Research article

DIGITAL IDENTITY AS DIGITAL PUBLIC INFRASTRUCTURE: ENABLING PRODUCTION LOCALIZATION IN AFRICA

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Abstract. Although digital identification is already a vital component of Digital Public Infrastructure (DPI), its structural importance in promoting industrial localization and regional economic integration throughout Africa is yet largely unexplored. With an emphasis on agriculture—one of the most economically significant sectors on the continent—this research investigates how digital identification frameworks spur the formalization and localization of production ecosystems. In terms of methodology, the study employs a conceptual and policy analysis, combining national digital identity initiatives, regional development strategies used in several African governments, and current literature.

This study's main claim is that digital identity systems serve as fundamental enabling infrastructures. They include informal producers into formal economic networks by lowering transaction costs and market friction through digital marketplaces, targeted governmental development initiatives, and easier access to financial services.

Furthermore, the analysis evaluates how these frameworks address the legal "identity gap" targeted by UN Sustainable Development Goal (SDG) 16.9, contrasting centralized and decentralized identity (DID) architectures and mapping their implications for financial inclusion, digital sovereignty, and industrial development. The findings indicate that while physical infrastructure deficits, interoperability bottlenecks, and cybersecurity risks persist as significant operational barriers, strategically designed digital identity frameworks act as structural levers. They strengthen domestic productive capacity and elevate Africa's positioning within regional and global value chains (GVCs). Ultimately, this paper concludes that digital identity must not be conceptualized merely as an administrative tool or an e-government mechanism, but rather as a critical catalyst for inclusive economic transformation and industrial sovereignty.

Keywords: Africa, Digital Identity (ID) Frameworks, Global Value Networks (GVN), Industrial Localization, Self-Reliance, Socioeconomic Development, Digital Sovereignty

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INTRODUCTION

A strategic change from raw material exports to localized production ecosystems is being facilitated by the current drive for African industrial sovereignty, which is being fueled by technocratic governance approaches and regional blocs like the AfCFTA [Gadha et al. 2022; Fituni 2021]. The conventional center-periphery model needs to be reconsidered in light of this shift. In particular, a trust-based digital architecture made possible by multidimensional digital identity frameworks must take the place of bureaucratic inefficiencies.

These frameworks serve as structural enablers that legitimize informal economic activity and bolster resource sovereignty as a manifestation of "Collective Self-Reliance" (CSR). African nations are implementing decentralized, service-oriented identification systems that facilitate a more integrated digital economy by "leapfrogging" legacy structural adjustment restrictions. In this situation, regional integration transforms into an interoperable system from a top-down administrative procedure.

Africa's digital transformation raises concerns about digital inclusion, technology dependence, and economic sovereignty while also offering enormous potential for industrial growth. A large portion of the material now in publication emphasizes digital identity mainly as a means of enhancing the provision of electronic public services[1]. Its structural function in promoting industrial development and productive sectors, however, has received less attention.

This essay aims to answer a crucial research question: how might digital identification frameworks help localize production and promote economic integration in Africa, especially in the agricultural sector?

This paper makes the case that digital identification is more than just a way to identify people and companies. Rather, it is a fundamental layer of infrastructure that makes it possible for productive enterprises to be localized. By providing reliable verification of individuals, firms, and economic actors, digital identity strengthens trust relations and reduces information asymmetries across markets.

[1] Digital identification in a broader sense is considered as the process of determining and confirming a person's identity in a digital environment using information systems and technologies. It provides access to services, transaction security, and a personalized experience.

In Africa, where a large percentage of the population lacks legal identity and a sizable fraction of economic activity is still informal, this problem is especially pertinent [Atick 2016]. Access to financial services, governmental development initiatives, digital platforms, and international regional markets is greatly hampered by this pervasive lack of documentation. As a result, many smallholders and local businesses continue to be structurally excluded from formal, high-value supply chains despite their significant contributions to national output [Maslov et al. 2025]. By providing these producers with access to vital digital services, digital identity performs a crucial enabling role. Farmers may access digital marketplaces, loans, insurance, extension services, mobile payments, and agricultural subsidies with verified identities. These services improve local producers' integration into regional and global supply chains and aid in the formalization of economic activity.

Digital identity offers standardized procedures that facilitate coordination across institutional and geographical borders, going beyond individual identification. According to a German scholar in business and management, Ricarda Bouncken, and a British researcher in international business and strategy, Roman Barwinski [Bouncken, Barwinski 2021], one of the main forces for institutional cooperation is digital identification. Such identification systems are in line with the goals of the African Continental Free Trade Area (AfCFTA), which aims to expedite regional economic integration, in the African setting.

Two essential elements are necessary for these digital networks to function effectively: trustworthy authentication methods and safe identity stores. While authentication systems confirm user identification and transaction legitimacy, identity repositories hold demographic and credential data [Geteloma et al. 2019; Owais et al. 2017]. In agricultural markets, where dispersed production systems have historically impeded coordination and investment, they work together to produce a secure environment that lowers economic exchange uncertainty.

At a higher level, this digital trust architecture will allow local businesses to generate verifiable credentials that are accepted by financial institutions, regulators, and international buyers. Digital identity is a governance tool and a service delivery instrument, which enables infrastructure for agricultural modernization, inclusive industrial development, and regional economic connectivity.

THEORETICAL FRAMEWORK AND CONCEPTUAL CATEGORIES

Digital identity is a layered system that combines social and technical elements. It's flexible enough to work in many different government and business situations. According to the International Telecommunication Union (ITU)[2], a national digital identity plan requires four main parts to be defined: how it's run, how people start using it, how it's set up, and how it can keep going over time.

[2] Digital Identity Roadmap Guide. *ITU.* https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-DIGITAL.01-2018-PDF-E.pdf (accessed: 29.06.2026)

Such a system uses three main types of identity, which show what each part does: Foundational Identity is the main ID governments issue through things like birth certificates and national ID numbers[3]. Functional Identity refers to IDs for specific purposes, like healthcare IDs or transportation licenses [Chowdhury 2025]. Transactional Identity is the part that lets one do secure, trusted online transactions, exchange information between businesses, and shop online.

In Africa right now, local production increasingly relies on businesses being able to safely share information and build trust across different places. Historically, sharing knowledge meant using local, in-person networks and also international "global pipelines" to get outside knowledge and technology [Guimón, Paraskevopoulou 2017]. But in today's digital production systems, trust has to be built online, even when people never meet in person.

