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Research Article

Collaborative approaches to open knowledge in Africa: A Systematic review of present realities and innovation

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Abstract

Background: Open Knowledge (OK) initiatives have the potential to democratize access to research, educational resources, and public data, thereby promoting innovation, evidence-based decision-making, and sustainable development in Africa. However, fragmented knowledge systems, unequal information access, and weak intra-African collaboration continue to limit their impact.

Purpose: This study examined how collaborative approaches to OK contribute to addressing Africa's development challenges and fostering sustainable innovation.

Methodology: A PRISMA-guided Systematic Literature Review synthesized studies published between 2014 and 2025. The reviewed literature was analysed thematically to identify collaborative approaches, implementation challenges, and strategic directions for strengthening Open Knowledge initiatives.

Results: Five interrelated themes emerged: foundational principles of OK, key actors, partnership mechanisms, implementation gaps and challenges, and strategies for strengthening practice. Multi-stakeholder partnerships involving governments, universities and research institutions, civil society organizations, and the private sector were found to enhance knowledge sharing, innovation, and equitable access to information. However, institutional fragmentation, inadequate infrastructure, and policy inconsistencies continue to hamper the scalability and sustainability of OK initiatives across Africa.

Conclusion: Collaborative, multi-actor engagement is fundamental to developing inclusive, resilient, and innovation-driven knowledge ecosystems capable of advancing Africa's sustainable development agenda.

Implications: This review provides a structured synthesis of collaborative OK practices in Africa and offers evidence-based insights for strengthening partnerships, harmonizing policy frameworks, improving digital infrastructure, and enhancing institutional coordination. The findings inform policymakers, researchers, and development partners seeking to scale OK initiatives for sustainable development and innovation across the continent.

Keywords: *Open Knowledge, Open Knowledge Networks, Collaboration, Partnerships, Innovation, Sustainable Development, Africa, Knowledge Ecosystems.*

Introduction

Open Knowledge (OK) refers to research output, educational resources, cultural heritage materials, government data, and indigenous knowledge that are freely accessible and reusable. The Open Knowledge Foundation (2015) defines OK as information that can be accessed, used, modified, and redistributed with proper attribution and shared under similar open licensing terms. Levey (2019) explains that OK integrates open access and open data to enhance the visibility, accessibility, and reuse of African research, thereby fostering inclusivity and innovation.

Open science is grounded in principles that provide a global framework for OK activities. To safeguard academic freedom and research integrity, Open Science emphasizes transparency and accountability in research processes. According to Radder, (2017) the principle of common benefit conceptualizes scientific knowledge as a public good that should be accessible and oriented toward collective welfare, rather than private gain,

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whereas equality and fairness stress equitable access, participation, and benefit across nations, disciplines, languages, and social groups. Diversity and inclusivity further require recognition of multiple knowledge systems and meaningful participation of historically marginalized communities (UNESCO, 2021).

Building on these principles, OK initiatives have transformed knowledge creation and dissemination, strengthening collaboration and inclusive innovation. When knowledge is openly shared, societies are better positioned to innovate and achieve sustainable development (Sebubi, Zlotnikova & Hlomani, 2020). In African contexts, where research visibility and information infrastructures remain uneven, OK offers significant potential. However, limited integrated analysis of stakeholder collaboration and partnership models necessitates systematic examination of principles, roles, and strategic pathways for coordinated OK networks. Guided by this gap, the study addresses the following research questions:

Research Objectives.

1. What are the key principles and features of OK in African contexts?
2. Who are the stakeholders/ actors in OK ecosystems?
3. Which case examples demonstrate successful OK partnerships in innovation, education, governance, and development?
4. How can OK partnerships be strengthened to advance sustainable development?

Foundations of Open Knowledge

To address these questions, this study is anchored in the conceptual foundations of OK, which emphasize openness, accessibility, and collaboration in the creation and dissemination of knowledge. OK perspectives position knowledge as a public good whose unrestricted flow enhances collective learning, innovation, and social development. Nogueira, Eikebrokk, and Aksetøy (2025), in Research Data: A Public Good or a Private Asset, argue that innovation, policy improvement, and capacity building are maximized when knowledge remains openly accessible.

To deepen this analysis, the study also draws on the Knowledge Commons perspective, which conceptualizes shared knowledge resources as governed through institutional arrangements, community norms, and structured participation to sustain collective use (Madison, 2024). Building on commons theory, this framework emphasizes collaborative stewardship and rule-based management of shared resources.

Together, these perspectives are complementary. OK articulates the commitment to openness and co-creation, while Knowledge Commons clarifies how shared systems are governed, coordinated, and sustained over time. In practice, OK implementation across Africa has evolved through policy reforms and multi-stakeholder initiatives, though uneven due to infrastructural and institutional constraints (Mensah, 2024; Chaminade & Padilla-Pérez, 2017). National efforts such as Kenya's Open Data Initiative (2011) links openness to transparency and public participation. On the other hand, the African Open science platforms play a critical role in strengthening research data sharing by enhancing accessibility and collaboration (Mwelwa et al., 2020). Similarly, initiatives such as African Storybook and Siyavula have expanded access to culturally relevant Open Educational Resources (Menefee, 2015). Within this context, OK, guided by principles of transparency, inclusion, cooperation, and equity (Cruz Romero, 2025; Maedche et al., 2024), fosters trust, reproducibility, and accountability in knowledge production and dissemination. Furthermore, it plays a vital role in safeguarding indigenous knowledge systems, while empowering marginalized communities to actively participate in knowledge creation and use (Chtena et al.,

2025). Collectively, these dynamics underscore OK's developmental significance in Africa. Open educational resources support equitable learning opportunities aligned with SDG 4 (Menefee, 2015), while open data enhances evidence-based policymaking and public oversight (Levey, 2019). On the other hand, open datasets stimulate innovation in education, health, and agriculture, strengthening participation in the global knowledge economy (Mwelwa et al., 2020; Smart Africa Alliance & OpenDevEd, 2024).

