deepening Africa), G20 Reports, national central bank and payment authorities.

Combinations of the following keywords were used to conduct a more complete literature search: "Digital Public Infrastructure", "Interoperable Payment Systems" or "Instant Payments"; including context focused on: financial inclusion & green Finance & climate finance + alternative credit data + MSME finance; and digital identity, with Africa being the key geography. Headings below this title were combined with Boolean operators (AND/OR) to search peer-reviewed publications and policy reports of relevance. The methodological framework is illustrated in Figure 2, where duplicate records were removed and title, abstract, and full-text screening performed.

4.4 Data Analysis

The documents collected were thematically analyzed, which was "a qualitative method for identifying, analyzing and reporting themes (patterns) within data" (Braun & Clarke, 2006, p. 79). Six iterative steps were followed for analysis, including familiarization with the documents, initial coding, development of themes, refinement of themes, cross-case comparison, and interpretation. It covered patterns in the explicit contribution of digital public infrastructure to financial inclusion and sustainable finance based on evidence identified in integrated payment systems, digital ID, trusted data-sharing frameworks, alternative credit data (ACD), credit-scoring mechanisms, financing for MSMEs, as well as green investment outcomes.

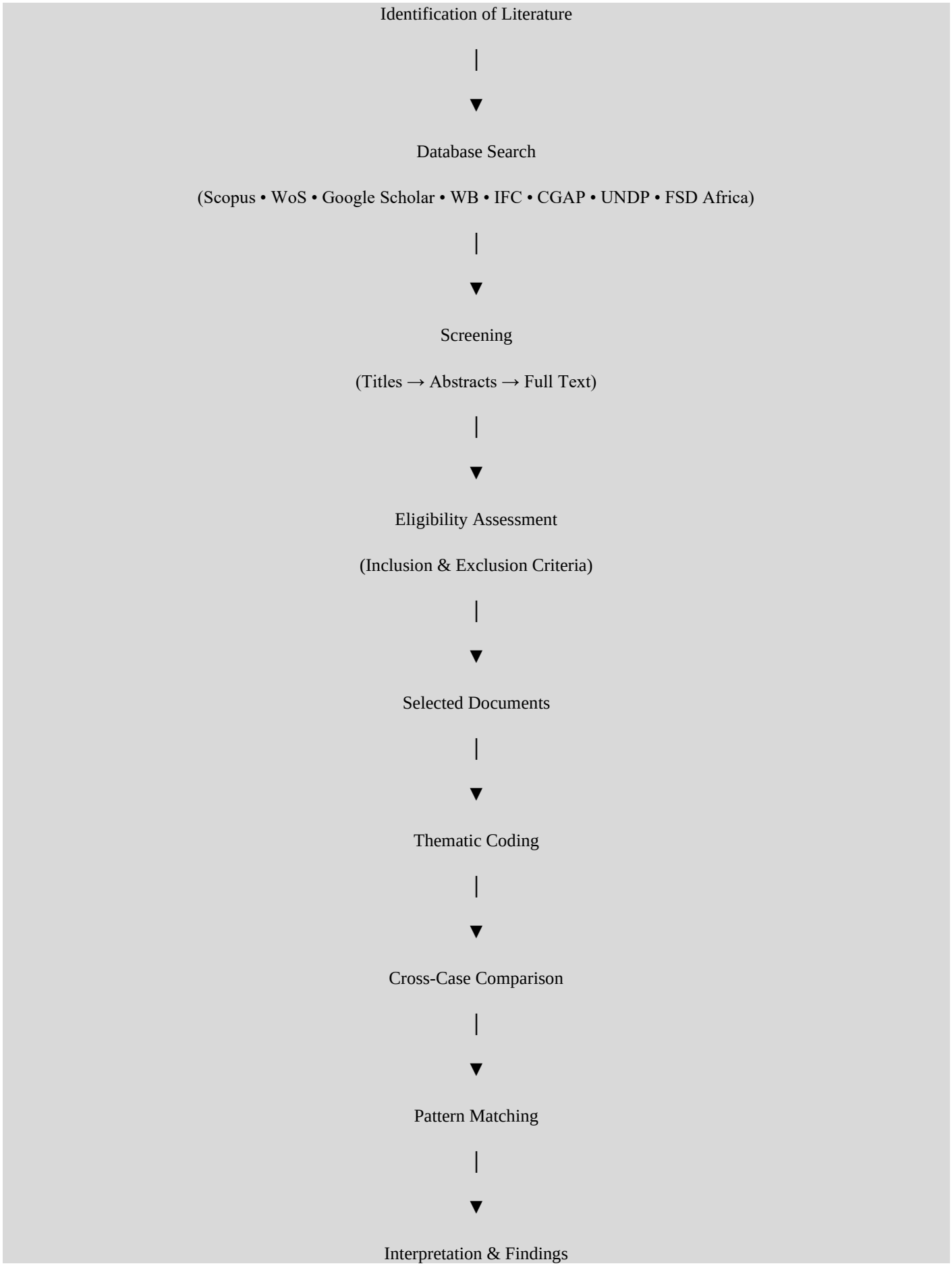
After analyzing each case, a cross-case comparison was performed to identify consistencies and contextual differences across the countries chosen for this analysis. Subsequently, pattern matching was employed to compare empirical results with theoretical propositions derived from Information Asymmetry Theory and the Integrated DPI-Green Finance Framework, following Yin (2018). Utilizing this analytical strategy allowed the study to highlight common institutional mechanisms while acknowledging variation in implementation across countries.