Within this context, the Trust over IP (ToIP[4]) model provides a valuable analytical lens for understanding how trust is maintained across organizational and jurisdictional boundaries [De Leon, Fernández Donoso 2017; Chango 2022]. Rather than serving as mere technical frameworks, these systems operate as trust-enabling mechanisms. They ensure the seamless verification of identities, credentials, and transactional legitimacy among key stakeholders—including farmers, processors, cooperatives, logistics providers, financial institutions, and regulatory authorities—thereby anchoring the modern African industrial ecosystem[5].

DIGITAL IDENTITY AS PUBLIC INFRASTRUCTURE FOR GOVERNANCE AND DEVELOPMENT

Digital Identity (ID) systems function as foundational socio-technical infrastructures, or Digital Public Infrastructure (DPI), that bridge the gap between informal economic actors and formal state mechanisms. Within public administration, these platforms are increasingly embedded in e-governance frameworks to replace fragmented, paper-based workflows with unified, data-driven service delivery systems [Giannopoulou 2023]. By establishing secure and verifiable links between governments and citizens, digital identity systems significantly enhance financial inclusion and access to public services.

In the African context, this structural transformation supports regional integration and production localization. Historically, small-scale producers and marginalized actors

[3] A national identification number is a unique code assigned by the government to a citizen or permanent resident. Its main task is to unambiguously link a person with their data in government databases in order to simplify interaction with various fields: employment, taxes, medicine, banking services, and benefits. This number is often included in a national document (passport, identity card).

[4] Trust over IP (ToIP) is an Internet Protocol Trust project, a model of a secure digital information exchange architecture developed by the ToIP Foundation, a division of the Linux Foundation.

[5] Digital Agriculture Strategy (DAS) and Implementation Plan 2024–2030. *African Union.* 2024. https://au.int/en/documents/20240212/au-digital-agriculture-strategy-das-and-implementation-plan-2024-2030 (accessed: 20.06.2026)

in subsistence economies have remained excluded from formal economic systems. Verified digital identities help reduce these structural barriers, enabling access to formal credit systems, regulatory approvals, and state development programs.

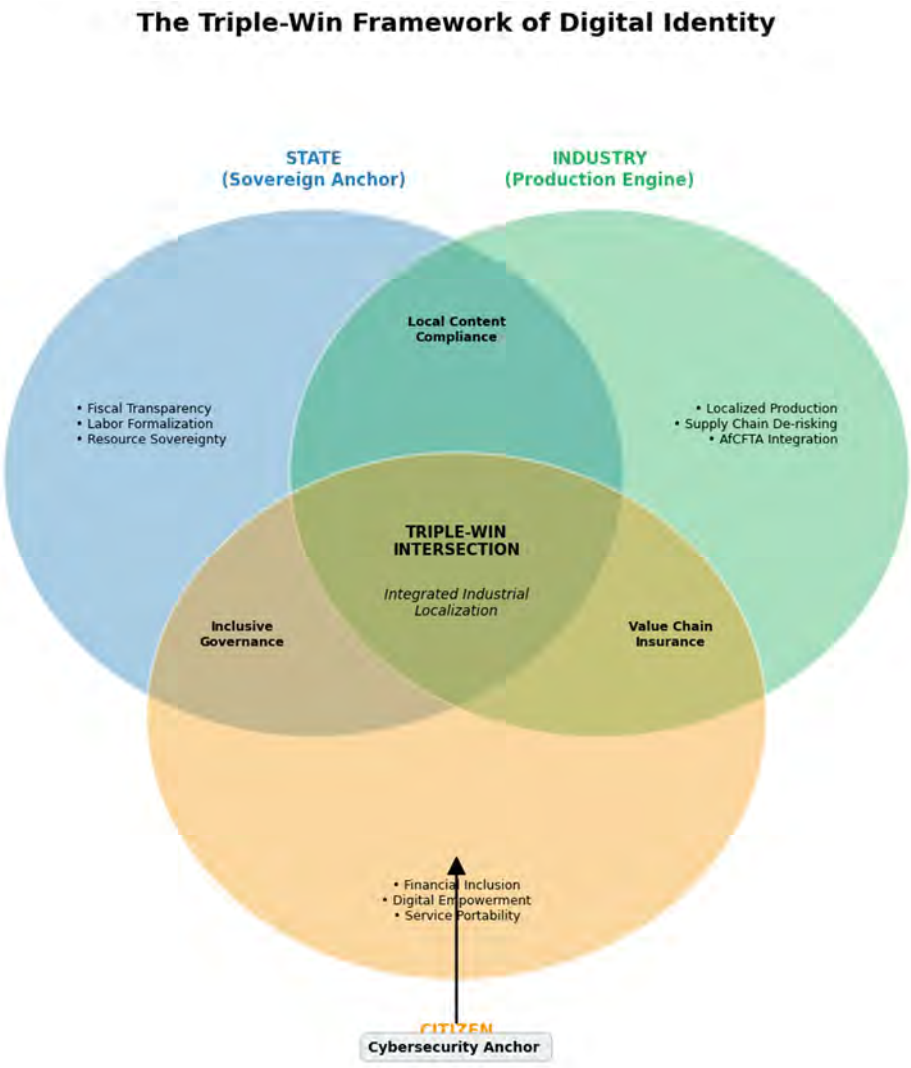


Fig. 1. **The Triple-Win Framework of Digital Identity**
Source: Author's elaboration

Furthermore, these systems provide public institutions with structured and verifiable data for monitoring industrial development and improving governance efficiency. By formalizing previously unregistered economic actors, digital identity systems enhance fiscal transparency and strengthen state capacity. For private-sector actors, verified identity systems reduce supply chain risks, streamline Know Your Customer (KYC) compliance, and facilitate trusted digital transactions, enabling local production systems to integrate more effectively into national and global value chains[6].

[6] Digital Agriculture Roadmap (DAR) Playbook. *World Bank*. 2025. https://documents1.worldbank.org (accessed: 20.06.2026)

According to the Triple-Win Framework, digital identification can facilitate coordinated value creation between the government, business community, and citizens. With the help of a fundamental cybersecurity layer that guarantees data integrity, authentication, and legal enforceability, the framework unifies disparate administrative registers into cohesive systems that promote regional economic growth.

Modern national ID systems dramatically lower transaction costs and decrease institutional intermediaries, according to empirical data. Some researchers, for instance, show how unified platforms like UAE Pass simplify access to social security, healthcare, taxation, and licensing services [Alhammadi et al. 2024]. When properly scaled, these technologies transform public administration into interconnected, citizen-focused digital ecosystems rather than dispersed service points.