Actors: The key actors include governments, academia, research institutions, civil society organizations and the private sector. Governments play a central role in advancing OK by providing infrastructure, policy direction, and legal frameworks supporting transparency, data governance, and equitable access to information. Additionally, governments create an environment and legislative frameworks for open data management and regulation (Eke et al. 2022, Mutuku & Mahihu, 2014, Onyancha, 2023 and De Beer et al., 2021).

Governments are also tasked with addressing aspects such as civic education, and structural inequalities in digital access. Inequalities including limited infrastructure, low digital literacy, and uneven connectivity continue to reinforce socio-economic disparities across Africa (Talema, 2025, (Bhanye & Shayamunda, 2025, Mutua, 2018).

Academic and research institutions are critical actors who support knowledge creation and are custodians of knowledge (Romero, 2025, Menefee 2015, Ngulube, 2023). Additionally, universities are seen as knowledge promoters who must emphasize sharing, transparency and ethical use of data and information (Mwelwa et al. 2020, Chtena et al. 2025). Universities and research institutions also support OK through repositories and collaborative research, which democratizes access to knowledge (Mwalubanda, 2021).

Civil Society Organizations (CSOs) contribute significantly to inclusivity, accountability, and public participation within OK ecosystems. They bridge institutions and communities by translating research into accessible formats, promoting digital literacy, and safeguarding indigenous knowledge systems in addition to civic stewardship, institutional trust, and social legitimacy (Kagoro, 2023; Ngulube, 2023; Cindi, 2021, Ofori & Anyigba, 2024, Karuri-Sebina & Mutua, 2023).

The private sector complements these efforts through innovation, funding, and technical expertise. Private firms collaborate with governments and CSOs to co-develop open tools, share non-sensitive datasets, and provide digital training through initiatives such as GIS Data Hub and the Ajira Digital Program (KEPSA, 2025, Mwelwa et al., 2020).

Successful Partnerships: OK in Africa is advanced through partnerships involving open data platforms, innovation hubs, and regional research networks guided by FAIR (Findable, Accessible, Interoperable, Reusable) and CARE (Collective Benefit, Authority to Control, Responsibility, Ethics) principles to enhance interoperability and ethical data stewardship (Ngulube, 2023). Collaboration among government, academia and research institutions, civil society, and the private sector is essential for mobilizing resources, fostering innovation, and sustaining open infrastructures. Successful regional networks such as the African Research Universities Alliance (ARUA) and UbuntuNet Alliance promote cross-border research integration and open science in Africa (ARUA, 2022; UbuntuNet Alliance, 2023). Other platforms developed from partnerships include the Africa Archive (AfricArXiv), Kenya Libraries and Information Services Consortium (KLISC), and Electronic Information for Libraries (EIFL) (Aguolu, 2022; UNESCO, 2023). Sustaining such initiatives, however, requires alignment with frameworks such as the Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024) to ensure policy coherence

and epistemic equity (African Union, 2020; UNESCO, 2021).

Collaborative knowledge partnerships are more effective when they are resilient, collaborative, inclusive, and locally grounded. These systems need also to be transparent and address public data needs (Nkontwana, et al, 2025, Kamau, 2020, Code for Africa, 2022). This is evidenced by Ushahidi, developed after the 2007–2008 Kenyan post-election crisis, which strengthened accountability and citizen participation through crowdsourced reporting, real-time information sharing, and mapping of crisis data. By decentralizing information production, Ushahidi enabled citizens, media, and humanitarian actors to monitor events and respond more effectively to crises and governance gaps (Marsden & Oduor Lungati, 2023).

In education, Open Educational Resources (OERs) reduce learning costs and provide localized multilingual content that enhances inclusion, collaboration, broadens equitable access to quality education, demonstrates the role of OK in democratizing learning and supporting Sustainable Development Goal 4 on quality education. (UNESCO, 2021; De Beer, 2017; Menefee, 2015, Maedche et al., 2024).

Research and innovation networks further illustrate successful OK partnerships. The African Open Science Platform supports research data sharing and policy coordination across African countries (Mwelwa et al., 2020). Successful platforms enhance data supply and demand thorough partnerships with governments and firms (Boulton, et al, 2020, World Bank, 2023). Across sectors, OK bridges knowledge divides by amplifying indigenous and marginalized voices, fostering equitable access to information, and strengthening digital literacy and inclusive innovation (Cindi, 2021; Kodua Ntim & Fombad, 2024; Mwelwa et al., 2020).

Challenges: The implementation of OK initiatives in Africa faces several structural challenges, including limited political commitment, inadequate infrastructure, weak human resource capacity, and the absence of supportive regulatory frameworks. Existing academic incentive systems also discourage participation in open science, as they continue to prioritize conventional publication models over openness and collaboration (Boulton et al., 2020). Similarly, Okafor et al. (2022) argue that open science in Africa is constrained by financial limitations that weaken research capacity and knowledge dissemination. Limited investment in education and research has reduced access to modern facilities and shifted publication costs to individual researchers, who often lack grant support. This resource scarcity affects both the quality and visibility of research outputs (Arinze, 2024, Mensah, 2024). These challenges reduce the ability of stakeholders to effectively manage, analyze, and utilize open data, demonstrating that access alone is insufficient without addressing broader institutional and resource-related constraints.

According to Maedche et al. (2024), open science is further shaped by a social dilemma in which the collective benefits of knowledge sharing conflict with individual risks and costs. Researchers may hesitate to adopt open practices because of the additional workload involved, fear of losing competitive advantage, and lack of recognition within current academic reward systems.

As research becomes increasingly data-intensive and globalized, the adoption of open science has gained importance. Mwangi et al. (2021) observe that despite growing global interest, many universities, particularly in Kenya, do not adequately equip students and researchers with practical open science skills. Consequently, many scholars lack the competencies needed to effectively use open science tools and participate in collaborative and transparent research.

