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TRANSFORMING AFRICA

Fostering a New Innovation Agenda

Edited by

OLUGBENGA ADESIDA, GECI KARURI-SEBINA & JOÃO RESENDE-SANTOS

Transforming Africa

This book is a much-needed intervention that finally moves Africa's innovation debate beyond rhetoric. It offers a grounded yet bold agenda that challenges the continent to confront hard truths: our innovation deficit is not a matter of missing strategies – we've had plenty – but of systemic inertia, weak implementation, and fragmented ecosystems. What sets this volume apart is its clear rejection of techno-fixes and donor-led models in favour of a more holistic, indigenous, and context-sensitive innovation paradigm. The contributions highlight the need for innovation not just in laboratories but across our governance systems, educational models, food systems, and development finance. It insists, rightly, that innovation is a societal project – and that the arts, informal sectors, and local knowledge are just as vital as advanced tech. This is a rare example of scholarship that is analytically rigorous, policy-relevant, and unafraid to ask difficult questions. I hope it finds its way into the hands of those willing to drive Africa's transformation with the urgency and imagination it demands.

—***Carlos Lopes*, Professor, Nelson Mandela School, University of Cape Town; Chair of the African Climate Foundation Board; Former Executive Secretary, Economic Commission for Africa**

Innovation is not a luxury; it is a necessity for Africa's future. Let this book be a rallying point for all who believe in Africa's promise. I commend it to everyone committed to building an Africa that is not only self-reliant, but also a source of inspiration and progress for the world.

—***Pedro de Verona Rodrigues Pires*, Founding Prime Minister & Former President of the Republic of Cabo Verde and Mo Ibrahim Laureate 2011**

Africa is faced with unprecedented opportunities – but realizing them requires a bold, inclusive innovation agenda. This book argues for a holistic, ecosystem-based approach that empowers diverse stakeholders and integrates multiple knowledge systems. I commend the editors of Transforming Africa for this vital call to action.

—***Ameenah Gurib-Fakim*, PhD, Former President of the Republic of Mauritius (2015–2018)**

This book makes a compelling case for systemic, inclusive innovation as the foundation of Africa's structural transformation. By uniting indigenous knowledge with modern science, empowering women and youth, and promoting regional collaboration and inclusive governance, it outlines a bold and Realistic

path forward. Its call to build strong innovation ecosystems – where government, business, academia, and civil society work together and trust each other is timely and vital. A must-read for policy makers and anyone committed to shaping Africa's future.

—***Dr Ibrahim Assane Mayaki*, Former Prime Minister of Niger; Former CEO NPCA and AUDA-NEPAD; African Union Special Envoy on Food Systems**

Innovation is the continent's most powerful lever for inclusive and sustainable development. This book highlights compelling case studies that demonstrate how systemic innovation can unleash Africa's full potential. With its practical insights and inspiring stories, it is an essential read for anyone determined to drive social impact and economic transformation. I wholeheartedly recommend it to leaders and changemakers committed to shaping Africa's future.

—***Élisabeth Moreno*, Chairwoman Ring Capital and Ring Africa; Former Minister Delegate for Gender Equality, Diversity and Equal Opportunities, France; Former vice-president and managing director of Hewlett-Packard for Africa**

"Transforming Africa" is a timely and inspirational call to action for all stakeholders involved in Africa's development journey. It positions innovation at the centre of efforts to solve real, everyday problems – from agriculture and health to education and governance. The book's call to integrate indigenous knowledge and traditional know-how with modern technologies, recognises the strategic necessity of hybrid solutions for creating real value and resilience. The African scholars and practitioners in this book do not shy away from identifying persistent policy challenges and implementation gaps and advocate for bold, systemic transformation that challenges conventional assumptions and fosters new forms of leadership. This book is an important piece in Africa's inclusive growth and self-reliance puzzle.

—***H.E. Ambassador Lerato Dorothy Mataboge*, African Union Commissioner**

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Transforming Africa: Fostering a New Innovation Agenda

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We also recognise the encouragement and support of our repeat publisher, Emerald, who have yet again been a professional and competent ally in actualising our vision. Daniel Ridge was particularly supportive in initially believing in the potential of this ongoing project and commissioning the book.

We extend our sincere gratitude to all the contributors and reviewers whose rigorous scholarship and practical insights have shaped this volume and enriched the series as a whole. We also thank the community of stakeholders who gathered with us in December 2025 to carefully analyse the emerging policy themes: Azeez Hazmat, Blaze Bayo, Doha Mghabbar, George Essegbey, John Mugabe, Kais Hammami, Koena Motloi, Linda Daniels, Mandry Ntshani, Nana Kofi Safo, Rebecca Hanlin, Sean MacGinty, Yap Boum, Yasser Buchana. Finally, we would like to thank our editorial assistant, Amy Mutua, for her excellent support and tireless effort in managing the production of this volume.

This series is part of the AIS Foundation's efforts to foster research, dialogues, marketplaces and robust innovation ecosystems to harness home-grown innovation across all sectors, drive systemic change and unleash Africa's promise to create an equitable, prosperous future for all.

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Chapter 1

Transforming Africa: A New Era Driven by Innovation

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Overview

The assertion that science, technology and innovation (STI) are the principal drivers of the global economy has become almost a cliché in contemporary discourse. Yet, this truism masks a more profound reality: the pace of innovation continues to accelerate, fundamentally reshaping societies and economies worldwide. Nowhere is this more evident than in the recent and rapid advances in artificial intelligence (AI), as well as ongoing progress in synthetic biology and genomic engineering, quantum computing, advanced robotics and autonomous systems.

These and other emerging technologies could herald revolutions across virtually all domains of human endeavour, even while they bring their own new (and some unknown) risks and dangers. The fusion of these innovations promises to transform how goods and services are produced, recalibrate the balance of power between capital and labour, disrupt established sectors and eliminate jobs while creating new opportunities.

By challenging the current models of value creation, labour and governance, the adequacy of prevailing profit-maximisation models as the philosophical underpinning of economic activities or the sole metric of economic success would be severely questioned. A critical uncertainty in this emerging future is whether or not the pursuit of individual gain or profit maximisation will be the basis for

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economic organisation in light of the plausible radical change in the balance of power between capital and labour.

In this emerging future, the imperative for African countries to innovate – and to do so systematically and inclusively – cannot be overstated. The transformative potential of AI and other advanced technologies cannot be realised equitably or sustainably without high-performing national innovation systems and robust national strategies that favour the common good.

For African countries, this means moving beyond ad-hoc or isolated initiatives to build comprehensive, resilient innovation ecosystems. Such systems require not only visionary policies but also effective and efficient coordination and accountability among diverse stakeholders, including government, industry, academia and civil society. They also depend on strong flows of information and knowledge, robust mechanisms for collaboration and learning, as well as strong capacity to adapt to rapid change.

Against this backdrop, the goals and focus of this innovation series, of which this book is the third volume, are more relevant than ever. As the world enters an era defined by AI and exponential technological change, African nations must ensure that their innovation systems are not only robust but also agile, inclusive and fit for purpose. Only then can the continent seize the opportunities and navigate the disruptions of the new technological age, driving sustainable and inclusive development for current and future generations.

This volume echoes the calls of previous volumes in this series regarding the urgent need to foster and expand innovation in all spheres. We are not the first or only ones to make these urgent calls or to recommend strategies. The problem has not been the lack of ideas and sound strategies. Indeed, for decades now, numerous action plans, strategies and proposals have been put forward and adopted at the national and continental levels. But progress has either been slow or non-existent. Hubs of innovation exist. Isolated cases have emerged and captured international recognition. Individual entrepreneurs and enterprises have found success. But the continent, as a whole, lags behind. Coherent innovation ecosystems are not easy to find, and the individual cases of success struggle against difficult business climates and sociopolitical conditions. Thus, as a first step, the people and governments of Africa must ask the hard and difficult question of why we have failed to achieve, sustain and scale meaningful progress.

The Innovation Africa Series

The first two volumes of the Innovation Africa series laid the groundwork for understanding and strengthening Africa's innovation landscape. *Innovation Africa: Emerging Hubs of Excellence* showcased how diverse actors across the continent are driving locally rooted, context-sensitive innovation. *Innovation Ecosystems in Africa: Solving the Problems We Have* broadened the focus to examine how national innovation systems address pressing developmental challenges. Both volumes emphasise the need for inclusive, systems-based approaches that integrate grassroots ingenuity with advanced research,

highlight persistent gaps in infrastructure, policy and human capital and call for coordinated, action-oriented strategies to foster resilience, collaboration and leadership. Collectively, they advocate for a bold, integrated innovation agenda as the foundation for Africa's sustainable and inclusive transformation.

The insights of the first two books have inspired this third volume of the Innovation Africa series. The third volume is a response to the call for African countries to bet on innovation with a greater sense of urgency, ensure bolder imagination about the future and invest in building more robust and effective innovation ecosystems.