STAKEHOLDER ORIENTATIONS AND INTERACTION MODELS IN E-GOVERNMENT

According to N. Paliwal [Paliwal 2020], e-government architecture can be “placed” into three main interaction models, which help with how public services and information get delivered. The Government-to-Citizen (G2C) model is mostly about widening access and pushing civic engagement, by offering digital means for routine public services like healthcare, education, and social welfare. When administrative hurdles get reduced, it tends to improve accessibility and makes the whole thing more inclusive for different people.

Then there’s the Government-to-Business (G2B) model, which supports the back-and-forth between governments and enterprises through digital regulatory and administrative workflows. This includes taxation, licensing, procurement, and also compliance procedures. These arrangements can raise operational efficiency, lower the overall cost of transactions, and also support wider economic development.

Finally, the Government-to-Government (G2G) model acts like the internal skeleton of digital governance. It makes possible data exchange, interoperability, and coordination among public bodies. With linked digital infrastructures in place, G2G systems help administrations make better decisions and run faster. Digital identity systems, in turn, reinforce all three interaction models because they add secure identity confirmation mechanisms, which enable dependable digital exchanges across citizens, businesses, and government settings.

The African Union High-Level Panel on Emerging Technologies, often called APET, has become, in a sense, a big push behind the expansion of e-government services across Africa, and it frames digital transformation as one of those central, regional-then-national development planks. By rolling out Information and Communication Technologies (ICTs), and also Internet-based applications, these efforts are meant to make public service delivery better and also make government more

accessible to citizens and businesses, even when the administrative jurisdictions are really different from one country to another.[7]

The transformative potential of the APET framework is grounded in its institutional role within AUDA-NEPAD. Rather than functioning solely as a policy concept, APET serves as an operational mechanism for implementing the Science, Technology, and Innovation Strategy for Africa (STISA) under the African Union's Agenda 2063. This approach is reflected in initiatives such as the AU Continental AI Strategy[8], which promotes harmonized regulatory frameworks across member states. Through the development of indigenous data governance frameworks, cross-border data-sharing protocols, and regulatory sandboxes, APET seeks to strengthen African digital sovereignty and reduce dependence on external technology providers. Furthermore, the framework supports capacity building through investments in regional STEM Centers of Excellence and high-performance computing (HPC) infrastructure. Collectively, these initiatives provide a foundation for sustainable and autonomous digital governance across the continent.

The deployment and operationalization of these frameworks continue to encounter significant institutional, legal, and socio-technical obstacles despite growing financial investments in digital identification efforts throughout Africa. The general lack of comprehensive, all-encompassing regulatory frameworks capable of providing unambiguous legal safeguards is a key weakness. A lack of strong cybersecurity procedures and enforced data protection measures sometimes exacerbates this legislative shortfall. Systemic exposure rises significantly in the absence of these structural protections, raising the possibility of illegal data access, serious privacy violations, and violations of basic digital rights. Furthermore, states are inadequately prepared to address systemic flaws, operational shortcomings, or malevolent security breaches due to the current lack of independent accountability structures and administrative disputes processes.

According to the Bank for International Settlements[9], tokenized deposits, private payment service providers, and API-driven financial infrastructures coexist with central bank money in a layered architecture. While efficiency is increased by these advancements, developing economies may become more vulnerable to macroeconomic shocks. Domestic currencies run the risk of becoming less significant in their own markets as financial transactions grow more reliant on private digital currencies or foreign-dominated payment platforms—a tendency known as "digital dollarization." Central banks may see a decline in the efficacy of monetary policy and a loss of control

[7] African Union High-Level Panel on Emerging Technologies (APET). *African Union Development Agency–NEPAD (AUDA-NEPAD).* https://nepad.org/microsite/african-union-high-level-panel-emerging-technologies-apet (accessed: 29.04.2026)

[8] Continental Artificial Intelligence Strategy. *African Union.* https://au.int/en/documents/20240809/continental-artificial-intelligence-strategy (accessed: 29.06.2026)

[9] Annual Economic Report. *Bank for International Settlements.* 2022. https://www.bis.org/publ/arpdf/ar2022e.pdf (accessed: 20.06.2026)

over financial intermediation as companies and consumers shift to external digital payment networks.

Initiatives like the Pan-African Payment and Settlement System (PAPSS)[10] have been formed to reduce these risks and bolster monetary sovereignty. PAPSS, which is coordinated by the Association of African Central Banks (AACB) and supported by the African Union, aims to enable smooth cross-border payments using local currencies. The system lowers transaction costs, promotes better economic integration across African markets, and improves regional financial interoperability by decreasing reliance on outside payment intermediaries.[11]

In general, modern digital governance systems are moving toward more flexible and networked structures. However, persistent institutional cooperation, ongoing oversight, and strategic planning are necessary for their long-term success. According to a recent study, cybersecurity and interoperability are two essential prerequisites for Africa's sustainable digital transformation. Interoperability supports integrated digital identity ecosystems by facilitating efficient communication and data exchange between government databases and digital platforms. In turn, cybersecurity reduces hazards related to growing digital infrastructures and safeguards sensitive data [Rijswijk et al. 2021]. These ideas can boost institutional coordination, lessen fragmentation of the governance, and improve the dependability, security, and resilience of digital governance systems when they are integrated into system design from the beginning.

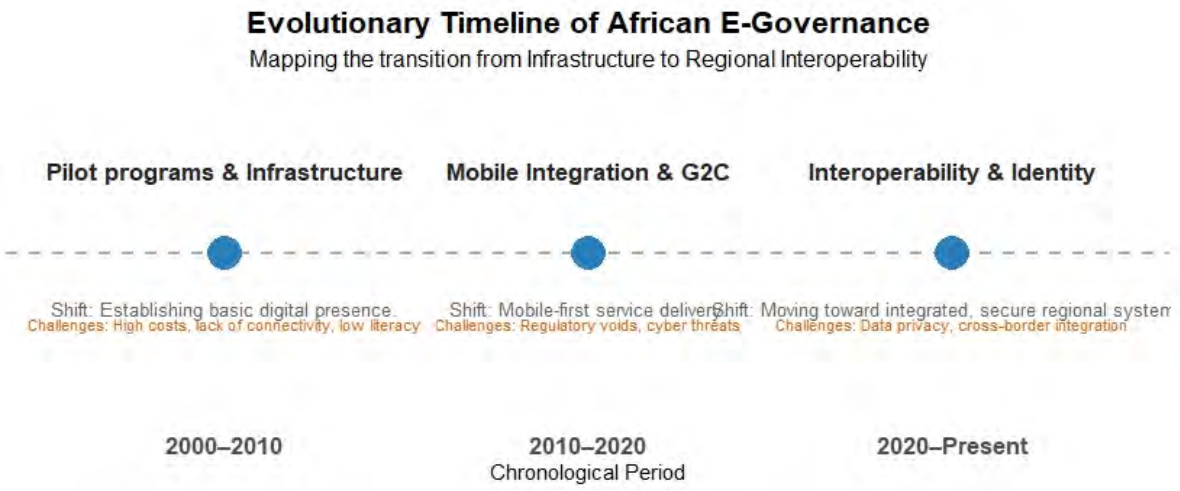


Fig. 2. **Evolutionary Timeline of African E-Governance**
Source: Author's elaboration

