

Identifying Impact Areas for Digital Solutions in Scaling Circular Economy SME Clusters in Africa

“DICE AFRICA PROJECT”

Nigeria | Ghana | Senegal | Cote d'Ivoire

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1.Executive Summary

The Digital Innovations for Circular Economy in Africa (DICE Africa) Project is a 30-month multi-country research initiative funded by the International Development Research Center (IDRC) and implemented by the Nigeria Climate Innovation Center (NCIC) in partnership with regional experts in Nigeria, Ghana, Senegal, and Côte d'Ivoire. The project is designed to identify, document, and promote the integration of digital solutions that can enable circular economy small and medium enterprises (SMEs) in Africa to scale, enhance competitiveness, and access climate finance. Ultimately, DICE Africa aims to strengthen sustainable economic development, accelerate inclusive growth, and support the transition to greener and more resilient economies across the continent.

To lay a strong foundation for the research, an inception report has been completed, which outlines the research framework, thematic priorities, and initial findings. The inception process adopted a rigorous, mixed-methods approach that combined both desktop reviews and primary data collection. A thorough review of secondary data was conducted to capture existing knowledge on circular economy practices, SME clusters, and digital innovation landscapes across the four countries. Building on this, a validated questionnaire was designed and deployed to SMEs, regulators, industry associations, and digital innovators to gather primary insights on digital adoption, barriers, and opportunities for scaling circular practices.

In addition, focus group discussions (FGDs) and key informant interviews (KIs) were held with a broad range of stakeholders across the circular value chain. These included regulators and policymakers, private sector players, academia, financial institutions, and technology developers, ensuring that the research captured diverse perspectives from both the supply and demand sides of the circular economy. This participatory process not only enriched the data collected but also created a strong foundation for stakeholder buy-in and future project implementation.

A key highlight of the inception phase was the integration of a gender lens throughout the research process. Gender-disaggregated data was collected to understand the unique challenges and opportunities for women-led SMEs in adopting digital tools and scaling circular models. Women entrepreneurs were actively engaged during the FGDs and interviews, helping to shape inclusive recommendations that will guide subsequent phases of the project.

Progress so far has demonstrated the significant potential of digital solutions to transform circular economy clusters, while also surfacing key constraints such as limited digital literacy, infrastructural gaps, financing barriers, and policy inconsistencies across the countries. These insights set the stage for the next phases of the project, including solution co-design, pilot testing, and scaling strategies.

Through its leadership role, NCIC has coordinated regional teams, facilitated stakeholder engagement, and aligned research efforts with IDRC's strategic priorities on digital innovation, climate resilience, and gender inclusivity. The project has also begun to establish the foundations for partnerships with financial institutions, policymakers, and innovation hubs, creating pathways for greater adoption of circular models across Africa.

The forthcoming official launch of the inception report on 9th October 2025 will provide an opportunity to disseminate these early findings, strengthen stakeholder collaboration, and set the tone for the next stage of implementation. This milestone underscores the project's importance as a regional platform for knowledge generation, digital innovation, and inclusive economic transformation in Africa's circular economy landscape.

2. The Research Problem

Africa's development is at a crossroads, facing mounting pressures of climate change, resource scarcity, and waste mismanagement. The continent generates over 125 million tons of municipal solid waste annually, a figure projected to more than double by 2025 due to rapid urbanization and population growth (UNEP, 2018). However, more than 85% of this waste is mismanaged, leading to environmental degradation, public health risks, and the loss of valuable resources that could otherwise be reintegrated into the economy (World Bank, 2018). In this context, the transition from a linear “take-make-dispose” model to a circular economy (CE) where resources are reused, recycled, and kept in productive use for as long as possible presents Africa with an opportunity to generate new forms of sustainable industrialization, reduce emissions, and create millions of green jobs.

SMEs, which account for 80–90% of businesses and up to 70% of jobs in Sub-Saharan Africa (AfDB, 2020), are central to driving this transition. Yet, they remain constrained by systemic barriers that limit their growth and circular impact. Key challenges include inadequate access to finance. Africa's SMEs face a financing gap of over \$330 billion annually (IFC, 2017), fragmented policy frameworks, weak market linkages, and low integration into formal value chains. These challenges not only hinder innovation but also perpetuate inefficiencies in waste recovery, recycling, and resource optimization.

Globally, digital innovation has emerged as a critical enabler of the circular economy, facilitating improved traceability, waste collection efficiency, and access to secondary material markets. For example, IoT devices support smart waste management systems, blockchain enhances supply chain transparency, and digital platforms create new marketplaces for recycled materials. However, in Africa, the adoption of such digital solutions remains weak and uneven. While mobile penetration exceeds 80% in many countries, advanced technologies like AI-driven waste sorting, blockchain traceability, and circular e-marketplaces are still nascent (GSMA, 2021). This digital divide fuelled by poor digital infrastructure, low digital literacy, and affordability gaps limits the ability of SMEs to leverage innovation for scaling their circular models.

The gender dimension of this challenge is even more pressing. Women constitute up to 70% of workers in the informal waste sector in Sub-Saharan Africa (ILO, 2019), yet they remain significantly excluded from digital opportunities. Limited ownership of digital devices, restricted access to finance, and gender biases in technology design widen the digital gender gap. Furthermore, women-led SMEs face a financing gap of \$42 billion across Africa (AfDB, 2015), which restricts their ability to adopt circular innovations or benefit from digital tools. This exclusion not only reduces inclusivity but also weakens the overall effectiveness of circular transitions by sidelining a key demographic.

Against this backdrop, there is a critical evidence gap regarding how digital solutions can systematically strengthen SME clusters in Africa's circular economy. While pilot initiatives exist, there is limited comparative analysis across multiple countries on:

- Which digital tools are most effective in addressing sector-specific challenges,
- How enabling environments can support adoption,
- What financing structures can catalyse uptake, and
- How gender-inclusive approaches can maximize social and economic benefits.