Another major challenge lies in the disconnect between knowledge production and its practical application. Although African universities

generate substantial scientific outputs, often through international collaborations, much of this knowledge remains inaccessible because it is confined to paywalled journals or institutional repositories (UNESCO, 2021; Mwelwa et al., 2020; Levey, 2019; Chtena et al., 2025). In many cases, research is academically driven, with limited involvement of end users, which reduces contextual relevance and societal uptake.

Policy: At the policy level, few national research and innovation frameworks explicitly integrate OK principles, resulting in fragmented implementation, duplication of efforts, weak cross-sector partnerships, and insufficient incentives for data sharing (Kodua Ntim & Fombad, 2024; Ngulube, 2023). Furthermore, the integration of African Indigenous Knowledge Systems (AIKS) into formal education remains constrained by weak policy implementation, inadequate teacher preparedness, and limited resources (Cindi, 2021). Addressing these challenges requires grounding OK initiatives in local contexts, languages, and cultural practices, while strengthening coordinated knowledge management policies (Olaopa & Ayodele, 2022; Kodua-Ntim & Fombad, 2024).

Methodology

This study employed a PRISMA-informed Systematic Literature Review (SLR) to examine how strategic partnerships and collaborations advance OK in Africa. A SLR is defined as a systematic, explicit, comprehensive, and reproducible method for identifying, evaluating, and synthesizing existing scholarly and practitioner knowledge (Azarian et al., 2023). Systematic reviews use explicit eligibility criteria and reproducible procedures to collect, appraise, and synthesize evidence relevant to a clearly defined research question (Brignardello Petersen et al., 2025). Adopting this approach enables a structured and transparent synthesis of literature on OK ecosystems, stakeholder roles, partnerships, and implementation challenges in Africa.

A thematic analysis approach was used to synthesize findings beyond descriptive summarization. This enabled the organization of complex evidence into coherent analytical themes that support interpretation and conceptual integration. Rouhani et al. (2025) note that thematic analysis strengthens systematic reviews by enabling structured synthesis of diverse qualitative and quantitative evidence.

Table 1: Systematic Literature Review Process

Systematic Literature Review (SLR) Process
Planning for literature review and problem contextualization
Key questions guiding the literature review were: 1. What are the key principles and features of OK in African contexts? 2. Who are the stakeholders in OK ecosystems? 3. Which case examples demonstrate successful OK partnerships in innovation, education, governance, and development? 4. How can OK partnerships be strengthened to advance sustainable development?
Conducting the literature review
Searching and Screening: A combination of keywords and Boolean operators was used, including: “Open Knowledge” OR “Open Science” OR “Open Data” OR “Open Educational Resources” AND Africa OR Sub-Saharan Africa OR Global South AND collaboration OR partnerships OR knowledge networks. Database: Google Scholar and science direct. Accessing and Extracting Information: Data and information on collaborative approaches to open knowledge in Africa: Relevant information generated between 2014 and 2025 was considered to understand realities and innovation in collaborative approaches to OK.
Analysis
The retrieved studies were analyzed to identify recurring themes related to structural and institutional challenges, drivers of innovation, and collaborative partnerships within OK ecosystems in Africa. These themes were subsequently synthesized to derive policy implications and strategies for promoting sustainable OK frameworks.

Literature was retrieved from academic databases including Google Scholar and

JSTOR, as well as institutional repositories such as OpenUCT, the University of Nairobi Digital Repository, and Makerere University Repository. Additional sources included organizational and policy reports from UNESCO, the African Union, African Research Universities Alliance (ARUA), the World Bank, and the Science for Africa Foundation. A combination of keywords and Boolean operators was used, including: “Open Knowledge” OR “Open Science” OR “Open Data” OR “Open Educational Resources” AND Africa OR Sub-Saharan Africa OR Global South AND collaboration OR partnerships OR knowledge networks. The search was refined iteratively to ensure relevance.

A snowballing technique was also applied to identify additional relevant studies from reference lists of selected publications. The first step was to identify key articles on collaborative approaches to open knowledge in Africa. The references used by the respective authors were identified and further subjected to the criteria presented. For example, they had to be published between 2014 and 2025 and also be context (Africa) specific. Through the snowballing approach, the paper was able to rely on other significant and important publications on the subject matter. Articles that had been quoted by other authors had definitely been through the peer review process, which made them credible and reliable.

Additionally, this study followed a structured literature review approach guided by PRISMA principles, focusing on transparency and thematic synthesis, rather than full systematic review protocol compliance. It employed a PRISMA-guided systematic literature review approach to identify, screen, and synthesize literature on strategic partnerships and collaborations in OK systems in Africa. The review followed key principles of systematic searching and thematic synthesis, although reporting was adapted to the available documentation. The screening process involved sequential stages of title screening, abstract screening, and full-text review.

Eligibility criteria included publications between 2014 and 2025, English-language sources, and studies focusing on Open Knowledge, Open Science, Open Data, Open Access, or Open Educational Resources in African contexts. Both peer-reviewed and grey literature were included if they addressed at least one of the following thematic areas: (1) foundations of OK (2) stakeholder roles in OK ecosystems, (3) partnerships and collaborations, (4) challenges in implementation, and (5) Recommendations for strengthening OK ecosystems. Excluded sources included non-English publications, inaccessible full-text studies, and works outside the defined timeframe, unless used for contextual comparison.

A total of 51 publications met the inclusion criteria and were synthesized thematically. A total of 136 articles were identified. Out of these, 110 were from databases and institutional repositories, while 26 articles were sourced from grey literature. A total of 20 articles were found to be duplicates and were not screened. At least a total of 116 articles were screened and 30 articles excluded making 86 articles eligible. A total of 35 articles were not retrieved from the 86 because e 20 articles were subscribed resources and 15 were out of the scope. A total of 51 articles were finally included in this review.