The progression of digital identity systems from the creation of fundamental infrastructure to interoperable digital identity ecosystems is depicted in *Fig* 2. While the "Challenges" row draws attention to enduring socio-technical obstacles such as gaps in

[10] About Us. *PAPSS*. https://papss.com/about-us/ (accessed: 20.06.2026)
[11] Pan-African Payment and Settlement System. *U.S. Department of Commerce*. https://www.trade.gov/market-intelligence/pan-african-payment-and-settlement-system (accessed: 20.06.2026)

digital literacy and institutional capacity and worries about data security and privacy, the "Shift" row defines the main strategic goal defining each stage of development.

An essential benchmark for evaluating how well African nations are moving from old bureaucratic structures to digitally enabled governance systems is the United Nations E-Government Development Index (EGDI). The African Union High-Level Panel on Emerging Technologies (APET) supports this viewpoint by highlighting how digital transformation advances regional integration and public service delivery. The Telecommunications Infrastructure Index (TII), Human Capital Index (HCI), and Online Service Index are the three sub-indices of the EGDI. [12]

Despite significant progress in expanding mobile connectivity, many African countries continue to face substantial challenges related to human capital development and digital skills. Experiences from Rwanda and Kenya demonstrate that investments in online service delivery platforms, such as Rwanda's Irembo portal[13], can significantly enhance Government-to-Citizen (G2C) and Government-to-Business (G2B) interactions, even where physical infrastructure remains under development. Consequently, the future advancement of e-governance in Africa depends not only on expanding digital connectivity but also on strengthening digital skills, institutional capacity, and user-centered service design [Rarhoui 2024].

South Africa (ranked 40th globally) and Mauritius (ranked 76th) are two of the top-performing African nations in terms of digital governance, according to the 2024 United Nations E-Government Development Index (EGDI)[14]. Tunisia (87th), Morocco (90th), Seychelles (92nd), and Egypt (95th), all of which are in the top 100 worldwide, come next.

These variations illustrate that progress in e-government development is shaped by a combination of factors, including infrastructure availability, human capital capacity, and the quality of online service delivery. Therefore, promoting greater technological cooperation among African countries requires balanced investments in digital infrastructure, human capital development, and regulatory harmonization to support sustainable digital transformation and regional integration [Shkvarya 2022].

According to Al-Khouri [Al-Khouri 2013], the growth of citizen-centric e-government is a three-stage evolutionary process marked by growing technology integration and administrative sophistication. In order to increase openness and foster public trust, the first stage, known as the *Era of Access*, focuses on one-way information dissemination.

Two-way communication between governments and citizens is introduced in the second stage, known as the *Era of Interaction*. At this stage, safe digital interactions are

[12] United Nations Department of Economic and Social Affairs (UN DESA). (n.d.). *E-Government Development Index (EGDI).* https://publicadministration.un.org/egovkb/en-us/About/Overview/-E-Government-Development-Index (accessed: 20.06.2026)

[13] IremboGov (irembo.gov.rws) is the official portal of the electronic Government of the Republic of Rwanda.

[14] United Nations e-government survey 2024: Accelerating digital transformation for sustainable development with the addendum on artificial intelligence. *UNDESA*. 2024. https://doi.org/10.18356/9789211067286 (accessed: 20.06.2026)

made possible by Identity and Access Management (IAM) systems. The final stage, the *Era of Engagement*, represents the highest level of maturity. It emphasizes active citizen participation in governance through integrated, multi-channel platforms, enabling feedback, consultation, and co-decision-making.

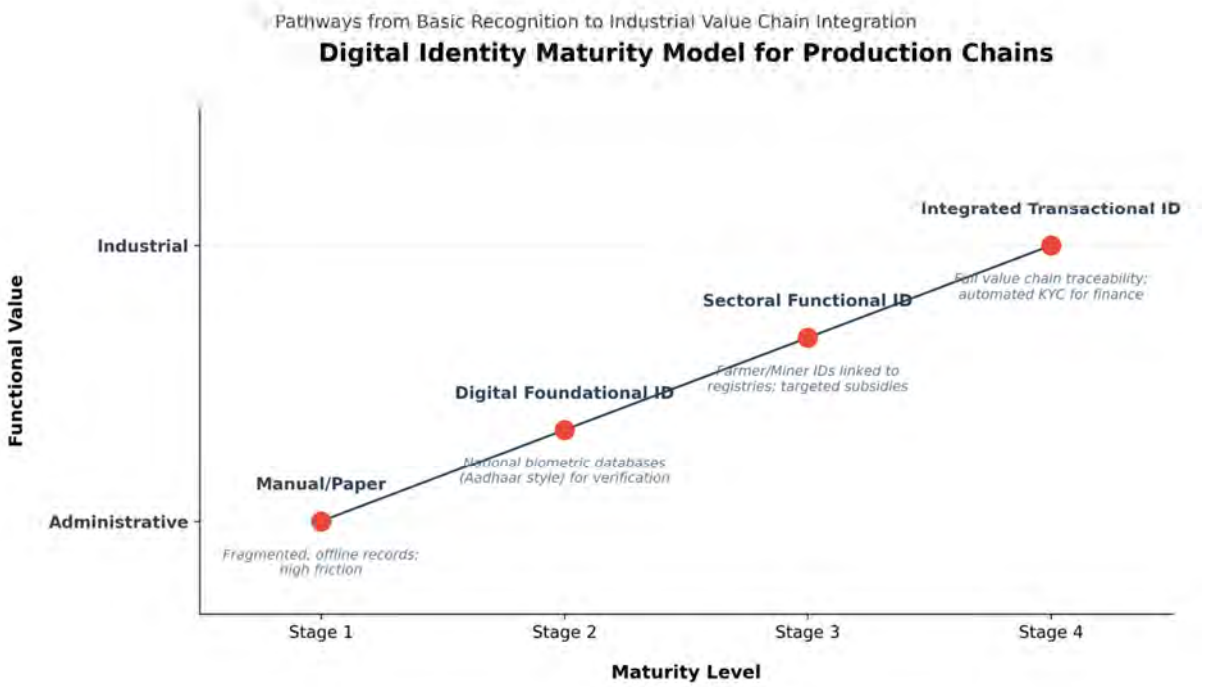


Fig. 3. **Digital Identity Maturity Model for Production Chains: Pathways from Basic Recognition to Industrial Value Chain Integration**
Source: Author's own elaboration.