The central thesis of this third volume, *Transforming Africa: Fostering a New Innovation Agenda*, is that Africa stands at a critical juncture, necessitating a bold and transformative innovation agenda to address its pressing challenges and seize emerging opportunities. The third volume is conceived as an agenda-setting work that seeks to chart a bold and imaginative course for Africa's innovation future. Building on the empirical insights and systems perspectives developed in the preceding volumes, this book moves beyond diagnosis to articulate a forward-looking agenda that addresses the urgent need for accelerated and transformative change across the continent.

At its core, this volume responds to the pressing question: why should Africa change the pace and direction of its innovation trajectory, and what concrete steps are required to do so? The book contends that, in a rapidly evolving world shaped by technological disruption, demographic shifts and intensifying developmental challenges, African countries cannot afford incrementalism. Instead, there is a need for a decisive shift; an intentional and strategic acceleration of innovation ecosystem building and direct enablement of innovation that can drive structural transformation and sustainable development.

Like its predecessors, this volume is simultaneously academic, policy-oriented and practice-focused. It aims to broaden the visibility and deepen the interrogation of African innovation systems by offering rigorous, contextually grounded analyses of endogenous innovation practices and lessons. Each chapter is designed to illuminate a thematic issue that is central to Africa's future, dissect the relevant innovation ecosystem and employ illustrative cases to distil both the challenges and the opportunities at hand. Importantly, the volume's structure ensures that each contribution culminates in a forward-looking agenda, proposing actionable policies and practical lessons to inspire and equip stakeholders – governments, business leaders, academics and civil society actors – for the urgent task of facilitating structural change.

Furthermore, this volume is explicitly policy-relevant. It seeks to provide not only inspiration but also concrete policy 'take-aways' for the continent's policymakers and the broader 'quadruple helix' of social actors. By synthesising evidence and experience from across Africa, the book offers a strategic agenda for moving the continent forward with speed and purpose, equipping stakeholders to address persistent challenges and seize emerging opportunities. In doing so, *Transforming Africa* aspires to contribute meaningfully to the continent's ongoing quest for innovation-led transformation and inclusive, sustainable development.

The Need for a New Innovation Agenda

The global innovation landscape is undergoing rapid transformation, driven by converging technological breakthroughs, new business models and shifting geopolitical and socio-economic dynamics. Africa is deeply influenced by these changes, with digitalisation, climate change and the rise of distributed innovation models opening new opportunities while also exposing persistent vulnerabilities. Over the past decade, African innovators have demonstrated remarkable ingenuity, from mobile money and decentralised energy to burgeoning tech hubs and social enterprises, yet progress remains uneven and constrained by infrastructural, financial and policy challenges. As global competition intensifies and the pace of change accelerates, Africa's unique demographic strengths and adaptive capacity underscore the urgent need for a bold, integrated innovation agenda capable of harnessing these trends to drive sustainable and inclusive development.

Innovation has long been recognised as a cornerstone of economic transformation, societal advancement and global competitiveness (Lundvall, 2007; Nelson, 1993). Yet, Africa's innovation landscape remains deeply fragmented and underperforming relative to global peers. Despite notable progress in certain countries and sectors, the continent as a whole continues to lag on critical indicators of innovation and development (Adesida et al., 2016, 2023). In a rapidly changing global context, a fundamental recalibration of Africa's innovation agenda is urgently required – one that addresses structural deficiencies, mobilises untapped potential and aligns innovation efforts with the continent's broader development aspirations.

The Changing Innovation Context

Technological convergence across fields such as AI, biotechnology, renewable energy and advanced manufacturing is reshaping industries and creating new opportunities for value creation (OECD, 2018). Concurrently, innovation is becoming more mission-driven, aimed at addressing global challenges like climate change, pandemics and social inequalities (Mazzucato, 2018). Innovation systems are increasingly characterised by open collaboration, rapid diffusion of knowledge and networked entrepreneurial ecosystems.

In this evolving global landscape, countries that fail to build robust, adaptive innovation systems risk being locked into low-value positions within global value chains. Africa's current innovation efforts, often incremental and narrowly focused, are insufficient to overcome the structural barriers of limited industrialisation, over-reliance on commodity exports and exclusion from the frontier sectors shaping the future global economy (Adesida et al., 2016, 2023).

Identifying the Gaps in Africa's Innovation Systems

While Africa is home to vibrant pockets of innovation – from mobile banking revolutions to health-tech and agri-tech innovations – these successes remain

isolated rather than systemic. A critical analysis reveals that the continent's innovation deficit stems not from a lack of ideas or strategies, as noted above, but from systemic weaknesses in implementation, governance and enabling environments (Adesida et al., 2023).

Many African countries have articulated ambitious STI strategies and established supportive institutions. However, weak governance, poor leadership continuity and the absence of robust performance measurement and accountability mechanisms have undermined their effective execution. The proliferation of plans has not translated into meaningful impact on productivity, resilience or inclusion.

Moreover, innovation efforts have often focused on incremental improvements rather than the radical, systemic changes needed to overcome entrenched constraints. Africa's continued position as a supplier of raw materials – despite holding critical minerals that are vital for the emerging global industries – illustrates the gap between potential and realisation. Innovation has yet to catalyse transformative industrialisation or significant value addition at scale. Indeed, Africa not only remains wedded to its role as a supplier of unprocessed raw materials and commodities, but it has not even directed any efforts to bringing innovation to these sectors to capture part of their value-addition by building local capacity for their partial processing and transformation.

Another persistent gap is the failure to mobilise civil society, youth and marginalised groups as active agents in innovation ecosystems. Despite a growing demographic dividend, youth engagement in structured innovation activities remains limited, and outdated organisational cultures, particularly within public institutions, hinder agility and responsiveness.

The Urgency of Innovation for Development

With the continent's population projected to double by 2050 (UN DESA, 2019), innovation – broadly conceived to include technological, organisational and social dimensions – is not a luxury but a developmental necessity. Taken together, the rapid population growth, technological change and the constraints of African economies also suggest that training and education systems must innovate their approaches to focus more on building hard and soft skills to prepare young people with the capacity to create their own opportunities and self-employment.

Innovation must be at the centre of efforts to address persistent poverty, inequality, governance deficits and the existential threats posed by climate change. It must underpin the achievement of the Sustainable Development Goals (SDGs) and support Africa's structural transformation by building productive capacities, resilience and sustainable livelihoods.

A renewed innovation agenda must move beyond incrementalism to embrace bold, systemic transformation. This requires fostering accountable, inclusive and responsive national and regional innovation ecosystems that empower all actors – government, private sector, academia and civil society – in collaborative efforts to

drive sustainable, value-added growth. Innovation must be harnessed not only for high-technology sectors but also for solving basic, yet critical challenges in agriculture, health, education, infrastructure and governance. Furthermore, innovation must also be positioned at the heart of efforts to resolve Africa's enduring conflicts, including those in the Sahel, Central Africa, the Horn of Africa and the Great Lakes region, offering new pathways for peacebuilding, inclusive governance and societal resilience.

Towards a New Innovation Paradigm

Africa's abundant critical minerals, youthful population, growing urbanisation and expanding digital infrastructure offer unprecedented opportunities. However, realising these opportunities demands deliberate and strategic efforts to:

- build indigenous technological and production capabilities rather than relying exclusively on imported solutions;
- develop entrepreneurial mindsets and innovation-oriented education systems that emphasise critical thinking, creativity and problem-solving;
- promote inclusive participation, ensuring that women, youth and marginalised communities are integral to innovation ecosystems;
- create enabling environments that support risk-taking, learning and scale-up of successful innovations;
- link innovation explicitly to addressing key challenges and emerging opportunities, from industrialisation to climate resilience and sustainable value addition.

Fundamentally, Africa must also address foundational issues of leadership, governance and self-reliance. Innovation must not be pursued as an isolated endeavour but as a cross-cutting strategy embedded within national visions for structural transformation and societal well-being. The complexity and urgency of Africa's developmental challenges demand a new, action-orientated innovation agenda – one capable of catalysing both radical and incremental change. Innovation must be repositioned as a societal project: an engine for inclusive growth, resilience and sustainable futures.

Recognising the imperative for a new, bold innovation agenda for Africa sets the stage for a deeper examination of the critical areas where transformation is both necessary and possible. This volume builds upon the foundational insights of earlier works, but shifts the focus towards thematic domains that are increasingly central to Africa's innovation future. It explores emerging trends, sectoral opportunities, institutional reforms and ecosystem dynamics that must be harnessed to drive systemic change. By framing innovation as a multifaceted, cross-cutting driver of structural transformation, the chapters in this volume aim to illuminate pathways for actionable, context-sensitive strategies that can sustain Africa's innovation momentum and bridge the persistent gaps identified

across the continent. In the following section, we outline the key themes that structure this exploration.

Key Themes of the Book

This volume advances a distinctive and expansive vision of innovation in Africa, moving decisively beyond conventional, technology-centric narratives. The book's central argument is that innovation must be understood and fostered not solely as high-tech or scientific advancement but as a multidimensional, society-wide phenomenon that encompasses new approaches in governance, education, health, agriculture, finance, the arts, infrastructure and beyond. In this way, the volume is intentionally atypical for the innovation literature: it foregrounds both high-end and low-end innovation and insists on the transformative potential of contextually grounded, inclusive and systemic change.