All retrieved records from databases, institutional repositories, and organizational sources were compiled into a single dataset prior to screening. Duplicate records arising from overlapping coverage across multiple databases were identified through manual comparison of titles and authors. Identified duplicates were removed before the commencement of the title screening stage to ensure that each study was considered only once in the review process.

The analysis focused on conceptual foundations, stakeholder dynamics, partnership structures, implementation challenges, and enabling strategies for inclusive OK in Africa. While limitations include language bias and uneven documentation of informal practices, the review provides a comprehensive and structured evidence base for understanding collaborative OK development in Africa.

The quality and reliability of the publications used was assured using several approaches. Firstly, the databases and search engines used such as Google Scholar and JSTOR are reliable

and widely used in academia. The qualitative literature review deployed supported the methodological rigour of the process. The steps followed to identify suitable data have been deployed elsewhere with significant success. Haning et al (2023) have demonstrated the various approaches to high quality literature reviews to meet research objectives. To ensure reliability, similar results would be obtained by other researchers if they were to conduct searches in the same databases and search engines used in this paper.

The schematic model and summary table presented in this methodology section provide a transparent and detailed overview of the methodological steps and approaches employed throughout the research process. Refer to figure 1 for the PRISMA guided flow diagram. Refer also to figure 2 for the summary of the methodology used;

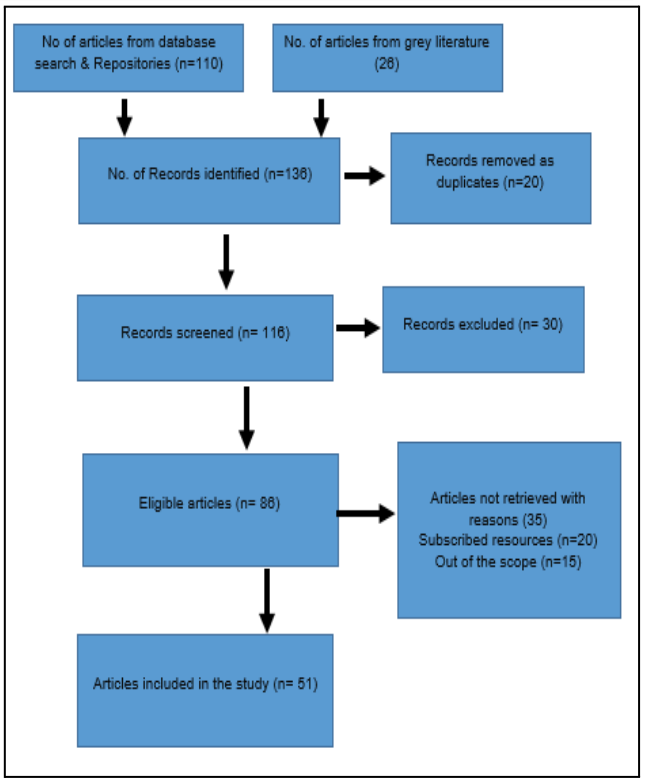


Figure 1:PRISMA guided flow diagram

Component	Details
Search strategy	Literature retrieved from Google Scholar, JSTOR, OpenUCT, University of Nairobi Digital Repository, Makerere University Repository, and reports from UNESCO, ARUA, AU, World Bank, Science for Africa Foundation. Keywords included "Open Knowledge in Africa," "Open Science," "Open Data," "Open Educational Resources," "Open Access," "collaboration," AND "knowledge networks," refined with Boolean operators. "Open Knowledge" OR "Open Science" OR "Open Data" OR "Open Educational Resources" AND Africa OR Sub-Saharan Africa OR Global South AND collaboration OR partnerships OR knowledge networks. Snowballing approach used trace references from publications.
Time frame	2015- 2025
Language	English
Inclusion criteria	Peer-reviewed and grey literature addressing at least one of four thematic areas: (1) Foundations & Principles of Open Knowledge, (2) Stakeholders in OK ecosystems and their roles, (3) Partnerships & Collaborations in OK, (4) Challenges 5. Impact of OK on Innovation & Transformation. Publications with Africa-specific geographical or thematic focus
Exclusion criteria	Non-English publications, subscription-only resources, and studies outside 2015–2025 (except when used for comparative purposes).
Analysis	Thematic analysis to categorize evidence into coherent themes for interpretability and synthesis.
Themes	1. Foundations of open knowledge, 2. Actor Roles 3. Partnership Models & Collaborations 4. Challenges in Africa's OK Ecosystem 5. Strategies for fostering inclusive and sustainable knowledge ecosystems

Figure 2: Summary of Methodology

Results and Findings

This section presents the findings of the systematic literature review covering studies published between 2014 and 2025. The analysis synthesizes the selected literature into five interrelated themes: Foundations of OK, Actors in OK ecosystems, successful partnerships,

challenges and recommendations. Together, these themes provide insights into how partnerships and multi-actor collaborations shape the development and sustainability of OK ecosystems across the continent.

1. Foundations of OK in Africa

Open Knowledge (OK) is grounded in the principles of openness, accessibility, and collaboration, positioning knowledge as a public good that enhances collective learning, innovation, and social development. The Open Knowledge Foundation (2015) defines OK as information that can be freely accessed, used, modified, and redistributed under appropriate open licensing conditions. Its foundation further integrates the Knowledge Commons perspective, which emphasizes that shared knowledge resources require governance structures, community norms, and structured participation to ensure sustainability and equitable use. OK encompasses Open Access, Open Data, Open Science, and Open Educational Resources (OER), with Indigenous Knowledge Systems (IKS) increasingly recognized as important components of sustainable and inclusive knowledge ecosystems (UNESCO, 2021). Legal frameworks, institutional arrangements, and cultural norms therefore play a critical role in shaping transparency, participation, and knowledge exchange.