The DICE Africa Project seeks to fill this gap by generating rigorous evidence across four countries including Nigeria, Ghana, Senegal, and Côte d'Ivoire through stakeholder engagement, surveys, and targeted research. By providing actionable insights, the project will inform policy frameworks, funding strategies, and innovation ecosystems, ultimately positioning circular SMEs to scale through digitalization and contribute to sustainable, inclusive growth.

3. Objectives

The Digital Innovations for Circular Economy in Africa (DICE Africa) project is guided by a central objective: to promote sustainable economic development and inclusive growth in circular economy SME clusters across Nigeria, Ghana, Senegal, and Côte d'Ivoire by leveraging digital innovations that enhance scalability, competitiveness, and access to climate finance. This overarching aim is supported by specific objectives and corresponding milestones that track progress toward implementation, as outlined in the grant agreement.

3.1 General Objective

To generate evidence-based insights on the role of digital solutions in scaling circular economy SME clusters in Africa, while fostering inclusivity and laying a foundation for policy and ecosystem strengthening.

Progress:

Significant progress has been made toward the general objective. A comprehensive inception report has been developed through a rigorous process combining desktop reviews, questionnaire deployment, focus group discussions, and key informant interviews across all four project countries. The inception report provides baseline insights on the digital and circular economy landscape, stakeholder mapping, and gaps for further exploration. The official launch of this report is scheduled for 9th October 2025, which will serve as a critical milestone for stakeholder engagement and visibility.

3.2 Specific Objectives and Milestones

Objective 1:

Establish a robust research framework and methodology for studying digital solutions in circular economy SME clusters.

- **Milestone 1.1:** Formation of a multi-country research team.

Progress: A coordinated research team has been established, led by NCIC in collaboration with Enterprise Development Center (EDC) of the Lagos Business School, alongside country-based consultants. Roles and responsibilities have been clearly defined to ensure harmonized implementation across the four countries.

- **Milestone 1.2:** Development of research instruments.

Progress: Validated questionnaires, FGD guides, and KII protocols were developed and standardized across project countries. This has ensured consistency in data gathering while allowing for contextual adaptation.

Objective 2:

Collect and analyse primary and secondary data on digital innovations within circular economy SME clusters.

- **Milestone 2.1:** Conduct desktop reviews and secondary data collection.

Progress: Desktop reviews were carried out to consolidate existing knowledge on circular economy clusters, digital adoption, and gender inclusion within the four project countries. These reviews form a key section of the inception report.

- **Milestone 2.2:** Facilitate focus group discussions (FGDs) and key informant interviews (KIIs).

Progress: FGDs and KIIs were successfully conducted with diverse stakeholders including regulators, academia, private sector players, financial institutions, and women entrepreneurs across the value chain. These sessions provided rich qualitative data that complement the survey results

Objective 3:

Promote inclusivity and integrate gender analysis into the research framework.

- **Milestone 3.1:** Collection of gender-disaggregated data.

Progress: Data collection instruments were designed to capture gender-disaggregated insights. Women-led SMEs and women workers in the circular economy were deliberately included in FGDs and KIIs, ensuring that the gender lens is embedded from inception.

Objective 4:

Disseminate findings and engage stakeholders in project countries to build awareness and ownership.

- **Milestone 4.1:** Preparation and launch of the inception report.

Progress: The inception report has been finalized and is undergoing graphic design for improved presentation. The official launch is scheduled for 9th October 2025 and will serve as a platform for disseminating findings, mobilizing stakeholder support, and positioning the project for subsequent phases. Invitations have been extended to key stakeholders, including policymakers, regulators, academia, and innovation ecosystem actors.

3.3 Summary of Progress Toward Objectives

To date, the project has successfully achieved early-stage milestones, including the formation of a research team, development of research tools, execution of field-level engagements, and preparation of the inception report. These achievements demonstrate strong alignment with the grant agreement and lay a solid foundation for subsequent phases of the project.

4. Methodology

The Digital Innovations for Circular Economy in Africa (DICE Africa) project employs a mixed-methods approach designed to generate comprehensive insights into the role of digital solutions in scaling circular economy SME clusters across Nigeria, Ghana, Senegal, and Côte d'Ivoire. This approach integrates quantitative and qualitative research methods to ensure depth, inclusivity, and rigor in addressing the project's research problem.

Research Design and Instruments

The research was structured in two stages: secondary data collection and primary field-level engagements.

1. Desktop Reviews and Secondary Data Gathering:

A comprehensive desk review was conducted across all four project countries to map the current state of the circular economy, existing digital innovation ecosystems, gender participation, and financing structures. This stage provided a contextual baseline and informed the development of research instruments.

2. Survey Questionnaires:

A standardized and validated questionnaire was designed and deployed across the four countries. The tool captured quantitative data on SME digital adoption levels, types of circular practices employed, perceived barriers to scaling, and access to finance. The survey included gender-disaggregated questions to better understand how women entrepreneurs are engaging with digital and circular economy solutions.

3. Focus Group Discussions (FGDs):

FGDs were conducted with SME cluster representatives, digital innovators, policymakers, and civil society actors. These sessions facilitated participatory dialogue on opportunities, challenges, and country-specific nuances influencing digital adoption in circular practices.

4. Key Informant Interviews (KIs):

In-depth interviews were conducted with regulators, financial institutions, academia, private sector leaders, and development partners. These interviews offered strategic insights on policy frameworks, financing gaps, digital infrastructure, and ecosystem linkages that support or constrain SME growth in the circular economy.

5. Interview and Discussion Guides:

Structured guides were developed for both FGDs and KIs to ensure consistency across countries while allowing for contextual adaptations. This enabled the research team to gather comparable data while also capturing unique national dynamics.

4.1 Analytical Techniques

The data collected was analysed using a combination of descriptive statistics for survey responses and thematic analysis for qualitative inputs. The quantitative analysis focused on identifying patterns of digital adoption, barriers, and opportunities across SMEs. Qualitative data from FGDs and KIs were tailored into thematic areas such as regulatory frameworks, financing challenges, gender dynamics, and technological gaps. Triangulation was employed

to cross-validate findings from different sources, thereby strengthening the reliability of the results.