4.5 Trustworthiness and Research Quality

Various quality assurance strategies were employed to ensure the rigor and credibility of the study. Each of the results was subjected to interpretation based on peer-reviewed journal articles, reports issued by international organizations and central banks, literature available from institutions specializing in development, and official policy doctrine. The aim of this approach was to reduce reliance on a single source and provide greater uniformity in results. It established credibility through systematic cross-case comparison and transparent documentation of case selection and analytical processes. Trustworthiness was provided through an audit trail of the search strategies and inclusion processes, decisions on coding, and how themes were developed. Third, we advanced transferability with a mix of cases representing diverse geographical areas and levels of Digital Public Infrastructure development in Africa (ranging from low to high maturity) as well as different institutional contexts.

While the study is based on secondary data and thus does not create direct causal links between ideas, the qualitative multiple-case design provides significant analytical leverage for establishing trends in how Digital Public Infrastructure enables financial inclusion and how MSMEs gain access to green finance. The methodology provides a solid basis for identifying relevant patterns in policy, combining evidence from multiple African contexts and paving the way to future empirical research on Digital Public Infrastructure & sustainable development.

Figure 2. Methodological Framework



5. Results

5.1 Overview of Cross-Case Findings

Thematic analysis revealed five mechanisms underlying the enabling role of Digital Public Infrastructure (DPI) for green finance in Africa. Despite differences in institutional leadership, technological maturity, sectoral focus, and regulatory structure across the selected cases, they all point to a converging trend from more interoperable digital infrastructures toward greater financial inclusion, information availability, and broader opportunities in sustainable finance.

First, interoperable digital payment networks link people and enterprises, financial institutions, FinTech firms, and public institutions in shared commercial ecosystems. Second, these systems link informal and formal financial channels and offer direct access to a financial ecosystem, especially for households, rural producers, and MSMEs that have largely operated on a cash basis. Third, each time it digitally expresses economic activity with cash or credit, it creates transaction histories, merchant records, repayment data, and cash-flow information that can serve as alternative credit data. Fourth, this data can enhance the evaluation of borrowers without traditional collateral or formal credit scores. Fifth, when DPI is linked with sectoral financing models, it has the potential to catalyze climate-smart agriculture and renewable energy adoption, sustainable production, and other green investments. This, therefore, implies that DPI is not a panacea for green finance. Although it is indirect, it is still strategically relevant: it forms the payment, identity, data, and governance basics on which even more inclusive and data-comprehensive financing methods can evolve through financial institutions and tech providers. As explained here and in Figure 1, the identified pathway across the cases is:

DPI → Financial inclusion → Alternative credit data→ Decreased information asymmetry → Better credit assessment→ Green Finance = Sustainable development.

This finding is consistent across national cases, and GIMACPAY demonstrates how this same pathway can be expanded through a regional interoperable infrastructure.