Open Science principles further strengthen OK initiatives by promoting transparency, accountability, inclusivity, and equitable participation in research and knowledge production (Radder, 2017; UNESCO, 2021). According to Radder (2017), scientific knowledge should serve the common good and contribute to collective welfare rather than private interests alone. Similarly, UNESCO (2021) emphasizes equality, fairness, diversity, and inclusivity in ensuring meaningful participation across different social groups, disciplines, and knowledge traditions.

In Africa, OK implementation has evolved through policy reforms and multi-stakeholder initiatives such as Kenya's Open Data Initiative, the African Open Science Platform, and culturally relevant OER platforms, including African Storybook and Siyavula. These initiatives reduce barriers to information access, foster collaboration, and broaden equitable participation in education, research, and innovation. Levey (2019) notes that open access and open data initiatives enhance the visibility, accessibility, and reuse of African research, thereby supporting innovation and inclusivity across the continent. Early donor-supported programs such as AGORA and HINARI also contributed significantly to expanding access to scientific knowledge and building foundations for local ownership and OK development.

Guided by principles of transparency, inclusion, cooperation, and equity, OK initiatives promote trust, reproducibility, accountability, and the safeguarding of Indigenous knowledge heritage. Sebubi, Zlotnikova, and Hlomani (2020) argue that openly shared knowledge strengthens collaboration, innovation, and sustainable development outcomes. Despite uneven progress across the continent, these initiatives reflect Africa's growing commitment to inclusive, ethical, and sustainable knowledge ecosystems that strengthen participation in the global knowledge economy, while contributing to quality education, poverty reduction, and innovation.

2. Actors in Open Knowledge

The study found that the sustainability and effectiveness of OK ecosystems in Africa depend on coordinated collaboration among governments, academic institutions, civil society organizations (CSOs), and the private sector. Governments play a central role in providing policy frameworks, regulatory oversight, and digital infrastructure that support open data governance, transparency, and equitable access to information (Eke et al., 2022; Mutuku & Mahihu, 2019). Political commitment,

institutional stability, and sustained investment were also identified as key factors influencing the implementation and long-term sustainability of OK initiatives (Onyancha, 2023; De Beer et al., 2021). In addition, governments help address digital inequalities through broadband expansion, civic literacy initiatives, and interoperable public systems that promote inclusive participation in digital knowledge ecosystems (Talema, 2025; Mutua, 2018).

Academic and research institutions contribute through knowledge production, preservation, and dissemination using repositories, open access platforms, and collaborative research initiatives. Their effectiveness depends on institutional capacity, ethical governance, and the adoption of FAIR and CARE principles in knowledge management (Ngulube, 2023; Mwelwa et al., 2020). Universities also strengthen transparency and equitable access through open repositories, capacity building, and collaborative knowledge-sharing mechanisms (Menefee, 2015; Cruz Romero, 2025). Regional networks and digital platforms further support cross-border collaboration, although sustainability challenges remain.

Civil society organizations were found to enhance inclusivity, accountability, and public participation within OK ecosystems. They contribute by translating research into accessible formats, promoting digital literacy, safeguarding Indigenous Knowledge Systems, and strengthening participatory governance (Kagoro, 2023; Ngulube, 2023). Civic technology initiatives and community-based programs further demonstrate how CSOs support transparency, evidence-based decision-making, and citizen engagement (Code for Africa, 2022; Ofori & Anyigba, 2024). These findings suggest that OK ecosystems rely not only on formal institutions but also on civic stewardship and public trust (Karuri-Sebina & Mutua, 2023).

The private sector also strengthens OK ecosystems through innovation, investment, digital platforms, and technical capacity development. Public-private partnerships support the co-development of digital tools, open data systems, and technology-driven training initiatives that enhance sustainable knowledge ecosystems (KEPSA, 2024; Mwelwa et al., 2020). However, persistent digital literacy gaps among marginalized groups continue to limit the inclusiveness of these contributions (KEPSA Foundation, 2024).

Overall, the findings demonstrate that multi-stakeholder collaboration is essential for promoting inclusive participation, ethical governance, equitable knowledge sharing, and sustainable development within African Open Knowledge ecosystems.

3. Successful Partnerships and OK Collaborations

Successful OK partnerships in Africa are characterized by cross-sectoral collaboration, inclusivity, local relevance, and ethical governance. The findings show that partnerships involving governments, universities, civil society and the private sector partners are more effective in mobilizing resources and translating open knowledge principles into societal impact. The application of FAIR (Findable, Accessible, Interoperable, Reusable) and CARE (Collective Benefit, Authority to Control, Responsibility, Ethics) principles further strengthens interoperability, inclusivity, and responsible data governance within collaborative knowledge ecosystems (Ngulube, 2023). Unlike fragmented initiatives, coordinated partnerships align policy, technology, and community engagement to enhance sustainability and long-term impact.

Regional and institutional networks also play a key role in promoting cross-border research collaboration, open science, and equitable access to knowledge. Platforms such as AfricArXiv, KLISC, EIFL, ARUA, and UbuntuNet Alliance enhance institutional collaboration, linguistic inclusivity, and access to scholarly resources across Africa (Aguolu, 2022; UNESCO, 2023; ARUA, 2022; UbuntuNet

Alliance, 2023). Similarly, initiatives such as the University of Cape Town's OpenUCT Repository and Makerere University's AirQo Project demonstrate the role of universities in advancing open innovation and knowledge dissemination (Goodier, 2020; Sabiiti et al., 2021). Sustaining these efforts requires alignment with frameworks such as STISA-2024 and the UNESCO Recommendation on Open Science to promote policy coherence and epistemic equity (African Union, 2020; UNESCO, 2021).