4.2 Methodological Challenges and Adaptations

Several challenges arose during the reporting period:

- **Stakeholder Availability:** In some cases, scheduling KIIs with senior policymakers and financial institutions required repeated follow-ups, leading to minor delays in data collection. This was mitigated through extended timelines and leveraging country coordinators' networks.
- **Data Quality and Consistency:** Given the multi-country nature of the project, ensuring data uniformity was a challenge. This was addressed by conducting joint training sessions with country consultants to harmonize data collection protocols.
- **Digital Literacy Gaps:** Some SME respondents demonstrated limited understanding of digital concepts, which required the research team to simplify language and provide examples during FGDs and surveys.

Learning and Adjustments

The inception phase has yielded key learnings that inform subsequent phases of the project:

- **Merits of Mixed Methods:** The combination of surveys, FGDs, and KIIs enriched the research by capturing both breadth and depth. Quantitative data provided measurable insights, while qualitative methods uncovered contextual nuances critical for designing practical digital solutions.
- **Value of Gender-Disaggregated Data:** Collecting gender-specific data has proven essential in understanding women's unique challenges and opportunities in adopting digital tools, reinforcing the importance of maintaining a gender lens throughout the project.
- **Iterative Tool Development:** Field experiences highlighted the need to simplify certain survey questions, especially around technical digital concepts. This learning will guide refinements in future instruments to enhance clarity and inclusivity.
- **Regional Coordination:** The joint work between NCIC, EDC, and country-based consultants demonstrated the importance of strong coordination mechanisms in ensuring comparability across diverse national contexts.

4.3 Orientation Changes

While the overall research framework has remained aligned with the project design, minor adjustments were made to enhance inclusivity and data quality. Specifically, research tools were refined to:

- Increase accessibility for SMEs with low digital literacy.
- Expand the scope of KIIs to include more women-led SME representatives.
- Incorporate additional questions on policy readiness and financing mechanisms to strengthen policy-relevant outcomes.

These methodological refinements have improved the robustness of the data collected and provided early insights into how digital solutions can be tailored to the diverse realities of SME clusters in the four target countries.

5. Progress Towards Thematic Priorities

Progress during this reporting period demonstrates that DICE Africa is well positioned to contribute to IDRC's Strategy 2030 priorities of driving resilient economies, inclusive innovation, and gender equity. While direct outcomes in governance and policy change are still forthcoming, the inception phase has created the necessary evidence base, partnerships, and stakeholder momentum that will enable the project to drive meaningful contributions to IDRC's strategic agenda in subsequent reporting periods.

In addition, putting this into perspective, the following matrix shows clearly the alignment of DICE Africa and IDRC's Strategy 2030 priorities:

IDRC Strategy 2030 Priority	Project Contribution	Evidence So far	Next Steps
Climate-Resilient and Sustainable Economies	Promotes circular economy SME clusters to reduce waste, enhance resource efficiency, and support low-carbon development.	Inception report identifies gaps/opportunities for digital tools (e.g., waste tracking platforms, resource marketplaces, digital finance tools).	Co-design and pilot test digital solutions in selected clusters; develop metrics to measure climate resilience outcomes.
Inclusive Growth and Gender Equality	Embeds gender lens across research to address inequalities in digital adoption among women-led SMEs.	Gender-disaggregated data collected via surveys, FGDs, and KIIs. Women entrepreneurs actively engaged in research design and validation.	Tailor capacity-building interventions for women-led SMEs; integrate gender-specific indicators into M&E framework.
Science, Technology, and Innovation for Development	Leverages digital solutions and innovation ecosystems to scale SMEs in circular economy sectors.	Mapping of digital innovators and tech-based tools across four project countries included in inception findings.	Identify promising digital prototypes and work with SMEs/tech partners to co-create scalable solutions.
Policy and Governance Influence	Engages policymakers and regulators to understand enabling environments for digital circular economy growth.	Initial KIIs and FGDs with regulators highlight policy gaps in waste management, SME support, and digital infrastructure.	Disseminate inception report (9th Oct 2025) to policymakers; begin drafting evidence-based policy briefs.

6. Project Implementation and Management

6.1 Activities Implemented and Timelines

During the reporting period, the project achieved several foundational milestones:

- **Inception Report Development:** A comprehensive inception study was completed across the four project countries (Nigeria, Ghana, Senegal, and Côte d'Ivoire). This combined desk research, stakeholder mapping, validated survey deployment, focus group discussions (FGDs), and key informant interviews (KIIs). The draft inception report is currently undergoing graphic enhancement and will be officially launched at a stakeholder event on 9th October 2025.
- **Research Instruments:** Questionnaires, interview guides, and FGD protocols were developed, validated, and applied across the four countries, ensuring methodological consistency and comparability.
- **Stakeholder Engagement:** Regional consultants were recruited and oriented. A two-day retreat with these consultants and the Enterprise Development Center (EDC) research team has been scheduled for 7–8 October 2025 in Lagos to harmonize objectives and strengthen shared understanding.
- **Project Launch Preparation:** Planning is ongoing for the stakeholder engagement and inception report launch event on 9th October 2025, where NCIC will formally present findings and engage policymakers, private sector leaders, academia, and development partners.

6.2 Budget Summary

A full financial report is provided separately. In brief, expenditures during the period were primarily allocated to:

- Consultant recruitment and professional fees
- Research implementation costs (data collection, FGDs, KIIs)
- Logistics and travel support across the four countries
- Communication and report design preparation

Some minor financial variances occurred due to higher-than-anticipated costs for cross-country coordination and translation of research instruments into French for Senegal and Côte d'Ivoire. These variances were managed through reallocation within the approved budget lines. A forecast of expenditures for the next reporting period anticipates increased costs for the project launch event, consultant workshops, and the initiation of digital solution design and testing.