Table 1. Comparative overview of case-study findings

Country/Ecosystem	Digital Public Infrastructure	Green Finance Mechanism	Financial Inclusion Outcome	Principal Lesson
Kenya	M-Pesa and digital payments	PAYGo solar through M-KOPA	Mobile-money inclusion	Repayment histories can substitute for conventional collateral
Nigeria	NIBSS Instant Payments, BVN/NIN and fintech ecosystem	Digitally managed solar financing through Arnergy	Digital payments for SMEs	Interoperable payments support productive and renewable-energy lending
Ghana	GhIPSS, mobile-money interoperability and digital agriculture	Farmerline and climate-smart agriculture	Inclusion of smallholder farmers	Agricultural and transaction data strengthen financing decisions
Rwanda	Digital identity, Irembo and integrated digital payments	Digital and climate-smart agriculture	Rural digital inclusion	Coordinated government leadership accelerates DPI adoption
South Africa	Digital banking and interoperable payment infrastructure	ESG-oriented and sustainable SME finance	Formal financial deepening	Mature financial markets can combine digital data with sustainability criteria
Egypt	InstaPay, Meeza and e-KYC infrastructure	Green and sustainable SME lending	Expanding digital inclusion	Central-bank leadership and public-private coordination are essential
GIMACPAY	Regional interoperable payment infrastructure across CEMAC	Potential regional green MSME finance	Cross-border financial inclusion	Regional DPI can scale sustainable finance beyond national markets

5.2 Case Study Findings

Table 2. Case-Study Findings Across Selected African DPI Ecosystems

Country / Ecosystem	Context	Digital Public Infrastructure	Green Finance Mechanism	Financial Inclusion Outcomes	Key Lessons
Kenya	Kenya is one of Africa's earliest and most mature digital financial markets, driven by widespread mobile-money adoption.	M-Pesa provides a broad digital-payment infrastructure connecting households, merchants, financial institutions, and service providers while continuously generating transaction records.	M-KOPA uses mobile-money payments to support pay-as-you-go financing for solar home systems and other productive assets. Small digital installments create verifiable repayment histories.	Previously excluded households and microenterprises can access clean-energy products and build digital financial profiles without relying exclusively on traditional collateral.	Digital payments can simultaneously expand financial inclusion, generate alternative credit data, and support renewable-energy adoption.
Nigeria	Nigeria combines a large fintech sector with strong payment-system modernization led by the Central Bank of Nigeria and NIBSS.	Nigeria Instant Payment supports real-time interoperability, while BVN and NIN strengthen identification, verification, and participation in formal financial services.	Arnergy uses digitally managed installment payments to finance decentralized solar-energy systems for households and SMEs. Sustainable banking principles and green bonds provide a broader enabling environment.	Digital wallets, agency banking, merchant payments, and cash-flow records improve the visibility of MSMEs and provide data for alternative credit assessment.	Interoperable payments and digital identity can transform everyday transactions into reliable information for productive and renewable-energy lending.
Ghana	Ghana has combined rapid mobile-money growth with agricultural digitization and increasing attention to rural financial inclusion.	GhIPSS and mobile-money interoperability connect banks, wallets, farmers, cooperatives, buyers, and financial institutions through shared payment channels.	Farmerline combines agricultural, production, sales, input-purchase, and payment data to support climate-smart agriculture and sustainable rural investment.	Smallholder farmers gain safer and lower-cost payment channels, while their digital activity produces information that can support financing decisions.	DPI can enable green finance by digitizing entire agricultural value chains and improving the financial visibility of rural producers.
Rwanda	Rwanda has pursued a coordinated, government-led digital transformation strategy linking digital government, finance, and development planning.	Digital identity, Irembo, electronic government services, and integrated payment systems provide a trusted digital ecosystem for citizens and businesses.	Digital agriculture platforms and payment systems can support investments in irrigation, drought-resistant seeds, sustainable land management, and climate-resilient farming.	Rural citizens gain greater access to formal services, while digital interactions generate validated records of payments and public-service use.	Strong public-sector coordination and institutional leadership are as important as technology in scaling DPI-enabled sustainable finance.