Transformational Reframing of Key Issues

A defining theme is the transformational reframing of Africa's core development challenges. The chapters collectively demonstrate that innovation is as vital in domains such as food security, water management, health systems, education and urban infrastructure as it is in emerging technological sectors. The book showcases some specific examples of innovation while also highlighting the need for innovation in Africa across a spectrum of activities: in the redesign of governance structures and policy planning, in the adaptation of farming practices, in the renewal of educational curricula, in management within public and private sectors and even in peacebuilding and conflict resolution. This broad lens challenges the persistent association of innovation with only high technology, highlighting instead the value of everyday, grassroots and organisational innovations that are often overlooked yet essential for impact at scale.

Innovation Ecosystems and the Quadruple Helix

Another central theme is the critical importance of robust innovation ecosystems. The volume underscores that innovation does not occur in isolation but is enabled by dynamic interactions among universities, research institutions, incubators, industry, government and civil society: the so-called quadruple helix. Effective ecosystems are those that activate and sustain collaboration across these diverse actors, fostering knowledge exchange, entrepreneurial activity and the translation of ideas into practical solutions. The book's case studies reveal both the promise and the persistent gaps in Africa's innovation ecosystems, emphasising the need for deliberate ecosystem-building strategies that connect micro-level entrepreneurial activity with supportive macro-level institutions, policies and infrastructure.

Policy, Regulation and Enabling Environments

The role of policy and regulation is examined as both a catalyst and a constraint for innovation. The book analyses how government policies – including intellectual property regimes, regulatory frameworks and tax incentives – can stimulate or stifle innovation. It calls for the creation of enabling environments that lower barriers to entry, encourage experimentation and protect the rights of innovators, while also ensuring that regulatory systems are adaptive to the fast-evolving realities of technology and entrepreneurship in Africa. More broadly, some chapters draw attention to the need to focus innovation in the area of governance and policymaking, advocating the adoption of anticipatory governance and foresight analysis.

Financing Innovation

Financing remains a perennial challenge and opportunity for African innovation. The volume explores the complex landscape of funding for innovation, while highlighting the importance of public–private partnerships and diaspora engagement. It also highlights the need for innovative financing mechanisms that can bridge the early-stage funding gap, support scaling and ensure that resources reach not only high-tech start-ups but also social enterprises and grassroots innovators.

Talent and Skills Development

Human capital is identified as a cornerstone of innovation-driven development. The book stresses the importance of investing in education and skills development, not just in STEM fields but also in fostering critical thinking, creativity and entrepreneurship. Chapters highlight initiatives aimed at building a skilled workforce, nurturing innovative entrepreneurs and reforming education systems to better align with the demands of a rapidly changing innovation landscape. Some chapters in the volume call for a rethinking of our traditional university models and curricula, while others focus our attention on the critical importance of hard and soft skills building outside the traditional confines of schools.

Harnessing and Governing Emerging Technologies

The governance of emerging technologies is a further thematic pillar. The book addresses the dual imperative of harnessing digital and other frontier innovations for development, while also instituting governance frameworks that ensure ethical, inclusive and context-sensitive adoption. This includes attention to issues of data sovereignty, cybersecurity and the responsible use of AI and other transformative tools.

Public Sector and Institutional Innovation

The volume gives special attention to innovation within governance and public institutions. It examines how African governments and public agencies can themselves become more innovative through anticipatory governance, institutional redesign and the adoption of new management practices. The capacity for public sector innovation is presented as essential, not only for delivering better services but also for creating the enabling conditions in which broader societal innovation can flourish.

This book's key themes reflect a commitment to a holistic, systemic and impact-orientated understanding of innovation in Africa. By reframing innovation as a societal project, activating diverse actors and addressing the full spectrum of enabling conditions – from policy and finance to talent and technology – the volume aims to chart a path towards inclusive, resilient and transformative development for the continent.

Overview of the Book

This book is structured to provide a comprehensive exploration of Africa's innovation landscape. It contains 13 chapters, including this introduction and the concluding chapters. The chapters are presented in four clusters. The first group focuses on the health-food nexus. The second cluster explores sectoral innovation focusing on apparel, agriculture, fintech and education, while the third addresses the larger systemic issues of governance and technology, with a focus on AI, peace building and education. The fourth group, which contains two chapters, provides the opportunity for speculative futures and innovation in the food and education spaces.

Chapter 2, *Stimulating Innovation in Africa's Food-Health Nexus*, authored by Safo and Essegbey, offers a foundational understanding of the health-food nexus. The chapter examines two critical development challenges facing Africa in relation to the SDGs: food and nutrition security (SDG 2) and good health and well-being (SDG 3). With 281.6 million people experiencing hunger in 2020 and significant burdens from both communicable and non-communicable diseases, achieving these SDGs seems increasingly difficult. The chapter explores the current state of food insecurity and health in Africa, using data from the Food and Agriculture Organization and the World Health Organization, and addresses the urgent need for innovation in these sectors. The chapter concludes by highlighting the need for strengthening these actors' roles and their interrelationships, with attention to policies at the continental level, such as the Digital Transformation Strategy for Africa and the African Continental Free Trade Area.

In Chapter 3, *Putting community at the centre of Health system transformation in Africa*, Boum, Ambe and Massengo provide a deeper understanding of the health sector while presenting an alternative vision for it. The authors advocate for a people-centred transformation of African health systems, grounded in community leadership and local knowledge. Drawing on case studies from

epidemic responses and neglected tropical diseases (NTDs), it highlights the critical role of community health workers (CHWs), traditional medicine and local governance in delivering equitable care. Boum, Ambe and Massengo call for the institutionalisation of CHWs, the integration of indigenous and digital tools and the establishment of policy benchmarks for CHW deployment in both routine and emergency contexts. A section of the chapter is dedicated to epidemics, including Ebola, COVID-19 and Mpox, demonstrating how CHWs have been instrumental in surveillance, contact tracing and vaccine delivery. In contrast, the response to NTDs requires sustained community trust and engagement.

Chapter 4, *Bringing the Traditional Grains of Sorghum and Millet back to the Dinner Table*, by Julius Gatune, makes a compelling case for the revival of Africa's indigenous grains, particularly millet and sorghum, to address the challenge of food insecurity while also ensuring better nutrition and health outcomes. While traditional grains once formed the backbone of African diets and are better suited to local agro-ecological conditions, their role has diminished over time, supplanted by 'new cereals' like maize, rice and wheat. Among these, maize has become the most widely grown staple in Sub-Saharan Africa. However, its high vulnerability to drought has made it an unreliable crop across much of the region, with climate change expected to further reduce yields by up to 22% by 2050. This overreliance on a climate-sensitive crop has led to increasing dependence on imports to meet domestic needs. In contrast, traditional African grains such as millet and sorghum are more resilient, nutritionally rich and better adapted to withstand climate shocks. The chapter argues for a strategic shift towards revitalising these native crops through supportive policy, investment in value chains and renewed public awareness of their cultural and nutritional value. The chapter makes a compelling argument that, with the global consumer surge for superfoods and healthy diets, Africa's traditional grains can capture global markets.

Chapter 5, *Innovation, Informality and Cultural Heritage: Lessons From a Study of Informal Apparel Businesses in South Africa*, initiates the section on sectoral innovation, with an emphasis on business. Authored by Petersen, the chapter explores the potential of the informal sector, particularly the creative economy, as a driver of inclusive industrial transformation in Africa. Focusing on informal apparel businesses in KwaZulu-Natal, a key region in South Africa's apparel industry, it applies a local innovation and production systems perspective to analyse how informal businesses sustain themselves through innovation. The chapter highlights how resource-constrained enterprises develop creative solutions but often struggle with low innovation complexity and inward learning approaches that limit their growth. It argues that strengthening local innovation ecosystems through networks, infrastructure and supportive institutions can enable informal businesses to build capabilities for more complex innovations, ultimately contributing to a more dynamic and sustainable African innovation system.

In Chapter 6, *Exploring firm-level classification of innovation behaviours in agricultural businesses: An input-output modes approach*, Buchana and Sithole explore agricultural innovation in South Africa, focusing on how agricultural

businesses adopt different innovation strategies in response to climate change, resource constraints and global competition. Despite agriculture's significant role in employment, food security and rural development, limited attention has been given to how agricultural firms innovate, particularly through various modes such as knowledge-driven, activity-driven or incremental strategies. The findings reveal that knowledge-intensive businesses involved in external collaboration tend to have higher ICT adoption, while those focused on incremental or process-based innovations adopt digital technologies at a slower pace.

In Chapter 7, *Innovation through educational arts in under-resourced communities in South Africa*, the second paper on the education theme, MacGinty and Daniels explore the transformative potential of arts education for school-age youth in under-resourced communities, focusing on the Lalela programme. The chapter examines how arts education fosters self-confidence, emotional awareness, respect for others and aspirations for meaningful careers. It also highlights broader shifts in perceptions about the role of art in education, challenging assumptions about educational arts and demonstrating the programme's role in facilitating systemic change.