6.3 Risk Management

Risks identified in the proposal, particularly around logistical challenges and cross-country coordination, remain relevant. However, early engagement of local consultants and digital collaboration tools have mitigated delays. A new emerging risk relates to fluctuating currency exchange rates, which could impact consultant fees and event costs; NCIC is proactively monitoring this and maintaining buffer allocations where feasible.

6.4 Research Partnerships

The project has already strengthened South–South collaboration between Nigeria, Ghana, Senegal, and Côte d’Ivoire, facilitated by NCIC and EDC. In-country consultants have been instrumental in tailoring tools to local contexts. Partnerships with academia, industry, and regulators have also been initiated, laying the groundwork for co-creation of digital solutions with SMEs and policymakers.

6.5 Research Ethics and Data Management

The project involves the collection of personal and corporate information from SME operators, regulators, and innovators. To safeguard participants:

- Informed consent forms were administered before all FGDs and KIIs.
- Data confidentiality is maintained through anonymization and secure storage on password-protected servers.
- Respondents were informed of their right to withdraw participation at any stage.

A Data Management Plan (DMP) has been developed in line with IDRC’s open science policies. The project intends to publish anonymized datasets that capture SME characteristics, digital adoption levels, and ecosystem insights.

- **Data repository name:** IDRC-supported institutional repository (in discussion with EDC/NCIC host systems)
- **Repository address:** To be confirmed by Q1 2026
- **Estimated publication date:** December 2026 (after validation and cleaning of full dataset)

6.6 Key Priorities for Next Reporting Period

- Launch and dissemination of the Inception Report (October 2025).
- Capacity-building retreat for regional consultants and research alignment workshops.
- Co-creation workshops with SMEs, digital innovators, and regulators to identify solution prototypes.
- Development of policy briefs based on inception findings to feed into stakeholder dialogues.
- Continued monitoring of budget utilization, particularly around cross-country activities.

7. Gender Equality and Inclusion

The DICE Africa project has been deliberate in positioning gender equality and inclusion as a cross-cutting principle rather than a separate add-on. From the outset, the research recognized that women and other marginalized groups play critical roles in Africa’s circular economy, yet their participation is often undervalued, invisible, or limited to low-income activities within informal waste management chains. By integrating a gender lens into both research design and implementation, the project has sought to go beyond documenting

participation gaps to also interrogate structural barriers such as restrictive social norms, unequal access to finance, and disparities in digital literacy.

During the inception phase, for example, focus group discussions in Senegal and Nigeria revealed that women waste pickers and recyclers often operate informally, receiving little recognition or compensation compared to male counterparts engaged in more formalized activities. These insights underscore the need to rethink how digital tools can not only improve efficiency in circular value chains but also shift the power dynamics that systematically disadvantage women.

Similarly, consultations in Ghana and Côte d'Ivoire highlighted the resilience and innovation of women-led cooperatives, many of which are actively exploring mobile-based solutions to improve waste aggregation and access to market linkages.

Gender has also been deliberately considered throughout the research cycle. The survey instruments and interview guides were designed to capture gender-disaggregated data, while female consultants and facilitators were recruited as part of the research teams to ensure balance in both analysis and interpretation.

Partnerships with women-led grassroots organizations provided valuable context for understanding how gender inequalities intersect with geography, class, education, and other identities, resulting in layered vulnerabilities that shape women's participation in the circular economy. For instance, women entrepreneurs in urban hubs such as Lagos demonstrated relatively higher digital literacy, while women in peri-urban areas of Senegal expressed exclusion due to limited access to mobile devices and weaker digital infrastructure.

This deliberate focus is already showing a shift from a gender-sensitive posture where differences are merely recognized to a more gender-responsive approach that actively seeks to address barriers and propose solutions. Women entrepreneurs interviewed across the four countries have begun to articulate digital priorities, including mobile applications for waste trading, simplified financing tools tailored to micro-enterprises, and digital training platforms to enhance their skills. Equally important, the project has created spaces for women researchers to take visible leadership roles in data collection and analysis, thereby contributing to local gender-responsive research capacity.

Looking forward, the project intends to sustain this momentum by ensuring that women's voices remain central to the co-design of digital solutions and by developing evidence-based policy briefs with a gender lens. These efforts will not only strengthen the inclusivity of circular economy clusters but also provide pathways toward what can be described as gender-transformative outcomes, where digital innovation becomes a tool to challenge structural inequalities rather than reinforce them.

8. Challenges Encountered and Actions Taken

Like most multi-country, multi-stakeholder initiatives, the DICE Africa project has faced several challenges in its early stages. One of the first was related to the complexity of coordinating across four different national contexts in Nigeria, Ghana, Senegal, and Côte d'Ivoire, each with its own regulatory frameworks, digital infrastructure, and socio-economic realities. Aligning research instruments to ensure methodological consistency while remaining sensitive to local nuances required more time than initially anticipated. This led to minor delays in the roll-out of surveys and focus group discussions. To address this, NCIC and the Enterprise Development Center (EDC) facilitated joint calibration sessions with the country research consultants, ensuring harmonized tools without losing contextual relevance.

Administrative hurdles also surfaced during the contracting phase with local consultants. Different national legal and institutional requirements for research approvals and partnership agreements slowed the initial onboarding process. In response, NCIC established a centralized administrative support unit within the project team to streamline contract management and documentation, which helped reduce bottlenecks in subsequent processes.

Logistical and technical challenges also became apparent. For example, in Senegal and Côte d'Ivoire, intermittent internet connectivity disrupted some virtual consultations and delayed the submission of digital survey data. The project team responded by adopting hybrid data collection methods, combining online questionnaires with in-person enumerator support to ensure coverage and reliability. This flexibility not only mitigated delays but also enriched the dataset by capturing insights from stakeholders who may have been excluded through purely digital channels.

From a human resources perspective, the project experienced high demand on the time of senior researchers at both NCIC and EDC, given overlapping responsibilities across other ongoing programs. This created risks of overextension and delays in quality assurance of early drafts. To counter this, NCIC restructured internal roles by delegating routine administrative tasks to junior staff, thereby freeing senior researchers to focus on core technical oversight and analysis.