South Africa	South Africa has one of Africa's most advanced banking systems, digital-finance markets, and sustainable-finance frameworks.	Its infrastructure includes national payment systems, advanced digital banking, electronic customer verification, and rapid-payment capabilities.	Banks increasingly use digital cash-flow data and ESG criteria to finance renewable energy, green buildings, sustainable manufacturing, and circular-economy SMEs.	Digital records supplement traditional credit files and help lenders assess SMEs that may still lack sufficient collateral or formal credit histories.	In mature financial markets, DPI improves the quality, efficiency, and sustainability orientation of financial intermediation.
Egypt	Egypt's financial transformation has been led by the Central Bank of Egypt through payment modernization, fintech reforms, and financial-inclusion policies.	InstaPay, Meeza, mobile wallets, e-KYC, and digital banking support interoperable and cashless transactions across the financial system.	Sustainable-finance policies and SME lending programs use digital infrastructure to facilitate loan disbursement, repayment, monitoring, and risk assessment.	More households and SMEs participate in formal finance, while electronic payment and cash-flow data strengthen credit evaluation.	Central-bank leadership, supportive regulation, interoperability, and sustainable-finance policy must work together to expand green SME finance.
GIMACPAY / CEMAC	GIMACPAY addresses payment fragmentation across the six CEMAC countries through a regional interoperable ecosystem.	It connects banks, microfinance institutions, mobile-money operators, fintechs, payment institutions, and public entities through wallet, bank, merchant, QR, government, and cross-border payments.	Its green-finance role is primarily prospective. Regional transaction and merchant data could support solar finance, climate-smart agriculture, green merchant ecosystems, and sustainable MSME lending.	Regional interoperability can reduce payment friction, expand formal participation, and generate more standardized cross-border transaction records.	GIMACPAY illustrates the potential of Regional Digital Public Infrastructure, although its direct green-finance impact still requires implementation and empirical evaluation.

6. Comparative Analysis

The comparative analysis indicates that although institutional contexts vary, the seven cases share a common developmental trajectory of integrating Digital Public Infrastructure (DPI) into their financial systems to strengthen financial inclusion and lay the groundwork for green finance. Kenya, Nigeria, Ghana, Rwanda, South Africa, and Egypt are all seeing success with national DPI strategies built around economic goals, but GIMACPAY shows how this can be scaled through a Regional Digital Public Infrastructure (RDPI) model. The results demonstrate that interoperable payment systems by themselves do not create green finance, but generate trusted digital transaction records that minimize information asymmetry in credit assessment and enable innovative financing models for underserved MSMEs.

This comparison also shows key differentiators in implementation. For this reason, the cases of Kenya and Nigeria demonstrate how market-driven innovation occurs, as private-sector fintechs exploit pre-existing interoperable payment infrastructure to heavily scale renewable energy financing. Ghana and Rwanda both highlight more sectoral, government-led approaches, emphasizing a combination of digital payments with agricultural value chains and public digital services that support climate-smart agriculture with data. Alternatively, South Africa and Egypt have coalesced on

key digital public infrastructure components with ESG frameworks and central bank leadership as focal points for more robust sustainable SME finance. While these nationwide efforts tend to showcase how national interoperability can foster domestic financial inclusion, GIMACPAY provides a natural example of regional interoperability fostering cross-border financial inclusion while creating an integrated digital infrastructure for future regional green finance initiatives.

Three key success factors can be distilled from those cases, irrespective of the methodology chosen. First, interoperable digital payments broaden access to formal financial systems. Secondly, continuous interactions in the digital spectrum produce verifiable (alternative) credit data, thus improving lenders' feedback mechanisms to borrowers with no traditional collateral. Third, digital infrastructure needs to be complemented by effective governance, including supportive regulation, institutional coordination, and multi-stakeholder collaboration, for the intended results in inclusive and sustainable financial outcomes to materialize. These results support the Integrated DPI–Green Finance Framework developed here, demonstrating that Digital Public Infrastructure acts as a process and not simply a payment platform and as an institutional catalyst for sustainability along with economic growth.

Table 3. Comparative Analysis of Digital Public Infrastructure and Green Finance Across Selected African Cases

Country / Ecosystem	Digital Identity	Interoperable Payments	Alternative Credit Data	Green Finance Model	Financial Inclusion Outcome	Governance Model	Key Contribution
Kenya	SIM registration and mobile customer verification	M-Pesa mobile money ecosystem	Mobile payment histories and repayment behavior	PAYGo solar financing (M-KOPA)	High mobile-money inclusion among households and MSMEs	Private sector-led innovation with regulatory support	Digital payment histories can substitute traditional collateral.
Nigeria	BVN and National Identity Number (NIN)	Nigeria Instant Payment (NIP) operated by NIBSS	Wallet activity, merchant transactions, digital cash flows	Solar financing (Arnergy) and sustainable banking initiatives	Expanded digital financial services for SMEs	Public-private partnership led by CBN and fintech ecosystem	Interoperable payments generate trusted data for productive and green lending.
Ghana	Ghana Card integrated with financial services	GhIPSS and interoperable mobile money	Agricultural production records, mobile payments, digital sales	Climate-smart agriculture (Farmerline)	Increased rural financial inclusion among smallholder farmers	Multi-stakeholder collaboration	Combining agricultural and payment data strengthens rural financing decisions.
Rwanda	National Digital ID	Integrated national payment ecosystem and Irembo	Government service usage, payment records, agricultural transactions	Digital agriculture and climate-resilient farming	Improved rural digital participation	Strong government leadership	Integrated public digital infrastructure accelerates inclusive sustainable finance.