The section concludes with Chapter 8, *Financial sector development: The fintech solution*, by Tochukwu Egesi. The author explores the transformative potential of financial technology (fintech) in addressing persistent challenges in Sub-Saharan Africa's financial sector, including low financial inclusion, underdeveloped infrastructure and widespread poverty. The chapter examines how fintech is expanding access to financial services, lowering transaction costs and fostering inclusive growth and highlights the role of group lending, open APIs and digital payment platforms in building synergies with traditional financial institutions and regulatory frameworks. The chapter finds that while fintech has created new economic opportunities and improved financial access, challenges such as uneven digital infrastructure, regulatory complexities and the exclusion of low-income populations due to financial literacy and connectivity gaps remain significant.

The next set of chapters explores AI (Chapter 9) and peacebuilding (Chapter 10) with a focus on critical policy issues for the continent. Chapter 9: *Transformative Impacts of Ethical and Responsible AI: The Case of AI Sandboxes for Economic Policymaking*, by Bayuo and Goriola, explores the transformative potential of integrating ethical and responsible AI into Africa's development agenda. Focusing on policy, economic and technological dynamics, the chapter examines how AI can be leveraged to drive economic transformation while ensuring accountability and ethical standards. It provides a nuanced understanding of the current state of ethical AI in Africa, highlighting social and economic factors and identifying gaps in the ethical AI landscape. The chapter underscores the importance of placing ethical deliberation at the heart of Africa's modernisation efforts, stressing that ethical AI frameworks can drive sustainable development and innovation. This chapter lays the groundwork for creating responsible AI structures that foster Africa's economic growth and transformation through presenting insights for policymakers, business leaders and researchers.

Chapter 10, *Countering violent extremism in Africa: The challenges of navigating uncertainty,* by van Nieuwkerk, critically examines the persistent challenges facing Africa's peacebuilding efforts despite the continent's comprehensive peace and security architecture. Using the Southern African Development Community missions in Mozambique (SAMIM) and the Democratic Republic of the Congo (SAMIDRC) as case studies, the chapter explores the complexities of achieving and sustaining peace. It argues that strategic foresight and anticipatory governance could enhance decision-making processes, enabling peace and security actors in Central and Southern Africa to improve the effectiveness of their interventions. By interrogating the structural and operational shortcomings of current peacebuilding frameworks, the chapter offers insights into fostering long-term, positive peace on the continent.

In Chapter 11, Oyewale and Omasire return the book to the topic of food. The chapter, *Harvesting Tomorrow: Revitalising African Foodscapes*, begins the fourth cluster, which provides speculative scenarios. This chapter reimagines a new organising principle for food production, distribution and consumption. The authors propose novel ways to reimagine African food systems, centring on the concept of 'food as a commons' rather than a commodity. The authors argue that recognising food as a common resource affirms the right of all Africans to access it, thereby placing responsibility on governments to ensure equitable provision, especially for vulnerable groups. This paradigm shift from commodification to collective stewardship repositions food as a public good and cultural asset, with implications for governance, equity and sustainability. Beyond access, the chapter also celebrates the cultural richness of African food systems, highlighting both the geographic diversity of food production and the continent's vibrant culinary traditions. By framing food as a shared cultural and social resource, the chapter envisions food as a powerful vehicle for social cohesion and culture preservation.

Chapter 12, *Reimagining African futures through higher education policy: Evidence from South Africa*, by Owen, Karuri-Sebina, Miller and Hackmann, closes out the book with a second speculative chapter. The chapter is deliberately provocative; it examines how dominant narratives about higher education's role in shaping Africa's future may constrain innovation in the sector by reinforcing predetermined visions of progress. The chapter investigates how anticipation influences policy development. Rather than offering prescriptive solutions, it demonstrates how futures literacy can expose implicit assumptions shaping higher education policy while enhancing the capacity to navigate uncertainty and complexity. The findings suggest that by making these dominant narratives visible, policymakers can choose to adopt more nuanced, flexible approaches that acknowledge the social, political and economic dynamics of the sector, leading to policies that are more adaptive, inclusive and better suited to Africa's evolving realities.

Making Sense of the Contributions and Emerging Recommendations

The chapters are interconnected by their shared commitment to broadening the definition of innovation, emphasising the importance of context and advocating for the integration of diverse knowledge systems. They build upon one another to advance a narrative that innovation in Africa is not the preserve of any single sector or technology, but is instead a dynamic, multi-level process that must engage communities, institutions and policymakers alike. The volume thus offers both a diagnosis of existing challenges and a roadmap for harnessing Africa's diverse innovation potential for sustainable and inclusive development. The chapters collectively highlight innovation as a dynamic, multi-stakeholder process that is essential for Africa's sustainable and inclusive development. The key recommendations emerging from these chapters are summarised below.

Integration of Knowledge Systems and Practices

A recurring insight is the imperative to integrate indigenous knowledge and traditional practices with modern technologies. This integration is not merely a matter of cultural preservation, but it is a strategic necessity for sectors such as health, agriculture and finance. Case studies in the volume show that hybrid solutions, such as the blending of traditional medicine with biomedical approaches, or the partnership of fintech startups with established banks, can unlock new forms of value and resilience. The challenge is to move beyond parallel systems towards genuine co-creation, where informal and formal innovation systems are mutually reinforcing. This requires deliberate policy support, recognition of diverse knowledge forms and investment in platforms that enable cross-sectoral learning and adaptation.

Collaboration, Partnerships and Ecosystem Building

The need for collaboration and partnership is a dominant theme. Robust innovation systems depend on the active engagement of multiple actors – government, industry, academia, civil society and communities – in what we referred to as the quadruple helix model in the first volume of this series. The chapters highlight that ecosystem-building is not just about clustering high-tech firms but also creating spaces for dialogue, co-creation and shared decision-making. Regional collaboration, particularly through platforms and organisations that span national boundaries, is also essential for scaling innovation and addressing shared challenges. However, collaboration must be intentional and inclusive, ensuring that marginalised voices, especially those of the youth and women, are not sidelined.

Capability, Capacity Building and Education

Many contributions underscore the centrality of education, skills development and knowledge acquisition to Africa's innovation future. This includes not only STEM education but also creative arts, entrepreneurial capacity and data literacy. Innovative educational models such as the use of arts in pedagogy, or bespoke technology literacy programmes for policymakers, are highlighted as promising avenues. The volume also calls for sustained investment in research and development and for the creation of enabling environments that nurture both formal and informal learning. Addressing the persistent 'brain drain' will require new strategies for leveraging diaspora talent and creating circular talent ecosystems that allow for mobility, knowledge exchange and return.

Anticipatory and Adaptive Governance

A key recommendation is the need to move towards anticipatory and adaptive governance. Africa's innovation systems must be able to foresee and respond to complex, rapidly evolving challenges, whether in health, food security or technology. This requires not only systematic foresight and scenario planning but also institutional cultures that value experimentation, learning and adaptation. Forward-looking governance models should be built on accountability, cross-sectoral cooperation and the capacity to learn from both successes and failures. The chapters argue for supportive policies and regulatory frameworks that foster the full spectrum of innovation activities, from grassroots experimentation to high-end research.

Mindset and Paradigm Shifts

Several chapters call for a fundamental shift in mindset among policymakers, innovators and society at large. This includes challenging conventional assumptions – such as viewing food solely as a commodity rather than a common resource – and embracing alternative perspectives that are more attuned to Africa's realities. Such paradigm shifts are essential for unlocking new opportunities, fostering resilience and enabling Africa to move from being a consumer to a producer of innovation.

Rethinking the Role of Technology and the Arts

There is a caution against over-emphasising technology in innovation discourse. The arts and creative sectors are highlighted as underutilised drivers of transformation that are capable of seeding new ideas, fostering social cohesion and catalysing change. Evidence-based support for the arts, as well as better understanding of their role in innovation, is recommended. Innovation is ultimately about human creativity, ingenuity and abstraction. At the same time, Africa must move beyond being a passive user of imported technologies to becoming an

active developer and innovator, with regionally based 'tech sandboxes' and platforms for experimentation.

Financing and Public Funding Structures

A persistent barrier to scaling innovation in Africa is the inadequacy of current funding structures. The volume calls for enhanced public funding for research and development, as well as the creation of innovative financing mechanisms, including impact investing, crowd investment and dedicated innovation taxes. Public funding strategies must be aligned with sectoral priorities, particularly in agriculture and health, to address food security and promote export opportunities. Strengthening formal innovation systems will require not only more resources but also more effective allocation and accountability.

Policy Implementation and Political Economy

A critical, often overlooked, challenge is the gap between policy formulation and implementation. The chapters point to issues of political will, resource constraints and capacity deficits as key impediments. There is a need for comprehensive, integrated approaches that address the entire innovation value chain, from ideation to commercialisation. The political economy of innovation, including the influence of external actors, the politics of knowledge and the taboo around industrial policy, must be openly debated and addressed if Africa is to chart its own development path.