Another key challenge related to stakeholder engagement. In some countries, initial participation from regulatory bodies and financial institutions was limited, as they were cautious about committing time to an emerging project. To overcome this, NCIC and local coordinators engaged in targeted follow-up meetings, clearly articulating the potential policy and financial implications of the research for each stakeholder group. This has since resulted in stronger buy-in, with regulators in Nigeria and Ghana offering to provide additional data access and policy insights to strengthen the research outputs.

While none of these challenges have derailed project implementation, they have underscored the importance of adaptive management. The project has taken lessons from these early obstacles to refine its risk mitigation strategy, strengthen coordination, and ensure that milestones remain on track. At present, no issues require direct intervention from IDRC, but the project team remains vigilant and committed to escalating matters promptly should external support become necessary.

Looking forward, the project team intends to build greater flexibility into implementation schedules by embedding contingency time around key milestones, particularly for cross-country data collection. The upcoming retreat with regional consultants will also serve as an opportunity to consolidate lessons from the inception phase, enhance peer learning, and preemptively address coordination gaps. Additionally, NCIC is developing a structured

stakeholder engagement plan for the next reporting period to sustain and deepen buy-in from policymakers and financial actors. These measures will help ensure smoother progress and more resilient delivery of outcomes in subsequent phases.

9. Project Outputs and Dissemination

During this reporting period, the DICE Africa project has made steady progress in generating outputs that contribute to both knowledge creation and practical policy insights on the role of digital solutions in strengthening circular economy SME clusters across Nigeria, Ghana, Senegal, and Côte d'Ivoire. The most notable achievement has been the completion of the Inception Report, which consolidates the research framework, thematic focus areas, and methodological approach. This report, validated through consultative meetings with partners and stakeholders, has served as the foundational document guiding subsequent phases of data collection and analysis. The official launch of the inception report, scheduled for October 2025, will also serve as a key dissemination milestone to engage a broader audience of policymakers, development partners, and private sector actors.

In terms of academic and technical outputs, draft instruments including survey questionnaires, interview guides, and focus group protocols have been developed and piloted. These instruments not only serve as tools for data gathering but also constitute substantive contributions, as they reflect a novel integration of digitalization metrics with circular economy performance indicators. Several partners have expressed interest in adapting these tools for their own sectoral research, highlighting their potential spillover impact.

On dissemination, project updates and early insights have been shared through NCIC's digital platforms (website and social media channels). A summary brief of the inception report will be circulated in both English and French to ensure accessibility and inclusivity across the four project countries. Plans are underway to submit at least two working papers to peer-reviewed journals by early 2026, focusing respectively on:

- the digital readiness of circular SMEs and
- gender-differentiated opportunities in digital adoption.

These manuscripts are currently in preparation.

From a scientific perspective, the project is already contributing to filling a significant gap in evidence around the intersection of digital transformation, circular economy, and SME competitiveness in Africa. Preliminary qualitative findings suggest that while SMEs recognize the potential of digital tools for waste reduction and efficiency, barriers such as cost of adoption, inadequate skills, and policy fragmentation persist.

Looking forward, additional outputs are planned, including:

- A technical bulletin summarizing interim data analysis (by Q2 2026).
- A policy brief series tailored for government agencies and development partners in each country.
- A regional dissemination workshop bringing together policymakers, SMEs, and digital innovators to validate findings and co-create actionable recommendations.

Through these outputs and dissemination efforts, the DICE Africa project is laying the groundwork not only for academic knowledge production but also for shaping policy discourse and accelerating SME innovation in the circular economy.

10. Project Outcomes

The DICE Africa project is still in its early stages, several tangible and emerging outcomes have begun to take shape, reflecting shifts in awareness, capacity, and collaboration among key stakeholders in the four target countries in Nigeria, Ghana, Senegal, and Côte d'Ivoire.

One of the most immediate outcomes has been the increased visibility and recognition of digital innovation as a lever for circular economy advancement. Through the dissemination of the inception report and related stakeholder engagement activities, government representatives, SME leaders, and development partners have begun to articulate more explicitly the role that digital tools such as data platforms, traceability systems, and resource-efficiency apps can play in strengthening SME competitiveness. Early feedback from stakeholders indicates a stronger willingness to integrate digital dimensions into ongoing national circular economy policies and SME support programs, marking an important attitudinal shift.

Another outcome relates to capacity building and relationship strengthening within SME clusters. The development and piloting of research instruments, particularly the survey tools and interview guides, have already enhanced the capacity of local research partners and SME associations to collect and interpret data on digital adoption and resource efficiency. Several SME clusters in Nigeria and Ghana have expressed interest in continuing to apply these tools independently, suggesting a trajectory toward more evidence-driven practices at the grassroots level.

From a gender and inclusion perspective, the project has contributed to raising awareness about the differentiated barriers faced by women- and youth-led SMEs in adopting digital tools. Initial qualitative findings presented during roundtables highlighted issues such as unequal access to finance, digital skills gaps, and cultural perceptions that limit women's leadership in technology spaces. As a result, local partners in Côte d'Ivoire and Senegal have already initiated conversations with women entrepreneur networks on how to tailor digital support programs to their needs. This outcome reflects a growing alignment between the project's evidence and community-driven advocacy for inclusive innovation.

At a broader systemic level, the project has stimulated cross-country dialogue and learning. By positioning the inception report as a shared reference point, DICE Africa has helped foster new linkages between West African SME networks, digital startups, and research institutions. These relationships are expected to strengthen over the course of the project, with the potential to create a regional knowledge-sharing platform on digital and circular innovation.

While many of these outcomes are still nascent, they demonstrate how research outputs are already influencing practices, capacities, and relationships across the ecosystem.

Looking ahead, it is anticipated that the continued generation and dissemination of evidence will translate into more concrete outcomes, such as the adoption of digital innovation frameworks by government agencies, increased investment flows into SME digitalization, and the mainstreaming of gender-responsive approaches in circular economy programs.