The *Fig.* 3. illustrates the evolution of digital identity systems through four stages, from basic administrative identification to advanced industrial applications.

The *first stage*, White Paper, is an example of disjointed, poorly coordinated paper-based systems. In order to improve service integrity, the *second step*, Centralized Foundational Identity, creates a single identity repository and permits record de-duplication.

Access to targeted services is made easier by the *third step*, Sectoral Functional Identity, which enables specialized identity systems suited to certain industries like mining and agriculture.

Full maturity is represented by the *last step*, Integrated Transactional Identity, where identities are cross-platform compatible, allowing for safe transactions, automated KYC procedures, and value chain tracking. This promotes economic integration and industrial growth[15].

[15] Regional payment systems and interoperability in Sub-Saharan Africa (Report No. P164770). *World Bank*. 2022. https://documents1.worldbank.org/curated/en/099650005162214653/pdf/P16477001277440f10b8080dc6f51daf2dc.pdf (accessed: 20.06.2026)

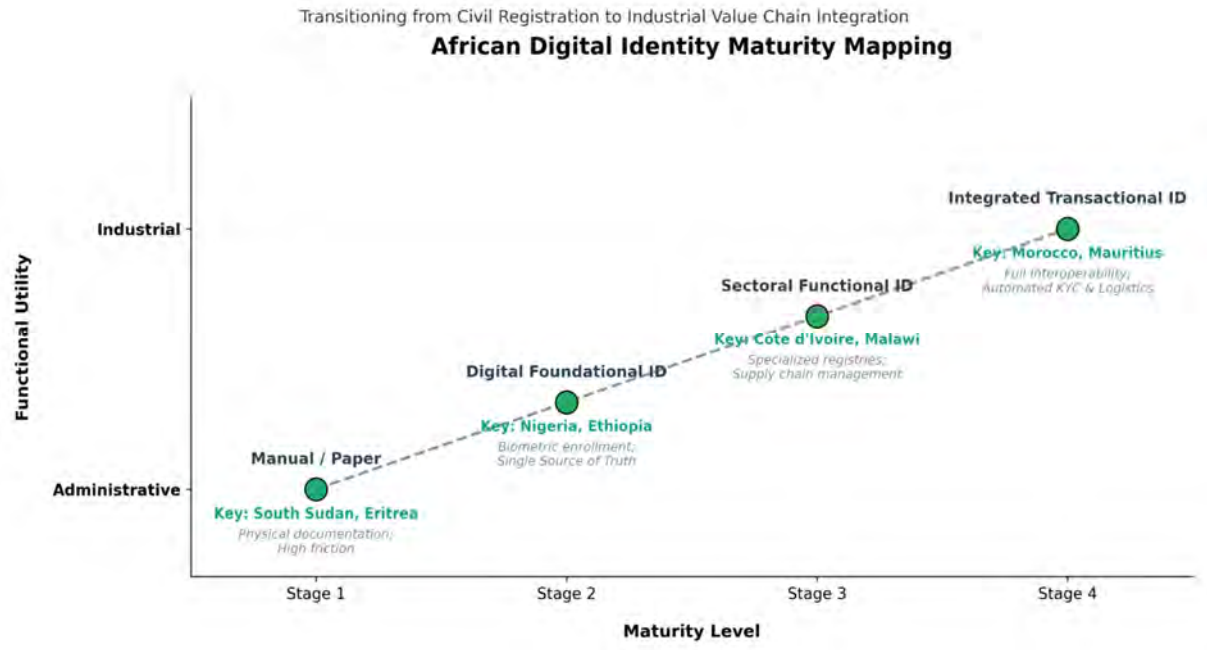


Fig. 4. **African Digital Identity Maturity Mapping: Transitioning from Civil Registration to Industrial Value Chain Integration.**
Source: Author's own elaboration.

Rural economies are changing as a result of the agricultural sector's massive digital change. This change lowers poverty, increases productivity, and improves food security. Digital technologies serve as a primary catalyst for the transition toward data-driven agricultural systems, directly facilitating precise resource optimization, localized climate adaptability, and highly informed institutional decision-making. Beyond stabilizing production, these digitized value chains generate novel economic opportunities and foster entrepreneurial ecosystems that are particularly vital for youth inclusion within rural economies [Peng et al. 2026].

Digital identification systems, which make it possible to access financial services, government initiatives, and online marketplaces, are a major facilitator of this change. These approaches encourage inclusive and fair economic growth in rural communities by lowering participation obstacles.

NATIONAL IMPLEMENTATION OF DIGITAL IDENTITY SYSTEMS

Strong frameworks for digital identities function as a potent developmental enabler, enabling countries to tackle basic issues in their political, administrative, and financial systems. In areas with insufficient traditional banking infrastructure, these solutions enable people to access mobile payment services by providing confirmed legal identification.

Digital identity systems can potentially improve the integrity of political processes. During the 2015 election cycle, for example, Nigeria used biometric e-identification,

which improved electoral credibility by reducing instances of multiple voting through digital voter authentication [Nwangwu 2015].

One of the best methods for increasing revenue collection and governance effectiveness in African nations is the digitalization of tax administration. By incorporating technology into taxpayer registration, filing, and payment systems, digital reforms seek to lower compliance costs, prevent corruption, and increase the tax base. The creation of electronic platforms that allow taxpayers to register, file returns, and make payments electronically is the first step in the digitalization of the tax system. This reduces administrative expenses and does away with the need for in-person visits to tax offices [Maslov, Golovko et al. 2025].