Inclusivity, Self-Reliance and Leadership

Finally, the future of African innovation depends on inclusivity, self-reliance and distributed leadership. Innovation systems must be solutions-orientated and people-centred, while ensuring equitable opportunities for all citizens and harnessing the continent's demographic dividend. Greater self-reliance will require domestic resource mobilisation, ownership of the development agenda and the leveraging of indigenous capabilities. Leadership – across government, business, academia and civil society – must be visionary, agile and collaborative, capable of driving systemic change and sustaining momentum.

In summary, the recommendations emerging from this volume are not simply technical fixes, but calls for systemic transformation. They urge African countries to embrace integration, collaboration, capacity building, anticipatory governance, mindset shifts and inclusive leadership as pillars of robust innovation ecosystems. Only through such a holistic and contextually grounded approach can Africa unlock the full potential of innovation to solve its most pressing challenges and realise its aspirations for sustainable, inclusive development.

Conclusion

This volume argues that Africa stands at a critical juncture where a bold, systemic and inclusive innovation agenda is essential for transforming the continent. Building on the insights of the previous volumes, the book underscores that innovation in Africa must move beyond isolated technological advances to embrace a holistic, ecosystem-based approach that integrates diverse knowledge systems, empowers all stakeholders and aligns with the continent's developmental aspirations. The chapters collectively demonstrate that only by fostering robust, adaptive and context-sensitive innovation systems can Africa address its persistent challenges and unlock its full potential for sustainable and inclusive growth.

Looking to the future, Africa's innovation journey will be shaped by its ability to harness emerging technologies, cultivate indigenous capabilities and build resilient ecosystems that are both agile and inclusive. The continent's youthful population, rich resource base and expanding digital infrastructure present unprecedented opportunities. Realising these, however, will require visionary leadership, coordinated action and sustained investment from policymakers, innovators, investors and civil society. This volume calls on all stakeholders to work collaboratively – across sectors and borders – to drive a new era of innovation-led transformation. In doing so, Africa would not only meet its own development goals but also contribute meaningfully to global progress in an increasingly interconnected world.

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Chapter 2

Stimulating Innovation in Africa's Food–Health Nexus

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Introduction

This chapter discusses two development challenges that confront Africa, especially in relation to the United Nations' (UN) Sustainable Development Goals (SDGs). There is the challenge of food and nutrition security and achieving SDG 2. There is also the challenge of good health and well-being and achieving SDG 3. These are interlocking challenges. Food insecurity manifested in about 281.6 million people in Africa in 2020, with 20% of people experiencing hunger. This is an increase of 46.3 million over the previous year (The Food and Agriculture Organization of the UN [FAO], 2021). Achieving SDG 2 of ending hunger in Africa is unlikely in this situation. Also, the state of health of the people in Africa shows that the communicable and non-communicable disease burden is at significant levels, which constrains the achievement of the SDG 3 of good health and well-being (World Health Organization [WHO], 2022). Using data and statistics from the relevant international sources, including FAO and WHO, the chapter discusses the state of food and nutrition security and the state of health and well-being in Africa. The fundamental question is as follows: how should Africa address these challenges and achieve SDG 2 and SDG 3, given the current conditions on the continent and the fast pace of innovation and technological transformation?

The innovation system (IS) concept provides a framework for analysing these two fundamental development challenges and the options for reorientation to achieve SDG 2 and SDG 3. Analysis of the roles of the critical actors begins with

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the elaboration of the IS concept. Variously defined, an IS comprises actors, networks, and institutions contributing to address the primary function of creating value in applying new knowledge for developing, diffusing and utilising new goods and services. The conceptualisation of ISs has progressed through the work of various scholars including Freeman (1987); Nelson (1993); Mytelka (2000); Lundvall (1992); Saviotti and Pyka (2013); Kraemer-Mbula and Wunsh-Vincent (2016) and Fu et al. (2019). Nevertheless, the role of critical actors and the interrelationships among these actors are underscored in the literature as the determinants in innovation. Therefore, this chapter focuses on IS analysis of the roles of critical stakeholders to stimulate innovation in the food–health nexus.

The critical actors in the food–health nexus that this chapter focuses on are farmers, researchers, healthcare professionals, industrialists and policymakers. Farmers constitute a core category of actors in the agricultural IS. In Africa, smallholder farmers dominate the agriculture sector. The question of how to enhance their roles in innovation to increase productivity is crucial for food and nutrition security. The researchers in the knowledge institutions – the universities and research institutes – play an important role in applying modern scientific knowledge and tools to generate improved technologies for agriculture and healthcare. However, the mechanisms of interaction with the end-users of their research outputs must be appropriate for the purpose. Bringing healthcare to the communities in the rural and peri-urban areas is crucial to the achievement of SDG 3. The question is: what institutional innovations can be made to increase the impact of the inadequate healthcare professionals in employment in Africa? Industrialists provide the private infrastructures and the means for significant value addition in the production of goods and services. Analysis of their constraints and opportunities will highlight their role in the IS.

In stimulating innovations in the food–health nexus, policymakers determine the plans and strategies for public influence on the critical actors. The regulations, legislations and policies resulting from the work of the policymakers determine the extent of innovation in the national IS. The chapter concludes with an emphasis on strengthening the roles of the critical actors and their interrelationships.

Problem Statement

Food and Nutrition Security in Africa

The level of food insecurity in Africa rose to 60.9% in 2022 (FAO et al., 2023), led by Central Africa (78.4%), East Africa (69.2%), and West Africa (66.4%). The severity of food insecurity levels has increased the risk of malnutrition in Africa. Fig. 2.1 shows the percentage of the population who are undernourished in selected countries in West and East Africa. Apart from Ghana and Senegal, whose percentage of undernourished population fell below the global status in 2017, and Cote d'Ivoire in 2019, all the selected countries in West Africa were above the global percentage of undernourished population.

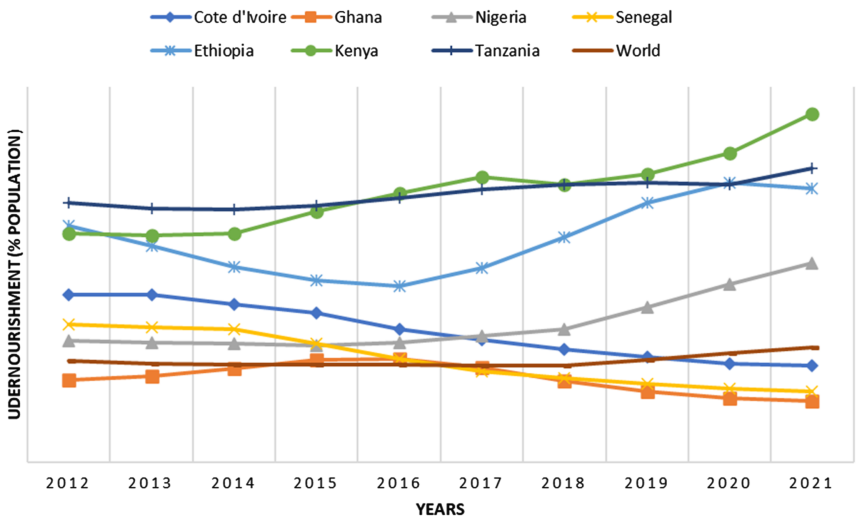

Fig. 2.1. Prevalence of Undernourishment in North and Southern Africa. *Source:* Authors' elaboration based on data from the World Bank (2020).

The situation was a bit better for the North African countries, where the percentage of the population who were undernourished was below the global average. However, the levels kept increasing steadily from 2018 to 2021, apart from Algeria, which had stabilised. The population of Morocco who were undernourished increased from 3.6% in 2018 to 6.3% in 2021 (Fig. 2.2). The situation was more pervasive in the Southern African countries, such as Malawi and Zambia. Although the population of Zambians who were undernourished has reduced steeply over the past years, it was above the global average.

Comparing these figures to other continents, it can be said that it will be difficult for Africa to meet the SDG targets of Zero Hunger for 2030. Other countries are on track to achieve the target. For instance, the populations who are undernourished have stabilised at 2.5% or below over the past 10 years in the United Kingdom and United States while that of Central Europe & the Baltics and East Asia & the Pacific have reduced steadily over the years until they also stabilised at 2.5% and 4.0%, respectively, in 2021.