South Africa	Electronic customer verification (e-KYC)	National payment system and digital banking	Digital banking activity, merchant transactions, business cash flows	ESG-oriented SME finance, renewable energy and green infrastructure	High formal financial inclusion with improved SME financing	Market-led under strong regulatory oversight	Mature financial markets leverage digital data to improve ESG financing.
Egypt	National Digital ID and e-KYC	InstaPay, Meeza, interoperable digital payments	Electronic payment records and SME transaction histories	Green SME lending and renewable energy finance	Growing digital financial participation	Central Bank-led digital transformation	Strong regulatory coordination supports digital sustainable finance.
GIMACPAY (CEMAC)	National IDs remain country-specific (no regional digital ID yet)	Regional interoperable payments connecting banks, MFIs, MMOs and fintechs across six countries	Cross-border payment records, merchant QR transactions, wallet-bank interoperability	Emerging potential for regional green finance and sustainable MSME financing	Cross-border financial inclusion and regional market integration	Regional governance through GIMAC and BEAC	Introduces the concept of Regional Digital Public Infrastructure (RDPI) capable of scaling sustainable finance across borders.

The comparison leads to the identification of four main patterns. First, digital identity enhances trust and safe engagement with formal financial systems (though this varies widely across countries). Second, interoperable payment systems are the shared backbone of all Digital Public Infrastructure ecosystems and usefully underwrite seamless financial transactions while generating common digital records. Third, these transaction records become a new type of credit data, reducing *information asymmetry* between MSMEs and lenders and increasing lenders' ability to analyze their risk exposure to MSMEs with no traditional collateral. Last but not least, the national development priorities also affect the green finance models either through renewable energy in Kenya and Nigeria, climate-smart agriculture in Ghana and Rwanda, ESG-oriented finance in South Africa, sustainable SME Finance in Egypt, or GIMACPAY, which is possibly the most recent regional financing initiative on this side of town. Taken together, these findings support the proposed Integrated DPI–Green Finance Framework, which illustrates how Digital Public Infrastructure functions as an enabling ecosystem that connects and cross-pollinates digital identity, interoperable payments, trusted data, and carbon assessment for financial inclusion and sustainable investment in Africa.

7. The GIMACPAY Ecosystem: A Regional Digital Public Infrastructure

Although studies on Digital Public Infrastructure (DPI) largely focus on national-level initiatives, Africa's increasing regional integration agenda and the political call for Regional Digital Public Infrastructure (RDPI) are driven by efforts to facilitate cross-border financial inclusion and sustainable development. This paper contributes to the existing DPI literature by identifying RDPI as a multi-country-governed, interoperable digital ecosystem that enables secure digital identity interoperability, real-time cross-border payments, trusted data exchange, and harmonized digital financial services within a regional economic community. While national DPI initiatives focus mainly on domestic transactions, RDPI

tackles cross-border fragmentation by linking financial intermediaries, payment service providers, governments, businesses, and citizens through shared technical standards, governance frameworks, and interoperability protocols.

One such model that exemplifies this regional trend is the GIMACPAY ecosystem. GIMACPAY is the interoperable payment infrastructure for the six Central African Economic and Monetary Community (CEMAC) member nations of Cameroon, the Central African Republic, Chad, the Republic of the Congo, Equatorial Guinea, and Gabon, developed as a joint venture between partner institutions managed by Groupement Interbancaire Monétique de l'Afrique Centrale (GIMAC), part of the Bank of Central States (BEAC). SmartKYC integrates banks, microfinance institutions, mobile money operators, fintech firms and other payment entities and public sector bodies through interoperable services that seek to enable a wide range of solutions across wallet-to-wallet transfers via QR codes, wallet-to-bank transactions, bank-to-bank instant payments (p2p), merchant QR-based payments, cashless collection in mass transit or local supply chains, among others. GIMACPAY furthers financial integration by supplanting fragmented national payment systems with a common regional infrastructure, while lowering cross-border transaction costs and operational barriers.