When these digital tax systems are coupled with national digital identification infrastructures, which offer dependable methods for taxpayer authentication and verification, their efficacy is significantly increased. For example, large-scale digital identification systems have been put in place in Tanzania and India to improve revenue collection, strengthen tax administration, and remove ghost workers from public payroll systems. This has led to significant cost savings and increased governmental efficiency [Masunga et al. 2020]. These examples show that digital identity systems are essential parts of contemporary e-governance infrastructures that promote accountability, transparency, and more effective public sector management in addition to serving as tools for citizen identification.

In order to create governance systems based on “trust-by-design” principles[16], developing economies have been investigating blockchain-based solutions in public administration more and more in recent years. Decentralized identification frameworks have been tested or adopted by countries like Ghana and India in an effort to lessen dependency on centralized databases and allow citizens to carry out safe online transactions. However, the governance design and implementation maturity of these strategies differ greatly[17][18].

The digital agriculture ecosystem illustrates how such technological advancements are reshaping traditional sectors by integrating digital tools with conventional farming practices, water resource management, and mechanization systems to enable efficient knowledge exchange [Vahdanjoo et al. 2025]. Digitalization in this context is inherently inclusive, as it allows individuals without direct access to digital devices or skills to participate through intermediary actors such as cooperatives, aggregators, and nucleus farms.

[16] "Trust-by-design" is a methodology for producing goods and services, implying a high level of trust and reliability embedded in it by design.

[17] Ghana Becomes First African Country to Integrate Payments into National ID. *FinDev Gateway*. 2026. https://www.findevgateway.org/news/ghana-becomes-first-african-country-to-integrate-payments-national-id (accessed: 20.06.2026)

[18] Sehloho M. India partners with Ghana, Namibia towards instant payment systems. *Connecting Africa*. 05.05.2024. https://www.connectingafrica.com/fintech/india-partners-with-ghana-namibia-towards-instant-payment-systems (accessed: 20.06.2026)

Digital personal identifiers—ranging from specialized Farmer IDs to national identity credentials—serve as foundational enablers of secure and efficient access to digital agrifood systems. They underpin virtually all digital services used by producers and consumers and play a critical role in establishing unified digital public infrastructure. However, in contexts where governments fail to implement standardized identity frameworks, private actors such as cooperatives and agribusiness firms often develop proprietary identification systems. While these localized solutions address immediate operational needs, they risk creating fragmentation and interoperability challenges, highlighting the necessity for standardized digital identity frameworks that ensure system-wide compatibility across sectors.

Digital identity systems often adhere to two predominant governance models on a global scale, each of which reflects different institutional, technical, and political agendas. The COVID-19 pandemic significantly increased the strategic urgency of these frameworks by spurring worldwide adoption and strengthening the G20's commitment to promoting interoperable, cross-border identification networks based on openness, security, and inclusivity.

One approach is embedded in the World Bank's Identification for Development (ID4D) program[19]. ID4D operates as a comprehensive, multi-sectoral partnership across international practices and operational units, as opposed to perceiving identity via a single administrative lens. The ID4D framework actively targets structural hurdles in fundamental economic sectors, such as public governance, healthcare, and agriculture, by combining knowledge of digital development, social protection and data privacy, to build equitable and resilient digital public infrastructure[20].

In contrast, China operates a highly centralized, state-led digital identity system through its Resident Identity Card framework, which links personal identifiers to both public services and private-sector platforms, including widely used mobile payment systems. This model creates a highly integrated digital ecosystem that prioritizes state oversight, administrative control, and national security, while also supporting domestic economic efficiency.[21]

Digital identification systems are mostly used for administrative purposes in sovereign-administrative models, like those used in China and Russia, but they also strengthen government control over industrial and economic activity. China's Resident Identity Card system allows citizens to access both public services and private-sector digital ecosystems within a highly integrated national digital economy by integrating digital identity with mobile payment platforms. In a similar vein, the "Gosuslugi" (State Services) platform in Russia functions as a centralized digital governance system that provides public services via a single administration interface. A "sovereign digital profile," which is necessary for verification in crucial administrative and financial

[19] ID4D. *World Bank*. https://id4d.worldbank.org (accessed: 20.06.2026)

[20] The World Bank Annual Report 2023. *World Bank*. 2024. https://documents1.worldbank.org/curated/en/099647503042425828/pdf/IDU-a9d1a6be-30dc-48e6-9318-cf9d26959fb9.pdf (accessed: 20.06.2026)

[21] Introduction of China RealDID System. *Crypto.news*. 2024. https://crypto.news/app/uploads/2024/12/Introduction-of-China-RealDID-System-20241106-Selva.pdf (accessed: 20.06.2026)

procedures like taxes and public service access, is created by the integration of the Unified Biometric System (EBS) with the ESIA platform [Romanenko 2019]. Belgium, on the other hand, has a high-integration strategy that enables effective and citizen-centered service delivery by fusing fundamental social identity systems with a national digital backbone.[22]

In order to balance decentralized IT infrastructure with standardized centralized identity and access control systems, the UK uses a hybrid governance architecture. These divergent architectural decisions show how national interests influence digital identity design, especially when it comes to striking a balance between the demand for smooth public service delivery and state security considerations.

Different architectural methods, from decentralized, service-oriented frameworks to centralized biometric systems, are used worldwide to construct digital identification systems. In a welfare-oriented governance framework, India's Aadhaar system serves as a fundamental identification infrastructure that uses biometric authentication to facilitate benefit distribution and improve fiscal efficiency [Tiwari et al. 2022].

REGULATORY FRAMEWORKS WITHIN THE AFRICAN UNION

Significant socio-technical challenges are brought about by the shift to digital identification systems, especially with regard to data security, privacy protection, and system resilience. Optimizing these systems inside the African Union necessitates a balanced regulatory strategy that harmonizes two different architectures: localized, relationship-driven trust networks and highly automated global digital networks.

Aligning international Anti-Money Laundering (AML) legislation and Know-Your-Customer (KYC) requirements inside a single compliance ecosystem is the main regulatory problem for cross-border transactions. In order to strengthen national data sovereignty and fundamental human rights, digital identification systems incorporate Customer Due Diligence (CDD) procedures directly into transactional workflows [Olaogun et al. 2023].