Ultimately, these outcomes align with the project's central objective of promoting sustainable and equitable development by enabling SMEs to thrive within the circular economy, reducing resource waste, fostering green job creation, and narrowing gender and social inclusion gaps across West Africa.

11. Recommendations

The DICE Africa project has benefitted greatly from IDRC's support and flexibility, which have been central to our progress so far. However, these are a few recommendations:

1. **Scope Enhancement**

Preliminary insights highlight the growing importance of digital finance and access-to-market solutions for circular SMEs. We propose a slight refinement of scope in subsequent research projects to allow the project to place greater emphasis on these emerging themes while staying aligned with IDRC's Strategy 2030 priorities.

2. **Support for Regional Coordination**

This is a multi-country project, regional workshops and coordination retreats have proven invaluable for harmonizing approaches and strengthening partnerships. We recommend provision within the budget to support these coordination activities, which directly contribute to efficiency, learning, and alignment across all research teams.

3. **Budget Optimization for Engagement and Accessibility**

Engagement with stakeholders especially grassroots SMEs, women-led enterprises, and local regulators has underscored the importance of inclusive participation. We recommend a balanced reallocation within the existing budget to strengthen activities such as translation, stakeholder workshops, and dissemination efforts, ensuring accessibility across English and French-speaking contexts.

In summary, these recommendations are intended to consolidate the strong foundation already established with IDRC's support, while ensuring that the project delivers outcomes of the highest quality and relevance for circular SMEs in Africa.

Annex I

DICE Africa Questionnaire (English Version)

DICE Survey

DIGITAL INNOVATIONS FOR CIRCULAR ECONOMY (DICE)

Purpose of the Survey

We want to understand how small businesses in West Africa (like Nigeria, Ghana, Senegal, Cote d'Ivoire) are using digital tools (phones, apps, internet) to reduce waste, reuse materials, and protect the environment. This is called the circular economy. Your answers will help improve support for businesses like yours.

Section 1: About You and Your Business

1. Country: ☐ Nigeria ☐ Ghana ☐ Senegal ☐ Cote d'Ivoire
2. Gender: ☐ Male ☐ Female
3. Main Work Area:
 - ☐ Waste (collection, sorting, recycling)
 - ☐ Farming/Food
 - ☐ Clothing/Textiles
 - ☐ E-waste/Electronics
 - ☐ Energy (solar, gas, etc.)
 - ☐ Water
 - ☐ Software/Digital
4. ☐ Automobile
 - ☐ Other: _____
5. Your Role:
 - ☐ Owner ☐ Manager ☐ Worker
 - ☐ Other: _____
6. Do you work in a business group or network?
 - ☐ Yes ☐ No ☐ Not sure
7. Years in Business:
 - ☐ Less than 1 year ☐ 1–5 years ☐ 6–10 years ☐ Over 10 years
8. Number of Workers: _____

Section 2: Policies and Support

9. Have you heard of any government rules or plans that support reuse, recycling, or less waste?
 - ☐ Yes ☐ No ☐ A little

10. Do these rules mention digital tools (apps, internet, tech)?
☐ A lot ☐ Some ☐ Not really ☐ Don't know
11. Are these government rules helping your business with digital tools?
☐ Very helpful ☐ Somewhat ☐ Not helpful ☐ Don't know
12. What help did your business get from the government for digital work? (Choose all that apply):
☐ Funding ☐ Training ☐ Advice ☐ None ☐ Other: _____
13. What are your biggest problems using digital tools in your work? (Choose top 2):
☐ Money ☐ Skills ☐ Internet ☐ Equipment ☐ Other: _____

Section 3: Use of Digital Tools

14. How much does your business use digital tools (like apps, software)?
☐ A lot ☐ Some ☐ A little ☐ None
15. Which digital tools do you use? (Choose all that apply):
☐ Waste tracking apps
☐ Online selling (e-commerce)
☐ Inventory software
☐ Other: _____
16. Why is it hard for small businesses to use digital tools?
☐ High cost ☐ No training ☐ No internet ☐ Fear of fraud ☐ Other: _____

Section 4: Technology and Impact

17. Which of these do you use? (Choose all that apply):
☐ Simple phone codes (USSD)
☐ WhatsApp or Facebook
☐ Apps for waste or sharing
☐ Smart tools (sensors, GPS)
☐ 3D printing, robots, or AI
18. ☐ Smart bins
☐ Other: _____
19. How much do you agree with the following statements about digital tools and your business
20. ☐ Digital tools fit well with our current way of working.
21. ☐ Digital tools work better than what we use now.
22. ☐ Digital tools are simple to use.
23. ☐ We can try out digital tools before fully adopting them.
24. ☐ Digital tools cost less to run.
25. Have these tools helped you? Rate from 1 (Not at all) to 5 (Very much):
 - Saved money: ☐1 ☐2 ☐3 ☐4 ☐5

- Grew revenue: ☐1 ☐2 ☐3 ☐4 ☐5
 - Hired more workers: ☐1 ☐2 ☐3 ☐4 ☐5
 - Got funding: ☐1 ☐2 ☐3 ☐4 ☐5
26. What helps the most when trying to get funding?
- Government incentives and subsidies
 - Awareness of circular economy benefits
 - Good business structures
27. Did you get climate or green funding?
- ☐ Yes ☐ No
- If Yes, what type?
- ☐ Grant ☐ Loan ☐ Training ☐ Other: _____
28. Did digital tools help you get the funding?
- ☐ Yes ☐ No ☐ Not sure

Section 5: Women and Digital Inclusion

29. Are there programs for women to join digital or recycling work?
- ☐ Yes ☐ No ☐ Not sure
30. Do women in your group have equal say in tech or funding decisions?
- ☐ Yes ☐ No ☐ Sometimes
31. What stops women from joining more? (Tick any that apply):
- ☐ Time/family ☐ No voice in group ☐ No tech access ☐ Skills gap ☐ Discrimination
32. How well are women represented in leadership and technical roles in digital innovation for the circular economy where you work?
- ☐ Women and men are equally represented
- ☐ Women are not represented
- ☐ Not Sure

DICE Africa Questionnaire (French Version)

Enquête DICE

INNOVATIONS NUMÉRIQUES POUR L'ÉCONOMIE CIRCULAIRE (DICE)

Objectif de l'enquête

Nous voulons comprendre comment les petites entreprises d'Afrique de l'Ouest (Nigeria, le Ghana, le Sénégal, la Côte d'Ivoire) utilisent les outils numériques (téléphones, applications, internet..) pour réduire les déchets, réutiliser les matériaux et protéger l'environnement. C'est ce qu'on appelle l'économie circulaire. Vos réponses permettront d'améliorer le soutien aux entreprises comme la vôtre.