Communicable and Non-communicable Diseases in Africa

The state of health of the people in Africa shows communicable and non-communicable diseases at significant levels, which constrains the achievement of good health and well-being (WHO, 2022). Apart from the North African countries, the percentage of deaths in Africa caused by the incidence of

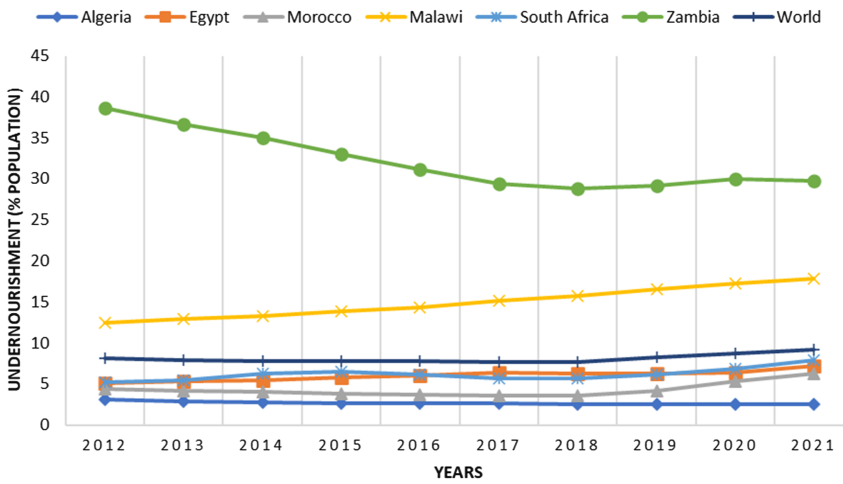

Fig. 2.2. Prevalence of Undernourishment in North and Southern Africa. *Source:* Authors' elaboration based on data from the World Bank (2020).

non-communicable diseases was minimal as compared to the global average and the selected continents (World Bank, 2020). See Fig. 2.3. However, the percentage of deaths caused by communicable diseases in 2019, as a percentage of total incidence of death, was extremely high, especially in the Western, Eastern and Southern African countries. This higher incidence of deaths might be due to the inability of Africans to produce vaccines as a quick response to control communicable diseases, compared to the other continents that have the technical know-how and the technology to produce sufficient good-quality vaccines. Africa imports 99% of its vaccines but in insufficient quantities and obtained with unacceptable delays due to a lack of negotiating skills and purchasing power (Laura et al., 2023).

GDP per capita in Africa

There is a relationship between the purchasing power of an individual, a group or a country and food insecurity and health. The minimum purchasing power of Africa, which has made it difficult to achieve SDG 2 and SDG 3, is evidenced in the share of gross domestic product (GDP) generated by the manufacturing sector. The average global GDP per capita has increased steadily for the past 10 years, from US$14,605 in 2013 to US$20,693 in 2022 (Fig. 2.4). However, the GDP per capita of all the selected African countries is far below the global GDP per capita. Although there has been an appreciable increase in GDP per capita of some of the Northern and Southern African countries, they performed below the

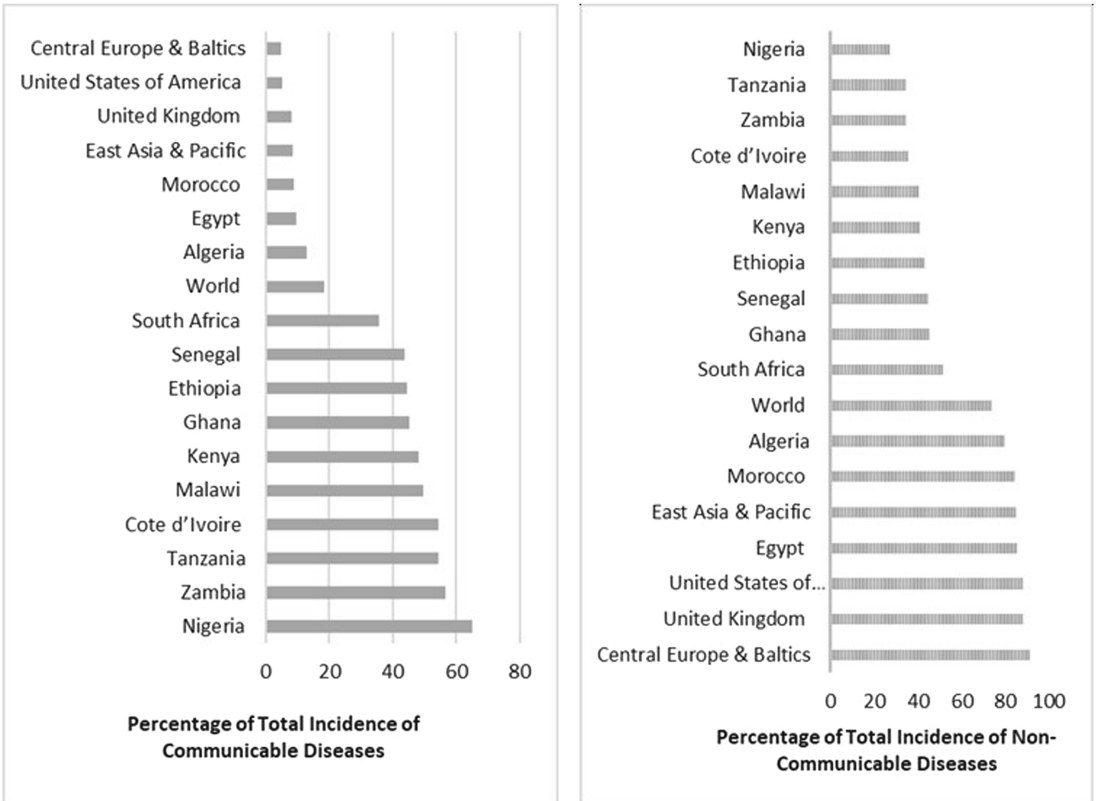

Fig. 2.3. Death by Communicable and Non-communicable Diseases (% of Total Occurrence in 2019). *Source:* Authors' elaboration based on data from the World Bank (2020).

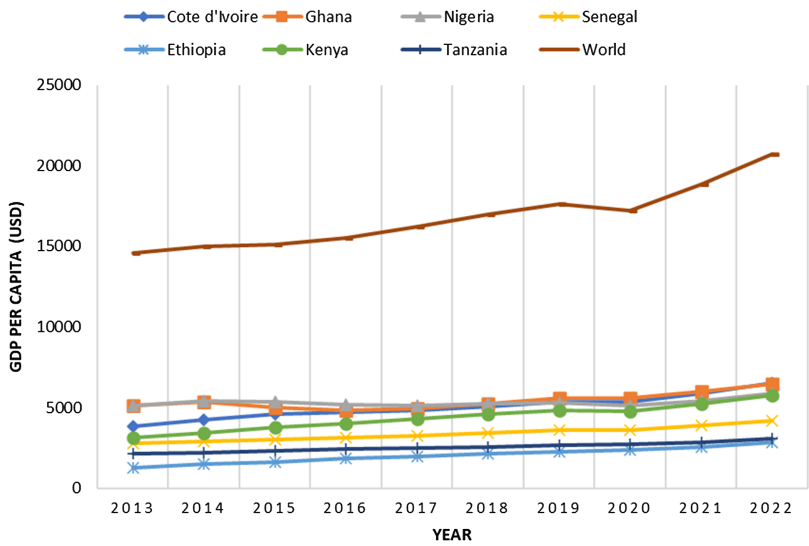

Fig. 2.4. GDP per Capita in East and West Africa. *Source:* Authors' elaboration based on data from the World Bank (2020).

global average and that of the United States, the United Kingdom, Central Europe & the Baltics and East Asia & the Pacific. This shows how difficult it is for African countries to achieve SDG 2 and SDG 3.

Life Expectancy at Birth in Africa

The severity of food insecurity levels and the devastating health conditions in Africa as a result of communicable diseases, coupled with the lower GDP per capita, have reduced the life expectancy in Africa. Although the life expectancy of Africa increased between 2012 and 2019, the regions were all less than the global average, except for the Middle East & North Africa. For instance, Ghana had a life expectancy of 63.8 years in 2021, representing 7.5 years less than the global estimated life expectancy of 71.3 years. With an estimated rate of 52.7 years in 2021, Nigeria had the shortest life expectancy among the selected countries in Africa, which was 20.4 years less than the global estimated life expectancy. On the contrary, all the other sub-regions of the world have a life expectancy above the global estimate. East Asia & Pacific, which was the least among the other global sub-regions, had a life expectancy estimate of 75.5 years in 2021, which was 4.2 years higher than the average global estimate.

Conceptual and Analytical Framework

In the 1950s and 1960s, the major theories that sought to explain innovation or technology and development were the technology push theory and the demand-pull theory. The technology push theory states that innovation is a linear process from research and development (R&D) to the market while the demand-pull theory posits that innovation is demand-driven, determined by market demand (Peters et al., 2012). These two theories created the assumption that innovation was reserved for highly trained labour and rigorous R&D in organisations associated with developed countries. However, other scholars came up with alternative explanations. For example, there came the IS concept. The national IS is 'a set of institutions whose interactions determine the innovative performance of national firms' (Nelson, 1993). Other studies such as Saxenian (1994); Cooke (1992) and Malerba (2005) later proposed that ISs operate and have a greater influence at different levels other than national. This is where institutions, firms and organisations interact within a specific geographic area, sectoral or technological space. The second step of IS analysis is to identify the main actors of the IS (mapping) to understand their roles, interactions and possible barriers that might hinder the overall performance of the IS. The final step is to describe the key functions of actors in the IS. This is done to offer recommendations that will help improve those functions.