While the primary rationale for developing GIMACPAY was to strengthen regional payment interoperability as opposed to financing environmental projects directly, this architecture is what creates the institutional conditions needed (e.g., each interoperable transaction creates standardized digital payment records that will be able to contribute to alternative credit data, which will create trust in MSMEs within country-operated markets. These data can enhance credit assessments for enterprises involved in renewable energy, climate-smart agriculture, sustainable trade and circular economy activities in areas where conventional forms of collateral are still scarce. Regional interoperability could, furthermore, foster digital lending products, regional merchant QR ecosystems and long–term cross-border financing mechanisms that would bolster sustainable value chains across Central Africa as well.

The reasoning in the GIMACPAY case thus carries the conceptual framework developed here up to a higher level of abstraction, beyond the national system. While Kenya, Nigeria, Ghana, Rwanda, South Africa, and Egypt show mainly how national DPI ecosystems can increase financial inclusion and green finance, RDPI does the same across jurisdictions with GIMACPAY. Through the coordination of interoperable payment infrastructure under a common governance framework, RDPI can reduce fragmentation in regional markets, enable intra-African trade within the African Continental Free Trade Area (AfCFTA), and lay a digital foundation for future regional sustainable finance opportunities. The experiences with GIMACPAY suggest that regional interoperable payment systems can grow from transaction infrastructure to strategic public digital assets that support inclusive, resilient, and sustainable economic development across Africa, although the direct impact of GIMACPAY on green finance is still in its infancy and needs empirical testing.

The proposed RDPI model, shown in Figure 2, describes how interoperable cross-border payments can produce trusted digital transaction data that helps reduce asymmetric information and promote the financial inclusion of MSMEs, an important trend in green finance with tremendous potential to grow regional sustainable development.

8. Discussion

8.1 Digital Public Infrastructure as an Enabler of Green Finance

The results show that DPI does not just serve as a payment network, but rather as an ecosystem enabling financial inclusion through better access to information and increased access to sustainable finance. The six national cases showed that credible digital financial evidence from interoperable digital payment systems could consistently facilitate more inclusive credit assessment for MSMEs and smallholder farmers. This suggests that DPI is more than just a mechanism for efficiently transmitting transactions; rather, it serves to remedy structural financing constraints due to information asymmetry.

These results are consistent with the World Bank's (2024) definition of DPI as infrastructure that supports inclusive participation in economic processes. Likewise, according to UNDP (2023), interoperable digital public systems will strengthen resilience, improve service delivery, and accelerate progress toward the Sustainable Development Goals. This study goes a step further and shows that DPI makes possible the informational basis for increasing green finance practice.

Unlike other studies that promoted digital payments as tools for financial inclusion, this research demonstrates how interoperable payment systems create digital public profiles that provide better information and reduce lending risk to environmentally sustainable enterprises.

8.2 Alternative Credit Data and Information Asymmetry

The most recurring theme throughout each of the case studies is that alternative credit data plays a key role in broadening access to finance. Digital payment transaction records, merchant transactions, agricultural production records, digital banking activity of an MSME, and government digital services all combine to reduce the information asymmetry that has historically restricted lending to MSMEs.

This evidence is consistent with Information Asymmetry Theory (Akerlof, 1970; Stiglitz & Weiss, 1981), which posits that inferior information causes lenders to ration loans and rents because the riskiness of borrowers cannot be estimated. In Kenya, Ghana, Nigeria, Rwanda, South Africa and Egypt, digital financial records increasingly replace traditional collateral and formal financial statements by providing verifiable proof of economic activity.

The results further resonate with CGAP (2022), which argues that digital transaction histories create new opportunities for inclusive lending by enhancing borrowers' visibility in financial systems. In a similar vein, the World Bank Global Findex (Demirgüç-Kunt et al., 2022) recognizes digital payments as another channel for financial data (which benefit historically unserved populations).

Yet, this paper contributes to the literature by showing that DPI as alternative credit data can also enhance financing for green projects, thus linking digital financial inclusion with green finance.