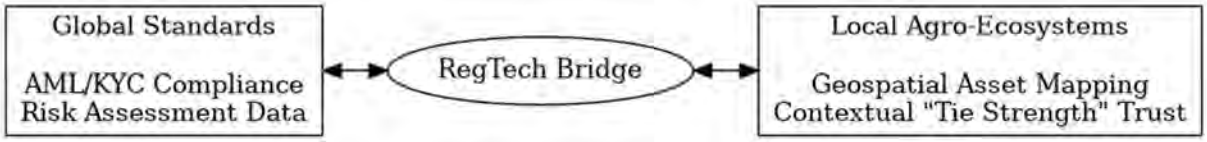


Fig. 5. **Strategic Workflow of Digital Identity-Enabled Agricultural Industrialization and Financial Inclusion within the APET Interoperability Ecosystem**
Source: Author's own elaboration

This ethical and legal framework must support domestic processors and marginalized smallholders in order for a state-driven development goal to be successful.

[22] Borak M. Belgium launches national digital identity wallet. *BiometricUpdate.com.* 2024. https://biometricupdate. com/202405/belgium-launches-national-digital-identity-wallet (accessed: 20.06.2026)

Verified digital IDs are used in this paradigm as formal measures of "tie strength." This enables small-scale economic players to successfully move from subsistence farming to industrial-scale production, unlock finance instruments, and comply with international risk-assessment norms.

Importantly, this shift in agriculture necessitates focused investments in digital infrastructure in rural areas. Agricultural output is geographically dispersed, whereas previous digitization attempts have focused on urban e-governance, commerce, and education. Reliable energy access and strong broadband connectivity must be extended into isolated rural areas in order to maintain an inclusive, localized production sector.

STRATEGIC FRAMEWORK FOR DIGITAL IDENTITY INTEROPERABILITY: FROM AGRICULTURAL INDUSTRIALIZATION TO DECENTRALIZED DIGITAL ECOSYSTEMS

Digital identity is becoming more and more of a strategic tool for industrial transformation, financial inclusion, and involvement in developing digital economies, rather than just an administrative tool. Digital identity is the cornerstone of a Pan-African trust architecture in the proposed African Platform for Emerging Technologies (APET) framework, which aims to maintain monetary sovereignty and industrial autonomy while standardizing metadata, facilitating interoperability among national identity systems, and supporting Collective Self-Reliance (CSR).[23]

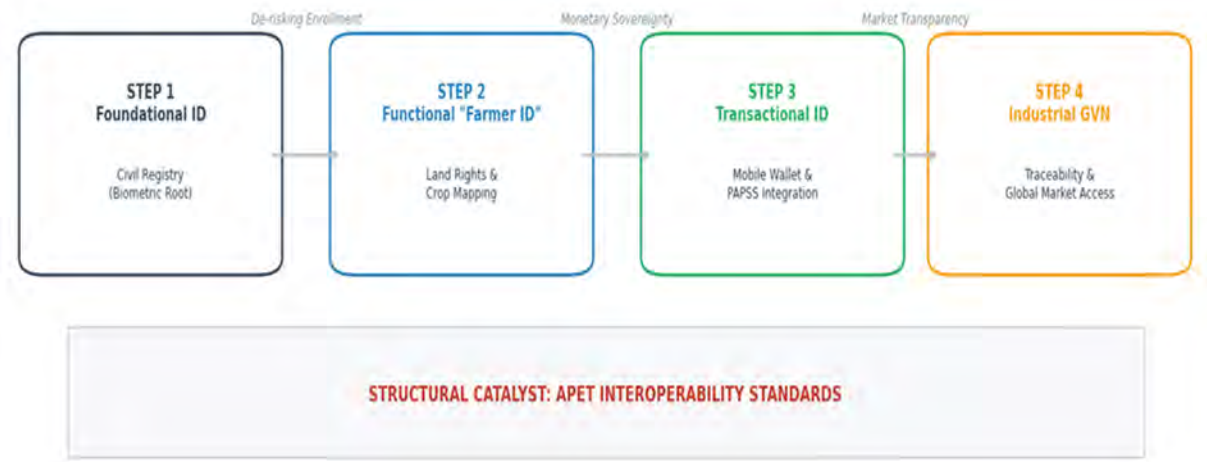


Fig. 6. **Strategic Workflow of Digital Identity-Enabled Agricultural Industrialization and Financial Inclusion within the APET Interoperability Ecosystem**
Source: Author's own elaboration

A four-stage evolutionary process for integrating African rural populations into the global economy is depicted in the schematic (*Fig.* 6): (1) creation of a Foundational ID

[23] An Integrated Prosperous and Peaceful Africa. AU Interoperability Framework for Digital ID. *African Union.* 2022. https://au.int/sites/default/files/documents/43393-doc-AU_Interoperability_framework_for_D_ID_English.pdf (accessed: 20.06.2026)

through biometric civil registries; (2) creation of a Functional "Farmer ID" connected to crop mapping and geospatial land rights; (3) implementation of a Transactional ID enabling financial inclusion through mobile wallets and PAPSS integration; and (4) transition to an Industrial Global Value Network (GVN) for enhanced traceability and market access. The entire framework is underpinned by APET Interoperability Standards, serving as the structural catalyst for cross-sectoral data exchange and systemic scalability.

The framework gives businesses a RegTech bridge to help them deal with issues related to currency hierarchy and over-reliance on major international payment systems. APET can facilitate the implementation of Foundational ID as a standardized Know Your Customer (KYC) tool for digital financial services by collaborating with African central banks and regulatory bodies. This strategy lessens the risks connected to unapproved private digital currencies functioning outside of national regulatory frameworks.

The concept of "Digital Shadows," in which industrial cooperatives uphold intermediary digital identities on behalf of marginalized agricultural and mineral producers, is incorporated into the framework to address ongoing digital exclusion. In order to facilitate regional interoperability without requiring direct ownership of digital equipment, APET should create technological standards for these intermediary identities. As a result, social inclusion and industrial sovereignty can be pursued in tandem to help close the identity gap mentioned in Sustainable Development Goal (SDG) 16.9.[24]

The APET framework should automatically expand to include Decentralized Identity (DID) and other virtual environments as digital ecosystems develop. DID systems, which provide users more control over their digital identities through cryptographically secured digital wallets, are the way of the future for digital identification. Users can keep ownership and control of their personal identifying data while storing validated credentials from reputable businesses. However, because users are now in charge of safeguarding their private cryptographic keys, this change raises serious security issues. Digital identities and related assets could be completely compromised if these keys are lost or if phishing and social engineering attempts are successful. Additionally, although DID ecosystems have fewer centralized points of failure, thorough smart contract auditing is still necessary because attackers may take advantage of flaws in blockchain infrastructures and distributed ledger technologies to facilitate credential fraud.