Section 1 : À propos de vous et de votre entreprise

33. Pays : ☐ Nigeria ☐ Ghana ☐ Sénégal ☐ Côte d'Ivoire
34. Sexe : ☐ Homme ☐ Femme
35. Domaine de travail principal :
- ☐ Déchets (collecte, tri, recyclage)
 - ☐ Agriculture/Alimentation
 - ☐ Vêtements/textiles
 - ☐ Déchets électroniques/électronique
 - ☐ Énergie (solaire, gaz, etc.)
 - ☐ L'eau
 - ☐ Logiciels/Numérique
36. ☐ Automobile
- ☐ autres : _____
37. Votre rôle :
- ☐ Propriétaire ☐ Gestionnaire ☐ Employé
 - ☐ Autre : _____
38. Travaillez-vous au sein d'un groupe ou d'un réseau d'entreprises ?
- ☐ Oui ☐ Non ☐ Incertain
39. Nombre d'années d'activité :
- ☐ Moins d'un an ☐ 1-5 ans ☐ 6-10 ans ☐ Plus de 10 ans
40. Nombre de travailleurs : _____

Section 2 : Politiques et soutien

41. Avez-vous entendu parler de règles ou de plans gouvernementaux en faveur de la réutilisation, du recyclage ou de la réduction des déchets ?
- ☐ Oui ☐ Non ☐ Un peu
42. Ces règles mentionnent-elles les outils numériques (applications, internet, technologie) ?
- ☐ Beaucoup ☐ Un peu ☐ Pas vraiment ☐ Ne sait pas

43. Ces règles gouvernementales aident-elles votre entreprise à utiliser les outils numériques ?
☐ Très utile ☐ Un peu ☐ Pas utile ☐ Ne sait pas
44. De quelle aide votre entreprise a-t-elle bénéficié de la part du gouvernement pour le travail numérique ? (Choisissez toutes les réponses qui s'appliquent) :
☐ Financement ☐ Formation ☐ Conseils ☐ Aucune ☐ Autre : _____
45. Quels sont les problèmes les plus importants que vous rencontrez dans l'utilisation des outils numériques dans votre travail ? (Choisissez les 2 principaux) :
☐ Argent ☐ Compétences ☐ Internet ☐ Equipement ☐ Autre : _____

Section 3 : Utilisation des outils numériques

46. Dans quelle mesure votre entreprise utilise-t-elle des outils numériques (comme des applications, des logiciels) ?
☐ Beaucoup ☐ Un peu ☐ Un peu ☐ Aucun
47. Quels outils numériques utilisez-vous ? (Choisissez tous ceux qui s'appliquent) :
☐ Applications de suivi des déchets
☐ Vente en ligne (e-commerce)
☐ Logiciel d'inventaire
☐ Autres outils : _____
48. Pourquoi les petites entreprises ont-elles du mal à utiliser les outils numériques ?
☐ Coût élevé ☐ Pas de formation ☐ Pas d'internet ☐ Peur de la fraude ☐ Autre : _____

Section 4 : Technologie et impact

49. Lesquels utilisez-vous ? (Choisissez tous ceux qui s'appliquent) :
☐ Codes téléphoniques simples (USSD)
☐ WhatsApp ou Facebook
☐ Applications pour les déchets ou le partage
☐ Outils intelligents (capteurs, GPS)
☐ Impression 3D, robots ou IA
50. ☐ Poubelles intelligentes
☐ Autres : _____
51. Dans quelle mesure êtes-vous d'accord avec les affirmations suivantes concernant les outils numériques et votre entreprise ?
52. ☐ Les outils numériques s'intègrent bien à notre mode de travail actuel.
53. ☐ Les outils numériques fonctionnent mieux que ceux que nous utilisons actuellement.
54. ☐ Les outils numériques sont simples à utiliser.
55. ☐ Nous pouvons essayer les outils numériques avant de les adopter pleinement.
56. ☐ Les outils numériques sont moins coûteux à utiliser.

57. Ces outils vous ont-ils aidé ? Donnez une note de 1 (pas du tout) à 5 (beaucoup) :

- Économies : 1 2 3 4 5 ☐☐☐☐☐

- Augmentation du chiffre d'affaires : ☐1 2 3 4 5☐☐☐☐

- Embaucher plus d'employés : ☐1 2 3 4 5☐☐☐☐

- Obtention d'un financement : ☐1 2 3 4 5☐☐☐☐

58. Qu'est-ce qui vous aide le plus à obtenir des fonds ?

-Les incitations et les subventions du gouvernement

-Sensibilisation aux avantages de l'économie circulaire

-Les bonnes structures d'entreprise

59. Avez-vous obtenu un financement pour le climat ou l'environnement ?

☐ Oui☐ Non

Si oui, de quel type ?

☐ Subvention☐ Prêt☐ Formation☐ Autre : _____

60. Les outils numériques vous ont-ils aidé à obtenir le financement ?

☐ Oui☐ Non☐ Pas sûr

Section 5 : Les femmes et l'inclusion numérique

61. Existe-t-il des programmes permettant aux femmes de participer à des activités numériques ou de recyclage ?

☐ Oui☐ Non☐ Pas sûr

62. Les femmes de votre groupe ont-elles leur mot à dire dans les décisions relatives à la technologie ou au financement ?