The findings further indicate that effective partnerships are trust-based, adaptable, and locally grounded, enabling responsiveness to Africa's socio-economic priorities. These collaborations operate through institutional agreements, research consortia, public-private partnerships, and community-driven knowledge networks, where shared ownership and inclusivity are central to resilience and sustainability (Nkontwana et al., 2025). Harmonized legal and regulatory frameworks also strengthen coordination and inclusive participation within OK ecosystems (Kodua-Ntim & Fombad, 2024; Levey, 2019).

Successful collaborations additionally operationalize openness through interventions in governance, education, research, and innovation. Civic technology platforms such as Ushahidi and Code for Africa enhance transparency, citizen engagement, and evidence-based governance (Marsden & Oduor Lungati, 2023; Code for Africa, 2022). In education, OER initiatives such as Siyavula and the African Storybook Project improve equitable access to localized and multilingual learning resources, supporting inclusive education and SDG 4 (UNESCO, 2021; Menefee, 2015).

Research initiatives including the African Open Science Platform and the Kenya Open Data Initiative further demonstrate how collaborative ecosystems strengthen innovation, research coordination, and knowledge sharing across sectors (Mwelwa et al., 2020; Boulton et al., 2020).

Overall, the findings demonstrate that inclusive, coordinated, and ethically grounded partnerships are central to sustainable OK ecosystems in Africa. These collaborations strengthen governance, education, innovation, and equitable access to information, while promoting digital inclusion and positioning Africa as an active contributor to the global knowledge landscape (Cindi, 2021; Kodua Ntim & Fombad, 2024; Mwelwa et al., 2020).

4. Challenges in Africa's OK Ecosystem

The findings reveal that despite increased adoption of OK initiatives across Africa, substantial structural and operational gaps continue to limit their transformative impact. Expansion in open data platforms, open access publishing, and digital repositories has not been matched by adequate infrastructure, policy coherence, or effective implementation mechanisms (Boulton et al., 2020; Okafor et al., 2022). Limited awareness and commitment at policy and political levels, inadequate infrastructure, insufficient human resource capacity, and weak regulatory support continue to constrain the implementation and sustainability of open knowledge initiatives across sectors (Mensah, 2024; Arinze, 2024).

The uneven distribution of digital infrastructure, characterized by limited broadband access, high connectivity costs, and underdeveloped institutional systems, restricts equitable participation, particularly for marginalized communities and under-resourced institutions. As a result, the availability of open resources does not consistently translate into meaningful access, interoperability, or sustained use (Arinze, 2024; Mensah, 2024). Findings further indicate that technical, institutional, and financial limitations undermine the scalability and long-term sustainability of open data and open access initiatives across African contexts.

The study also identifies fragmentation across sectors as a persistent challenge. Many OK initiatives operate in isolation, with weak

coordination among governments, academia, civil society organizations, and the private sector. This lack of integration reduces efficiency, limits scalability, and undermines long-term sustainability (Kodua Ntim & Fombad, 2024; Ngulube, 2023). Existing academic incentive structures further discourage researchers from engaging in open science practices because conventional systems continue to prioritize traditional publication models over openness, collaboration, and data sharing (Boulton et al., 2020; Maedche et al., 2024). Researchers are therefore often reluctant to adopt open practices due to concerns relating to workload, recognition, and competitive disadvantage within existing academic systems.

Another critical gap identified is the disconnect between knowledge production and practical application. Although universities and research institutions generate substantial scholarly output, translation into policy, innovation, and community-level impact remains limited (UNESCO, 2021; Mwelwa et al., 2020). Research outputs are frequently inaccessible to policymakers, practitioners, and communities because they remain confined within paywalled journals or institutional repositories, thereby limiting societal uptake and contextual relevance (Levey, 2019; Chtena et al., 2025). Findings further suggest that knowledge creation processes remain predominantly academically driven, with limited participation of end users and local communities in shaping research priorities and utilization.

The study additionally found that inadequate training, low awareness, and insufficient digital literacy continue to hinder participation in open science and collaborative knowledge practices, particularly within higher education institutions (Mwangi et al., 2021). In many cases, formal university curricula do not adequately equip students and researchers with the competencies required to engage effectively in open, collaborative, and data-driven research environments.

At the policy level, insufficient institutionalization of OK principles results in fragmented implementation, duplication of efforts, weak incentives for data sharing, and inadequate funding mechanisms (Kodua Ntim & Fombad, 2024; Ngulube, 2023). Additionally, Indigenous Knowledge Systems remain insufficiently integrated into formal knowledge infrastructures due to weak policy implementation, limited institutional support, and inadequate resource allocation (Cindi, 2021). The findings therefore suggest that without stronger policy alignment, coordinated governance structures, inclusive infrastructure development, and locally grounded implementation strategies, OK initiatives risk remaining fragmented and symbolic, rather than achieving equitable and sustainable developmental impact (Olaopa & Ayodele, 2022; Kodua-Ntim & Fombad, 2024). A summary table linking themes and key authors is presented in figure 3.

Theme	Key Authors
Foundations of OK in Africa	Nogueira, Eikebrokk, and Aksetøy (2025), Madison (2024), Mensah (2024), Chaminade & Padilla-Pérez (2017), Mwelwa et al. (2020), Menefee (2015), Cruz Romero (2025), Maedche et al (2024), Chtena et al., (2025), Menefee (2015), Levey (2019), Mwelwa et al (2020).
Actors in Open Knowledge	Eke et al (2022), Mutuku & Mahihu (2014), Onyancha (2023), De Beer et al (2021), Talema (2025), Bhanye & Shayamunda (2025), Mutua (2018), Romero (2025), Menefee (2015), Ngulube (2023), Chtena et al (2025), Mwalubanda (2021, Kagoro (2023), Ngulube (2023), Cindi (2021) Ofori & Anyigba (2024), Karuri-Sebina & Mutua, 2023), Mwelwa et al (2020).
Successful OK Partnerships, Collaborations and Models	Ngulube (2023), ARUA (2022), UbuntuNet Alliance (2023), Aguolu (2022), UNESCO (2023), STISA (2024), African Union (2020), UNESCO (2021), Nkontwana, et al (2025), Kamau (2020), Code for Africa (2022), Marsden & Oduor (2023), UNESCO (2021), De Beer (2017), Menefee (2015), Maedche et al (2024), Mwelwa et al (2020), Boulton, et al (2020), World Bank (2023), Cindi (2021), Kodua Ntim & Fombad (2024), Mwelwa et al (2020).
Challenges in Africa's OK Ecosystem	Boulton et al (2020), Okafor et al (2022), Arinze (2024), Mensah, (2024), Maedche et al (2024), Mwangi et al. (2021), UNESCO (2021), Mwelwa et al (2020), Levey (2019), Chtena et al (2025).
Strategies and Policy Implications	Kodua Ntim & Fombad (2024), Ngulube (2023), Cindi (2021), Olaopa & Ayodele (2022), Kodua-Ntim & Fombad (2024).