The growing adoption of immersive virtual environments further expands the significance of digital identity. Within the Metaverse, digital identities are represented through avatars that facilitate social, educational, commercial, and industrial

[24] Transparency, Accountability and Participation for 2030 Agenda. Target 16.9: By 2030, provide legal identity for all, including birth registration. Unite for Peaceful, Just and Inclusive Societies. *SDG16Now.* https://sdg16now.org/report/ target16-9/ (accessed: 20.06.2026)

interactions. The operation of these virtual environments requires sophisticated perception systems, authentication mechanisms, and encryption technologies capable of ensuring secure and authentic interactions among users [Wang, Wang 2023]. One of the most significant cybersecurity threats within such environments is the “Man-in-the-room” attack, whereby unauthorized actors gain access to communication streams for eavesdropping, surveillance, or manipulation of virtual interactions [Ebers 2024].

The integration of immersive hardware introduces additional risks associated with biometric data theft and deepfake avatars. Consequently, a robust identity architecture is required to establish secure and trustworthy relationships between multiple avatar representations and the authentic human identity underlying them.

To address these challenges, future APET implementations should incorporate Zero Trust Architectures (ZTA) supported by continuous authentication mechanisms capable of validating user identity throughout avatar interactions rather than relying solely on initial authentication events. Such systems are particularly important in environments characterized by digital doubles and avatar-based interactions, where identity spoofing and impersonation risks are significantly elevated [Mejail 2024].

Viewed collectively, the APET framework positions digital identity as a strategic infrastructure that extends beyond governance and financial inclusion into the broader domains of digital sovereignty, decentralized trust, and virtual economies. By integrating foundational identities, transactional interoperability, decentralized identity systems, and Metaverse applications within a unified governance architecture, APET can function as a structural catalyst for Africa's digital transformation. Grounded in the principles of Collective Self-Reliance, the framework offers a pathway through which African states can transition from technology adopters to autonomous architects of their own digital futures while maintaining economic independence, industrial competitiveness, and inclusive participation in the evolving global digital economy.

CONCLUSION

For African countries, the shift from conventional administrative registries to digital identity systems is a revolutionary move. This study shows that digital identification is the fundamental layer of trust that supports larger ecosystems for digital governance. African governments may improve public service delivery, boost economic participation, and ease integration into regional and global value networks by building secure and interoperable identity infrastructures.

An important turning point in Africa's digital transformation process is the move from Transactional Identity to involvement in Global Value Networks (GVNs). Countries can enhance economic inclusiveness, foster industrial development, and encourage sustainable growth by strategically implementing digital identification technology. Research from top African nations indicates that developments in online public services, biometric identity systems, mobile-first digital services, and

cybersecurity capabilities are contributing to greater digital readiness and social mobility.

The results also show that citizen-centered, safe, and interoperable digital identification systems can be used to implement the "Triple-Win" concept. In this framework, businesses benefit from increased market efficiency, regulatory certainty, and trusted digital interactions; governments gain increased transparency, accountability, and administrative efficiency; and citizens gain better access to basic services and greater social inclusion. When taken as a whole, these results establish digital identity as a vital facilitator of equitable economic growth and industrial transformation.

New cybersecurity and governance issues are also brought forth by developing technologies like the Metaverse and Decentralized Identity (DID) systems. Strong identity assurance, interoperability, privacy protection, and data governance processes are necessary for these systems. By allowing people to engage, ideas like the Digital Double and Alternative Modernities create new opportunities for inclusion by enabling individuals to participate in digital environments beyond traditional physical and social constraints. However, the realization of these opportunities depends on maintaining secure, trusted, and sovereign links between virtual identities and verified real-world identities.

The viability of African digital identification systems in the future will ultimately depend on the concepts of digital sovereignty and collective self-reliance (CSR) in addition to technological growth. African nations must maintain local ownership, regulatory autonomy, and strategic control over digital infrastructures. They may improve regional integration, boost economic resilience, and help close the global digital identity divide by creating interoperable digital identity ecosystems that are backed by RegTech frameworks and inclusive digital participation mechanisms.

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Научная статья

ЦИФРОВАЯ ИДЕНТИФИКАЦИЯ КАК ЭЛЕМЕНТ ЦИФРОВОЙ ОБЩЕСТВЕННОЙ ИНФРАСТРУКТУРЫ: НА ПУТИ К ЛОКАЛИЗАЦИИ ПРОИЗВОДСТВА В АФРИКЕ

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Аннотация. Хотя цифровая идентификация уже стала неотъемлемой частью цифровой общественной инфраструктуры (ЦОИ), ее структурная роль в содействии локализации промышленности и региональной экономической интеграции в Африке остается малоизученной. В данном исследовании рассматривается вопрос, как цифровая идентификация способствуют формализации и локализации производственных экосистем с акцентом на сельское хозяйство, один из наиболее экономически значимых секторов на континенте. Основной тезис исследования заключается в том, что системы цифровой идентификации представляют собой ключевую инфраструктуру, необходимую для функционирования экономических систем. Они позволяют неформальным производителям интегрироваться в формальные экономические сети, снижая транзакционные издержки и рыночные барьеры благодаря появлению цифровых рынков, целенаправленных государственных инициатив в области развития и упрощению доступа к финансовым услугам. Кроме того, в ходе анализа оценивается, как эти системы помогают устранить правовой «пробел в идентификации», о котором говорится в Цели устойчивого развития ООН № 16.9, с противопоставлением централизованной и децентрализованной архитектуры идентификации, а также их влиянием на финансовую доступность, цифровой суверенитет и промышленное развитие.

Результаты показывают, что, несмотря на наличие значительных операционных барьеров, таких как нехватка физической инфраструктуры, проблемы совместимости и риски кибербезопасности, стратегически разработанные системы цифровой идентификации могут стать мощными структурными инструментами. Они способствуют укреплению внутреннего производственного потенциала и усилению позиций Африки в региональных и глобальных цепочках создания стоимости. В конечном итоге, в статье делается вывод, что цифровую идентификацию следует рассматривать не просто как административный инструмент или механизм электронного правительства, а как важнейший драйвер для инклюзивной экономической трансформации и укрепления промышленного суверенитета.

Ключевые слова: Африка, системы цифровой идентификации, глобальные производственные цепочки, локализация промышленности, самообеспеченность, социально-экономическое развитие, цифровой суверенитет

Конфликт интересов. Автор заявляет об отсутствии конфликта интересов.

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