☐ Oui☐ Non☐ Parfois

63. Qu'est-ce qui empêche les femmes de s'engager davantage ? (Cochez toutes les réponses qui s'appliquent) :

☐ Temps/famille ☐ Pas de voix au sein du groupe☐ Pas d'accès à la technologie☐ Manque de compétences☐ Discrimination

64. Dans quelle mesure les femmes sont-elles représentées dans les rôles techniques et de direction en matière d'innovation numérique pour l'économie circulaire là où vous travaillez ?

☐ Les femmes et les hommes sont représentés de manière égale

☐ Les femmes ne sont pas représentées

☐ Pas sûr

Annex II

FGD Guide

Focus Group Discussion Guide: DIGITAL INNOVATIONS FOR CIRCULAR ECONOMY (DICE)

Section 1: Introduction and Background

Interviewee/s introduction (name, age, gender, role within the firm, educational background, experience, role and involvement in circular economy)

1. Can you briefly describe your role and experience within circular economy SMEs as well circular economy models you are using(e.g., waste-to-value, repair, leasing models)
2. What are your main day-to-day challenges in running a circular economy business?
3. What factors are currently driving the growth of circular economy businesses in your cluster?
4. How have networks or clusters helped or hindered your business?

Section 2: Digital Innovations and Scaling (25 minutes)

5. What digital tools have you used, or seen others use effectively in circular businesses and how have these tools helped you to:
 - a. Manage waste or raw materials?
 - b. Reach customers or new markets?
 - c. Improve operations (e.g., sorting, logistics)?
 - d. Track materials across your value chain.
6. What digital innovations do you think could significantly help scale circular SMEs or clusters? (e.g., digital platforms, blockchain, AI)
7. What are the main barriers preventing more digital tools usage? (e.g., cost, internet access, digital skills)
8. How can digital innovations help improve access to climate finance for circular businesses? (e.g., fintech, impact tracking, investor platforms)

Section 3: Barriers and Enablers to Digital Adoption

9. What are the biggest barriers and enablers for digital adoption among circular economy SMEs clusters? (e.g., infrastructure, market conditions, policy)
10. What policies or initiatives do you think would support greater adoption? (e.g., digital literacy programs, incentives, tech hubs)

Section 4: Climate Finance and Trade (20 minutes)

Objective: Understand access to finance and how digital tools impact trade.

11. Are you aware of any green or climate finance opportunities? Are they accessible to SMEs like yours?
12. What are the funding challenges that limit your growth?

13. Can you share examples of successful digital interventions that helped your businesses grow or access finance

Section 5. Jobs and Skills

14. What new jobs are being created in your sector?
15. What skills are becoming most important?
16. How is digital innovation changing the way people work in your space?

Section 6: Gender and Inclusion

17. Do you think men and women are facing different opportunities or barriers in circular economy SMEs?
18. How do gender roles affect access to and use of digital tools?
19. How can digital tools be used to better support women entrepreneurs and workers?
20. What can be done to ensure women have equal access to digital resources? (e.g., training, policy reforms)

Section 7: Strategies and Collaboration

21. What strategies would you recommend helping SMEs overcome digital challenges?



DICE Africa Focus Group Discussion at the Federal Capital Territory, Abuja, Nigeria

Methodology

1. Methodology

The research for the Digital Innovation for Circular Economy (DICE) project employed a mixed-methods approach to provide a more nuanced understanding of the intersection of digital innovation, circular economy practices and access to climate finance in West Africa. This methodology was designed to triangulate findings from both quantitative and qualitative data sources, ensuring the robustness and validity of the results.

1.1. Quantitative Data Collection

A quantitative survey was administered across the four selected West African countries: Ghana, Nigeria, Senegal, and Côte d'Ivoire. A total of **549 responses** were collected from small and medium-sized enterprises (SMEs) and other stakeholders engaging in circular economic activities.

To ensure broad reach and accessibility, the survey instrument was translated and administered in French for the francophone regions of Senegal and Côte d'Ivoire. The responses were subsequently translated back into English for standardized analysis. The survey was structured to capture a range of data, including:

- Demographic information of the respondents and their organizations.
- Perceptions on policy and government support.
- Adoption and usage of digital tools in their operations.
- Barriers and enablers to digital innovation.
- The perceived impact of digital tools on key business outcomes such as revenue, cost savings and access to funding.
- Gender-specific insights on women's participation, decision-making and barriers to digital adoption.

1.2. Qualitative Data Collection

To enrich the quantitative findings with in-depth perspectives and contextual understanding, two primary qualitative data collection methods were utilized:

- Focus Group Discussions (FGDs): A total of five FGDs were conducted, with one held in each of the country of Ghana, Senegal, and Côte d'Ivoire. In Nigeria, given the country's size and diverse CE landscape, two separate FGDs were held in the major active circular economy hubs of Abuja and Lagos. These discussions brought together a diverse group of stakeholders,

including SME owners, waste collectors, innovators, academia and policy experts, to explore shared experiences, challenges and aspirations.

- Key Informant Interviews (KIIs): 28 KIIs were conducted with sector experts, policymakers and leaders of CE organizations. These one-on-one interviews provided critical insights and perspectives that helped to contextualize the survey findings and shed light on complex issues such as policy harmonization and the broader ecosystem dynamics.

1.3. Data Analysis

The collected data was subjected to a rigorous analysis process:

- Quantitative Analysis: The survey data was analyzed using statistical software to identify key patterns, trends and differences across countries and respondent demographics.
- Qualitative Analysis: The transcripts from the FGDs and KIIs were coded thematically. A thematic analysis approach was used to identify recurring themes, patterns and insights related to digital innovation, policy, funding and gender.

Triangulation: The qualitative and quantitative findings were then triangulated to provide a comprehensive and robust set of conclusions. The survey data helped to quantify the prevalence of certain issues and perceptions, while the interview and FGD data provided the rich, descriptive context behind those numbers. This ensured that the recommendations were grounded in both empirical evidence and practical, on-the-ground realities.