The IS approach argues that the determinants of technological change are not only found within the individual firm but are also a collective responsibility among actors in the IS (Edquist, 2001). Thus, the IS embraces a shift from the conventional, linear approach to R&D by providing an analytical framework that involves complex relationships among various actors, including firms, universities and research institutions, policymakers, financial institutions, market and non-market institutions, and users/consumers, to achieve poverty reduction and socioeconomic development (Metcalfe & Miles, 2000). The concept of IS is based on theories such as interactive learning (e.g., Lundvall, 1992), evolutionary-institutional theories (Nelson, 2002) and classical theory of international trade (Myint, 1992), among others. A study by Fagerberg et al. (2010) suggests that innovation may not necessarily be high-tech from R&D activities, but innovative ideas may originate from several sources and take several forms, including product adaptation and process improvements.

Botta et al. (2015) outline three steps of IS analysis. First is the selection of the level of analysis, be it national, regional, sectoral or technological IS. The IS framework has been used as an important tool to explain the differences in economic performance in developing countries. Understanding the interactions of the various actors involved in the innovation process and the knowledge flow among them helps in the formulation of appropriate policies that will create the enabling environment to enhance the performance of the actors (Iizuka, 2013). However, IS analysis suffers from two major flaws. First, it focuses on comparing the social structure of different ISs and less emphasis is placed on the analysis of the dynamics of ISs. Second, the framework focuses mainly on the institutions and less on the actions of the individual (Edquist, 2001). However, several studies have

proposed similar frameworks to address these flaws. Carlsson et al. (2002) address these flaws by identifying actors in the IS and their key relationships and performances. Similarly, Jacobsson and Bergek (2004) also proposed a framework known as functions of IS that focuses on mapping the activities that take place to enhance technology development and diffusion.

Discussion of the Food–Health Nexus

The analysis of the food–health nexus in Africa takes into consideration all the levels of ISs (national, regional, sectoral and technological). The critical actors this chapter focuses on are the farmers, researchers, healthcare professionals, industrialists and policymakers. Analysis of these actors is focused on their functions, constraints and opportunities in the IS and how policies, regulations or legislations by the policymakers can improve their roles.

Farmers

Functions and Constraints

Farmers constitute a core category of actors in the agricultural IS. In Africa, smallholder farmers dominate the agriculture sector. They purchase farm inputs for their farming activities to provide food, fibre and other resources for human consumption and economic development (Ikram et al., 2023) through their forward and backward linkages. However, climate change, which has contributed to persistent drought/flood, the degradation of soil, the loss of biodiversity and the spread of plant and animal diseases and pests, has reduced agricultural productivity drastically (FAO, 2017). Other constraints confronting smallholder farmers include post-harvest losses, limited or lack of agriculture mechanisation and deplorable road access (FAO, 2019). Meanwhile, there are modern technologies that have transformed agriculture in Europe, the US and Asia, enabling farmers to increase production efficiency (Rehman et al., 2016). Therefore, enhancing the role of Africa's smallholder farmers in technological innovation to increase productivity and agriculture sustainability is crucial for food and nutrition security in Africa.

Opportunities

Table 2.1 shows agricultural technologies and innovations that can be leveraged to achieve food nutrition and security. For example, aerial drones with sensors or cameras help farmers to obtain data and images on crop growth rate, health and nutrient levels to manage their crops and increase yield (Ahirwar et al., 2019). The use of biotechnologies in different applications enables farmers to produce crops that are resistant to pests, diseases and adverse environmental conditions. It also promotes the efficiency of crop breeding programs, protects germplasm resources and improves the quality and outputs of agricultural products. In animal

Table 2.1. Profiling Agricultural Technologies.

Name of Innovation/Technology	Function of Technology
Satellite imagery and aerial photography	Helps to track farm conditions and biodiversity.
The ICT-based digital advisory technologies	Enable farmers to access best agronomic practices, market price information, crop insurance packages, weather updates and access to finance.
Warehouse receipt system	Enable farmers to gain access to finance and market and reduces post-harvest losses.
Sustainable intensification technologies	Enables farmers to increase productivity while minimising negative environmental impacts, reducing greenhouse gas emissions, enhancing soil health and promoting biodiversity.
Radio frequency identification (RFID) tags	Enables farmers to monitor animal health and trace animal products through the supply chain.
Biosensors	Enables farmers to monitor soil and water quality, disease detection, pesticide and herbicide detection.
Aerial robotics and drones	Enable farmers to conduct soil health assessments, crop health monitoring, irrigation, application of fertilisers and insecticides.
DNA-based technologies	Promotes the efficiency of crop breeding programmes, protects germplasm resources, improves the quality and outputs of agricultural products.
Automated machinery and robotics	For planting, pruning, spraying and harvesting.

(Continued)

Table 2.1. *(Continued)*

Name of Innovation/Technology	Function of Technology
Biotechnology	This technology is produced by researchers and adopted by farmers to produce crops that are resistant to pests, diseases, and adverse environmental conditions and produce animals with desirable traits.
Data analytics and artificial intelligence algorithms	Farmers adopt this technology, produced by researchers, to predict crop growth, yields and disease outbreaks.
Artificial general intelligence (AGI) in agriculture	To analyse data from sensors, satellites and drones to detect diseases, pests, nutrient deficiencies and weather predictions.
Smart irrigation systems	To monitor soil moisture levels, and weather conditions, and automatically adjust irrigation schedules remotely.
Drip irrigation	To conserve water, improve plant health, control weeds and apply fertiliser directly to the root zones of crops.
Greenhouse cultivation	Extends growing seasons, protect crops from the weather, diseases and pests, and conserve water.

Source: Authors' compilation, drawing on Alexandrova-Stefanova et al., 2023; Fang et al., 2016; Ikram et al., 2023; Sadiku et al., 2020; World Bank, 2012.

production, biotechnology enables farmers to produce animals with desirable traits or develop vaccines and other treatments for livestock.

Healthcare Professionals

Functions and Constraints

The essential role played by healthcare professionals in the promotion of good health cannot be exaggerated. They contribute immensely to supporting the health requirements of people through illness prevention and primary healthcare (Abdullah et al., 2022). However, the limitations and underdeveloped healthcare systems in Africa, characterised by inadequate human resources, inadequate budgetary allocation to health, poor leadership and management, and dilapidated healthcare systems, have caused people to leave Africa to seek various forms of treatment abroad (Oleribe et al., 2019). Aside from the problems confronting the medical system in Africa, such as the inadequate administrative infrastructure, adherence to medical prescriptions by patients is also a challenge. Studies have shown that about 50% of patients do not adhere to their prescribed medications, which leads to a relapse or rehospitalisation (Pal et al., 2021).

Opportunities

Amid the inefficiencies in healthcare procedures that result in late detection and inaccurate diagnosis and inadequate infrastructure to improve operations and healthcare (Georgiou et al., 2021; Minopoulos et al., 2022), technological innovations are the way forward to reducing disease severity and mortality, increasing life expectancy and achieving good health and well-being of the people in Africa. There are advanced technologies (Table 2.2) that enable health professionals to monitor whether patients take their medications seriously or not. These technologies, including smart blister packs, medication event monitoring system (MEMS®), GlowCap, radio frequency identification (RFID) embedded smart drawers and the wisely aware RFID dosage (WARD) system, either sound an alarm to remind patients to take their medication or allow health professionals to monitor the number of times patients open their medicines.

There are also biotechnology-based health technologies that continue to break ground in the medicine and healthcare field. The areas of application of biotechnology in healthcare include precision medicine, pharmacogenomics, gene mapping, genetic testing and biopharmaceuticals, among others. Through these biotechnology-based health technologies, health professionals can investigate individual differences in genes, environment and lifestyle to predict disease occurrence in a particular group of people and predict accurate treatment and medication (Bhatia, 2021). It is also used in forensic and identity testing, among others. These innovations, in addition to the use of artificial intelligence (AI), big data analysis (BDA), the Internet of Things (IoT), augmented reality (AR) and wireless sensor networks (WSN), among others, can help overcome several limitations or barriers in detecting and fighting diseases to achieve SDG 3.

Table 2.2. Profiling Healthcare Technologies.

Name of Innovation/Technology	Function of Technology
Smart blister packs, and medication event monitoring system	To monitor when a pill is taken out of its packing and to measure patients' medication adherence.
GlowCap	This system has a wireless connection that plays an alarm tone to remind patients to take their medication.
Biosensors and trackers	These are shrinking wearables and medical devices that help to monitor and track patients' health, enabling earlier intervention.
OrCam MyEye	This is a device that has a camera mounted on the frame of eyeglasses to capture images of the wearer's surroundings. The device then uses AI to provide auditory feedback to the user, such as reading text aloud or identifying objects in the environment.
Artificial intelligence (AI) (e.g. IBM Watson computer system)	This AI assists doctors in diagnosing and analysing symptoms to prescribe the best treatment to patients.
Advances in vaccine technologies such as live-attenuated vaccines	To build the immune system to recognise parts of pathogens or their secreted components to protect the body against further occurrence of a disease.

Biotechnology-based health technologies such as precision medicine	Help to predict disease occurrence or determine the sex of babies, forensic and identity testing.
Robotic surgery	Robotic surgery is minimally invasive, more precise, less prone to infection and quicker to heal surgery procedures that use advanced robotic systems.
Blockchain	This involves the use of a decentralised and secure digital ledger to store, manage and share medical data between facilities, and scientists.
Augmented reality or virtual reality	Assist surgeons during surgical procedures by bringing out important information such as patients' anatomy, vital signs and surgical plans onto the surgical field to enhance precision.
Medical drone deliveries	For transporting medical supplies such as vaccines, medications, blood samples and emergency medical equipment to remote areas.
Medical imaging	To visualise and diagnose various medical conditions including fractures, tumours, infections and internal injuries.