8.3 Green Finance Beyond Financial Inclusion

One of the most significant findings of this study is that financial inclusion does not in itself mean green finance. Although all six countries expanded digital finance, green financing was successful only where ecosystems for digital payments were combined with sector-specific financing mechanisms.

For example, M-KOPA in Kenya combined digital payments with pay-as-you-go solar financing. Nigeria paired innovations at the intersection of renewable energy financing, like Arnergy, with interoperable payments. Ghana and Rwanda scaled digital financial services in climate-smart agricultural value chains, while South Africa expanded financial access via digital banking for ESG-oriented SME finance. Egypt integrated digital payments into a wider sustainable finance framework centralized by the Central Bank of Egypt.

This mirrors OECD (2023) and UNEP FI (2023), which argue that digital innovation cannot deliver sustainable development by itself and demand the right financial and regulatory frameworks to complement digital tools. The findings therefore indicate that DPI should be treated as providing enabling infrastructure rather than standalone green finance tools.

8.4 Comparison with Digital Finance Literature

In this sense, the study also adds to the increasing body of digital finance literature. Arner et al. Digital finance, as defined by Zetzsche et al. (2020), is an ecosystem that disrupts and innovates the financial services landscape with technology, data, and regulations. Likewise, Ozili (2018) maintains that the lowered transaction costs that *digital financial services* (DFS) provide lower barriers to obtaining banking services and allow for broader service availability.

The current results will substantiate these conclusions but argue that the real benefit of digital finance is not only access to payments, but also the creation of reliable financial data that facilitates productive investment. This approach shifts the focus from viewing digital payments as a final stage of payment to treating them as an enabler of better financial decision-making at scale and more sustainable finance.

The evidence also supports work by Jack and Suri (2014) that demonstrated the pro-resilience and financial inclusion effects of mobile money on households. The current study builds on their work, demonstrating that digital financial ecosystems are progressively shaping enterprise financing and sustainability via alternative credit assessment.

8.5 From National Digital Public Infrastructure to Regional Digital Public Infrastructure

The main value added to the literature on DPIs comes from the case of GIMACPAY, which pushes back against some of the national bias in much existing DPI research.

Existing frameworks on DPI, including those from the World Bank (2024), UNDP (2023), the G20 (2023), and the Center for Digital Public Infrastructure, essentially define what constitutes multi-country infrastructure across different jurisdictions. India's UPI, Brazil's Pix, Kenya's M-Pesa ecosystem, and Nigeria's NIBSS mainly work as national systems.

On the other hand, GIMACPAY shows that Digital Public Infrastructure can be a regional public good. GIMACPAY itself is a transnational retailer payment system that expands the interconnectedness and interoperability among financial institutions across its six member CEMAC countries, providing infrastructure to allow cross-border digital transactions, generating regional deep-digital-financial data, and underpinning financial integration beyond national borders.

This discovery builds on the current data paper, Infrastructure Theory, by adding the concept of Regional Digital Public Infrastructure (RDPI). While national DPI allows for increased financial inclusion, RDPI will enable regional dynamics of effective cross-border MSME participation and better nationwide alternative credit datasets that can promote lending across many jurisdictions. Consequently, regional DPI may be the critical institutional base necessary to expand sustainable investment across African markets alongside a growing AfCFTA.

9. Policy Implications

The results indicate that DPI should be regarded by policymakers as a tool for payments modernization or rather as a strategic enabler of sustainable finance. Governments should drive investments in interoperable payment systems, digital identity and trusted data-sharing frameworks, which can enable secure digital transactions to produce credible financial information for underserved MSMEs. It is also critical to build regulatory frameworks for trust by enhancing interoperability, data rights, consumer protection, cybersecurity, and broader principles of responsible data sharing in ways that engage consumers in digital financial ecosystems.

Such credit rating models for MSMEs in renewable energy, climate-smart agriculture, and other environmentally sustainable sectors should integrate interoperable digital transactions-based alternative credit data. Central banks and financial regulators must push for this integration process. These can serve to reduce dependence on traditional collateral and expand the universe of green finance without compromising financial stability. At the regional level, Economic Communities can use Regional Digital Public Infrastructure (RDPI) by harmonizing technical standards and payment regulations to deepen cross-border interoperability, facilitate regional trade under instruments such as the African Continental Free Trade Area (AfCFTA), promote economic stability and financial inclusion, and enable sustainable investment.