Figure 3: Table of themes and related authors

Discussion

1. Open Knowledge as a Collaborative and Development-Oriented Ecosystem

The findings demonstrate that Open Knowledge

(OK) in Africa is increasingly conceptualized as a collaborative, inclusive, and development-oriented ecosystem grounded in openness, accessibility, transparency, and participation. Consistent with the Open Knowledge Foundation (2015) and UNESCO (2021), the study confirms that OK extends beyond open access publishing to include Open Science, Open Data, Open Educational Resources, and Indigenous Knowledge Systems. The integration of knowledge commons further suggests that sustainable knowledge ecosystems require governance structures, institutional coordination, and shared norms, to support equitable participation and long-term stewardship of knowledge resources.

The findings also indicate that OK initiatives contribute to broader sustainable development objectives by improving access to education, strengthening research visibility, supporting innovation, and enhancing evidence-based governance. This supports arguments by Levey (2019) and Sebubi et al. (2020) that openness strengthens collaboration, innovation, and inclusive development. However, the uneven implementation of OK initiatives across African contexts suggests that openness alone is insufficient without supportive infrastructure, policy coherence, and institutional commitment.

2. Multi-Stakeholder Collaboration as a Foundation for Sustainable OK Ecosystems

A major finding of the study is that the effectiveness and sustainability of Open Knowledge ecosystems depend on coordinated multi-stakeholder collaboration. Governments, academic institutions, civil society organizations, and the private sector each play complementary but interconnected roles in shaping knowledge production, governance, dissemination, and access.

Governments were found to act as systemic enablers through policy development, digital infrastructure investment, and regulatory oversight. This aligns with Eke et al. (2022) and Onyancha (2023), who emphasize the role of states in institutionalizing FAIR-oriented open data systems and strengthening national knowledge infrastructures. At the same time, the findings suggest that inconsistent political commitment and weak institutional coordination continue to undermine long-term sustainability.

Academic and research institutions emerged as central actors in advancing open science, repositories, and collaborative research practices. The findings reinforce arguments by Ngulube (2023) and Mwelwa et al. (2020) that universities function as intermediaries between policy aspirations and societal knowledge use. However, persistent reliance on conventional academic reward systems continues to discourage openness and data sharing.

The study further highlights the growing importance of CSOs and civic technology platforms in democratizing access to information and strengthening participatory governance. Civic actors such as Code for Africa and Ushahidi demonstrate how OK can enhance transparency, accountability, and citizen engagement beyond formal institutional systems. These findings suggest that sustainable OK ecosystems depend not only on formal governance structures but also on social legitimacy, trust, and community participation.

3. Partnerships and Networks as Drivers of Innovation and Inclusion

The findings demonstrate that successful OK partnerships in Africa are characterized by inclusivity, trust, adaptability, and local embeddedness. Regional collaborations such as ARUA, UbuntuNet Alliance, AfricArXiv, EIFL, and KLISC illustrate how institutional networks strengthen cross-border research integration, open science, and equitable access to knowledge resources.

The study further reveals that collaborative ecosystems are most effective when they combine technical infrastructure with local responsiveness and ethical governance. This supports Nkontwana et al. (2025), who argue that resilient ecosystems depend on collaborative and locally grounded approaches. Similarly, initiatives such as Siyavula, African Storybook, and the African Open Science Platform demonstrate how openness can support multilingual education, innovation, and inclusive knowledge production.

Importantly, the findings suggest that successful partnerships are not solely technological arrangements but socio-institutional systems shaped by trust, shared ownership, and coordinated governance. This reflects broader debates within the knowledge commons theory, which emphasize that shared knowledge resources require collective stewardship and negotiated governance mechanisms to remain sustainable.

4. Persistent Structural and Institutional Challenges

Despite growing momentum, the study identifies significant structural, institutional, and socio-technical barriers that continue to constrain the transformative potential of OK in Africa. Limited infrastructure, inadequate funding, weak policy implementation, and fragmented governance structures continue to hinder equitable participation and sustainability.

The findings particularly reveal a persistent disconnect between knowledge production and practical application. Although African universities generate substantial research output, much of this knowledge remains inaccessible to policymakers, practitioners, and local communities due to paywalls, weak dissemination systems, and limited public engagement. This reinforces concerns raised by UNESCO (2021) and Levey (2019) regarding the limited societal uptake of African scholarship.

The study also reveals that digital inequality remains a major challenge. Limited broadband access, low digital literacy, and uneven institutional capacity disproportionately affect marginalized communities and under-resourced institutions. Consequently, the expansion of open platforms does not automatically translate into meaningful inclusion or equitable participation.

Another significant challenge relates to the insufficient integration of Indigenous Knowledge Systems within formal OK frameworks. Although inclusivity is widely emphasized within open

science discourse, practical implementation remains constrained by weak policy execution, limited institutional support, and inadequate ethical safeguards. This suggests that achieving epistemic equity requires moving beyond symbolic inclusion toward genuinely participatory and culturally responsive knowledge governance systems.

5. Implications for Policy and Sustainable Knowledge Governance

This study contributes to the growing discourse on OK in Africa. From a theoretical perspective, it advances the understanding of OK as a socio-political and developmental construct, demonstrating that it extends beyond information-sharing systems to encompass broader issues of governance, equity, innovation, education, and social justice. The findings reinforce the view that knowledge openness is not merely a technical endeavor but a transformative process shaped by political, institutional, and socio-cultural contexts.

This study also makes an empirical contribution by synthesizing fragmented literature on OK ecosystems across Africa. It provides an integrated understanding of how policy environments, institutional capacities, technological infrastructures, and collaborative networks interact to influence knowledge creation, sharing, and utilization. This synthesis highlights the interconnected nature of factors that may facilitate or constrain the development of inclusive and sustainable OK ecosystems on the continent.

Also, realizing the transformative potential of OK in Africa requires coordinated, multi-sectoral strategies that address policy fragmentation, structural inequalities, and institutional weaknesses. Sustainable OK ecosystems depend on the alignment of open data, ICT, research, and higher education policies within coherent governance frameworks that promote collaboration across governments, universities, civil society organizations, and the private sector.

The study further underscores the importance of grounding OK initiatives within local socio-cultural realities, while strengthening regional and continental collaboration. Strategic frameworks such as STISA-2024 and the UNESCO Recommendation on Open Science provide valuable policy direction for advancing inclusive and collaborative knowledge ecosystems. However, their effectiveness depends on contextual implementation, institutional ownership, and sustained investment in digital infrastructure, capacity building, and digital inclusion initiatives.

6. Strategies and Policy Recommendations

Building sustainable OOK ecosystems in Africa requires coordinated and context-responsive strategies that strengthen governance, digital inclusion, institutional capacity, and multi-stakeholder collaboration. The following recommendations are directed toward governments and policymakers, academic and research institutions, civil society organizations, and the private sector, to support inclusive, ethical, and sustainable OK systems.

(i) Governments and Policymakers

Governments play a central enabling role and should: i. Institutionalize OK within national development, research, and innovation frameworks to ensure policy coherence and sustained budgetary allocation. ii. Invest in digital infrastructure, interoperable data systems, and inclusive broadband expansion to reduce structural inequalities. iii. Establish blended financing models that reduce donor dependency and support long-term infrastructure sustainability. iv. Embed citizen participation in policy co-design to enhance legitimacy and contextual responsiveness. v. Strengthen legal and regulatory frameworks to safeguard data sovereignty, cybersecurity, and Indigenous Knowledge rights, while promoting

openness. vi. Develop national monitoring and evaluation frameworks to assess the social and economic impact of OK initiatives.

(ii) Academic and Research Institutions

As knowledge producers and custodians, institutions should: i. Integrate open practices across teaching, research, and administration through repositories, open educational resources, and collaborative platforms. ii. Reform promotion and tenure systems to reward open publishing, data sharing, interdisciplinary work, and community engagement. iii. Embed open science, research ethics, licensing literacy, and data stewardship in curricula and professional training. iv. Align repositories and metadata standards with interoperable regional and global frameworks. v. Promote participatory research models that engage communities and end users in knowledge co-creation.

(iii) Civil Society Organizations

Civil society actors should: i. Bridge institutions and communities by translating research into accessible, multilingual, and culturally relevant formats. ii. Advocate for transparency, accountability, and equitable access to public information. iii. Empower communities to generate, manage, and protect their own knowledge systems, particularly Indigenous Knowledge. iv. Monitor institutional adherence to openness, equity, and ethical data principles. v. Promote data literacy and civic education to strengthen inclusive participation.

(iv) Private Sector

The private sector should: i. Co-invest in sustainable digital infrastructure and open innovation ecosystems. ii. Develop affordable, context-sensitive technologies that enhance accessibility and participation. iii. Collaborate with governments and universities to co-create open tools, data platforms, and skills development programs. iv. Support youth and gender-inclusive digital entrepreneurship initiatives. v. Contribute technical expertise in cybersecurity, interoperability, and scalable innovation systems.

Conclusion

Collaboration is the key strategy for improving information access, innovation, and sustainable knowledge sharing across the continent, rather than competition. Advancing OK in Africa requires the government, academia, industry and civil society to contribute to embedding openness, inclusivity, and sustainable knowledge ecosystems. Robust OK partnerships depend on coherent national and regional policies, inclusive governance, and sustained investment in digital infrastructure. Governments should therefore create enabling policies; academia should produce and disseminate high-quality knowledge; civil society to safeguard equity and accountability; and the private sector should drive innovation and scalability. Additionally, countries should allocate budgetary resources annually to improve infrastructure, including relevant ICT infrastructure that promote data and information generation, sharing and application.

The role of the African Union is critical in this regard, where the harmonization of national policies towards OK and associated elements is critical to developing standards aimed at sustainability and impact to citizens.

Regional bodies such as the African Union, ARUA, and among others, can further promote peer-learning platforms for sharing best practices in youth engagement, open governance, and data ethics. Such collaboration will foster continental policy alignment and accelerate progress toward shared development goals. Therefore, this study affirms other author's views that trace the importance of awareness creation and targeted training initiatives to broader sustainable development objectives by improving access to education, strengthening research visibility, supporting innovation, and enhancing evidence-based governance.

Directions for Future Research

Future studies should assess the impact of OK partnerships on innovation, governance, and learning outcomes across Africa. Further research should also explore how emerging technologies can reshape Africa's Open Knowledge future.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

AI Use Declaration

Artificial intelligence (AI) tools such as QuillBot, ChatGPT, and Microsoft Copilot were used for language refinement, grammatical correction, editing, and formatting. The authors take full responsibility for the originality, accuracy, and integrity of this work, and all AI-assisted outputs were reviewed and validated prior to submission.

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