10. Practical Implications

The study offers practical applications for various stakeholders. Interoperable payment data, merchant transaction histories, and digital cash-flow records should enable financial institutions to conduct credit assessments of MSMEs that have little or no formal history with the traditional financial system. They can also underpin the creation of new green financial products combining renewable energy financing, climate-smart agriculture and sustainable supply chains with digital payments. They can partner with development partners to build interlinked digital infrastructure and increase structural capacity, regulatory harmonization, and support for digital literacy across Africa.

For pan-regional payment infrastructures like GIMACPAY, the results underscore new areas of potential beyond payment interoperability, including supporting digital merchant ecosystems, interoperable QR payments, cross-border SME financing, and future green finance infrastructures. Utilizing Digital Public Infrastructure along with sustainable finance initiatives can enhance resource allocation, thereby lowering transaction costs and facilitating inclusive economic development across all corners of the region.

11. Limitations and Future Research

This study has several limitations. To begin, it uses only secondary qualitative data, which prevents the establishment of causal relations from Digital Public Infrastructure to green finance outcomes. Second, while this selection of cases provides a fair geographic representation, it cannot compare the diversity of Digital Public Infrastructure implementation across all African nations. Third, the analysis focuses on institutional mechanisms and recorded practices and has not measured the quantitative impact of Digital Public Infrastructure on credit access, investment volumes, or environmental outcomes. Lastly, GIMACPAY is an emerging RDPI model about which the direct impact on green finance remains conceptual and empirically untested.

Using mixed-methods and quantitative designs, future research should examine the effect of Digital Public Infrastructure on MSME financing, renewable energy uptake, agricultural productivity, and climate resilience. They could model differences in credit risk as a result of digital transaction histories between cohorts over time, or study how alternative credit data used in digital environments affect loan performance relative to traditional finance models. A comparative study with other African Regional Economic Communities (RECs) such as ECOWAS, SADC, EAC and COMESA would provide a further understanding of Regional Digital Public Infrastructure. Finally, further studies should explore the role of emerging technologies such as artificial intelligence, open finance, programmable payments, central bank digital currencies (CBDCs) and interoperable systems for digital identity in reinforcing Digital Public Infrastructure and enhancing sustainable finance across Africa.

Conclusion

DPI has been a leading component of inclusive digital economies, but less explored as a strategic enabler of interoperability for an efficient enterprise in the green financial space through the African lens. This study filled that gap by exploring how interoperable digital public infrastructures, such as the UBI and CRI of India's National Economics and Financial Inclusion Inc., foster financial inclusion, generate alternative credit data,

increasing access to financial products while mitigating information asymmetries between lenders (and other providers of services) and the micro, small- and medium-sized enterprises (MSMEs). By means of a qualitative multiple-case study of Kenya, Nigeria, Ghana, Rwanda, South Africa and Egypt as well as the regional GIMACPAY ecosystem between them, it shows that DPI not only provides value in terms of enabling digital transactions but also because they generate reliable financial data sources which help lending institutions with more accurate credit evaluation and move towards investment in the environmentally sustainable sector.

This study contributes to the literature in three primary ways. The first contribution is empirical evidence that builds on theory by showing that alternative credit data are intermediating variables through which interoperable digital systems alleviate information asymmetry to enable sustainable lending. Second, it supplies comparative evidence from different country contexts across Africa, where, although countries adopt various implementation models, interoperable payments and digital financial records (such as a register of loans), together with a coordinating institutional mechanism, are salient to enabling the extension of green finance. Third, and perhaps most importantly, the study discusses RDPI. The paper illustrates this argument with GIMACPAY as a case in point and articulates how regional interoperable payment infrastructures can transcend the traditional national frameworks, such as DPI, by catalyzing continental financial inclusion/empowerment, regional digital financial ecosystems, and better financing avenues for green growth.

Finally, the study highlights potential areas for future research. Emerging topics such as AI, CBDCs, Open Finance (digital assets), interoperable digital identity, carbon markets and Regional Digital Public Infrastructure continue to have limited quantitative analyses or mixed-methods research exploring the same context across countries. As countries pursue Digital Public Infrastructure investments to unlock practical paths towards financial inclusion and broader digital transformation, the role of these ecosystems in supporting greener, more resilient economic transition will become an increasingly significant frontier for academic research and policy experimentation.

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