Source: Authors' compilation, drawing on Alexandridi et al., 2022; Pal et al., 2021; Nhuong 2018; Bhatia, 2021; Leeming et al., 2019; Junaid et al., 2022.

Researchers and Universities

Functions and Constraints

Godin (2006) explains that there are three elements in the innovation process: obtaining knowledge from fundamental and strategic research; translating the knowledge into actual products or technologies through strategic, applied and adaptive research and commercialisation of the products or technology through effective communication and service delivery. This shows that researchers in the knowledge institutions – the universities and research institutions – play an important role in applying modern scientific knowledge and tools to generate improved technologies for agriculture and healthcare. As depicted in Table 2.1, the contribution of R&D in agricultural technology and innovation cannot be overstressed. However, several studies (Fadeyi et al., 2022; Addison et al., 2022; Achukwu et al., 2023; Arslan, 2020) acknowledge that the rate of adoption of agricultural technologies by smallholder farmers in Africa is low, stemming from inadequate education and extension services and lack of access to finance, among others. To enhance the uptake of agricultural technologies to increase productivity and enhance food nutrition and security in Africa, the mechanisms of interaction of researchers with the end-users of their research outputs must be appropriate.

In addition, R&D in medicines and health technologies mainly focuses on expensive products that can yield higher incomes while investment in poverty-related and neglected diseases, which is prevalent in Africa, is less than 2% of the $240 billion annual global expenditure on health R&D (Bessel et al., 2018). What worsens the situation is that there is inadequate investment in the education of healthcare professionals in Africa, which has led to shortages of health workers in the health systems (Okoroafor et al., 2022).

Opportunities

To attain the goal of good health and well-being of SDG 3, it is necessary to adopt a product development partnership as the best approach to invest in safe, effective, affordable and accessible health technologies, including vaccines, diagnostics and drugs for poverty-related and neglected diseases (Bulc & Ramchandani, 2021; Bilinski et al., 2017). There is also a need to educate and train three million additional healthcare professionals by 2030 to render indispensable health services in Africa (WHO, 2016). Additionally, there is a need for universities and research institutions to adopt innovative methods of teaching to develop human resources to produce knowledge and technology (World Bank, 2012). Some of these innovative ways of teaching include technological advances in medicine and healthcare education, where medical students learn anatomy and practice operations using virtual reality (VR) or AR to interact with human models in a realistic 3D environment and can zoom in and out to focus on the details (Nhuong, 2018).

Industrialists

Contributions to Healthcare Development

Recent studies have demonstrated a positive relationship between industrialisation and improved healthcare (Ackerman & Koziol, 2019) through the production of emerging technologies, machines and equipment, or infrastructure as a strategy for effective healthcare, prolonged life expectancy and increased general safety and welfare for Africa (Signé, 2021; Bedir, 2016). The role of the Fourth Industrial Revolution in transforming healthcare is enormous. Industrialists have developed sophisticated medical and public health safeguards that have greatly improved the quality of life. For example, there is the development of drones that are capable of supplying medical items to remote medical centres. Other essential clinical equipment built by the industrialists includes dialysis machines, lung and brain protective ventilators, magnetic resonance imaging (MRI) and X-ray machines. Industries have also helped to improve health by producing personal protective equipment, test kits and adapters that allow ventilators to serve more than one patient at a time. All this equipment facilitates medical treatment and allows healthcare professionals to take better care of patients and to enhance their good health and well-being. A study by Thomas et al., 2021 suggests that the breakthrough in the production of sophisticated clinical machines has been possible as a result of R&D activities carried out by industrialists in partnership with universities, research institutions, and health professionals.

Contributions to Agricultural Development

In agriculture, industrialists provide the private infrastructures and the means for significant value addition in the production of goods and services. 3D printing technology is used to produce a variety of food items and beverages, and internet of food technology can help to improve the food supply chain (Alexandrova-Stefanova et al., 2023). IoT technology can also be used in packaging to monitor the condition of food products, such as temperature, humidity and freshness.

Industrialists in Africa have contributed to the improvement of agricultural productivity through the production of agrochemicals and feed with fertilisers, weedicides, pesticides, poultry and animal feed and drugs (Balchin et al., 2016). However, there is little development in the production of higher or more sophisticated agricultural machinery compared to other regions, caused by the effects of trade and globalisation as African countries have not seized the opportunity of comparative advantages in manufacturing (Roberts, 2017).

Opportunities

To enhance agricultural productivity and increase food nutrition and security, there should be intersectoral cooperation between agricultural industrialists, processing factories, farmers and other actors in the value chain on the

integration of storage, processing and sale of products in the manufacturing process (Tukhtabaev et al., 2022). Additionally, there should be appropriate pathways, such as patenting and licencing, for the transfer of knowledge from universities and research institutions to the industry, especially when the knowledge to be transferred is embodied in human capital that moves from research institutions or universities to the industry (Veugelers, 2014).

The Role of Policymakers in Stimulating Innovations in the Nexus

Functions and Constraints

Policymakers are responsible for creating an enabling environment that allows innovation to happen in the food–health nexus. They determine the plans and strategies for public influence on the critical actors in the food–health nexus. The regulations, legislations and policies resulting from the work of the policymakers determine the extent of innovation in the national IS. Farmers, health professionals, researchers and entrepreneurs will only risk their lives and resources to innovate if there are favourable conditions, such as an established intellectual property registration system, to protect their works (World Bank, 2012) and ensure that they obtain the benefits they deserve from their innovations. Through the appropriate regulations, policies and legislation, policymakers also encourage the formation of various groups, associations and co-operatives by actors in the ISs for a common purpose. The import and export activities of entrepreneurs and investors are largely driven by policies, regulations and legislations.

Bringing healthcare to the communities in the rural and peri-urban areas is crucial to the achievement of SDG 3. However, studies (Peprah et al., 2020; Sulemana & Dinye, 2014; Lu et al., 2010) have revealed that inadequate health facilities, long distances to health facilities, poor roads and inefficient transportation systems, inadequate healthcare professionals, high-cost of health services and unreliable supply of electrical energy are the major constraints to the accessibility of health services by rural communities. Private sector professionals such as doctors and pharmacists will act to address the rural healthcare challenge where there are clear policy incentives for them to do so.

Opportunities or the Way Forward

To enhance good health and well-being in Africa, there is a need for policymakers to embark on infrastructural development and the establishment of enough universities and research institutions to train adequate healthcare professionals, and the acquisition of sophisticated clinical equipment and medicines, among others. In addition, there should be policies that seek to establish convenient care centres such as community health-based planning services (CHPS) compounds at remote centres that provide conducive and affordable care to patients.

In agriculture, there is a need for policymakers to devise a strategy for the preparation, dissemination and adoption of innovative technologies by farmers or other actors in the food value chain (Alexandrova-Stefanova et al., 2023). Agricultural innovation policy laboratories are an evidence-based approach to the formulation and implementation of such policies. This is where stakeholders are brought together to discuss and contribute to the policy in a participatory manner to enrich the process with their demands and concerns, knowledge and technical know-how (Alexandrova-Stefanova et al., 2023). This approach enhances the adoption of agricultural innovations. Government policies should be directed towards the building of infrastructure such as irrigation facilities, agribusiness marking systems, public warehouses for agricultural products and processing plants to reduce post-harvest losses. Additionally, there should be an institutional arrangement to reduce the cost of borrowing for farmers through banks, cooperatives and informal credit institutions and address the land tenure system problem and price stabilisation of agro-products through price-settings and buffer stock management.

Policymakers should also provide adequate funding for R&D to accelerate agricultural and biomedical research to increase innovations in the food–health nexus. Finally, there should be an appropriate industrial policy direction to determine the kind of agricultural and clinical equipment to produce, in terms of quality and sophistication, to enhance agricultural mechanisation and quality healthcare in Africa.

Conclusion and Recommendations

The chapter discussed two development challenges that confront Africa, especially in relation to SDGs. These are the challenge of food and nutrition security and achieving SDG 2 and the challenge of good health and well-being and achieving SDG 3. The discussion centred on the state of food and nutrition security in Africa and the state of health and well-being of the people of Africa, focusing on farmers, researchers, healthcare professionals, industrialists and policymakers as the critical actors in the food–health nexus. The conclusion is that the severity of food insecurity levels in Africa has increased the risk of malnutrition, and the communicable and non-communicable disease burden is at significant levels. The percentage of deaths caused by communicable diseases in Africa was higher above the global average, compared to Europe, the US and Asia, inhibiting the achievement of SDG 3. Additionally, the GDP per capita in the year 2022 of all the selected African countries was far below the global average. The severity of food insecurity levels and the devastating health conditions in Africa as a result of communicable diseases, coupled with the lower GDP per capita, have reduced the life expectancy in Africa.

To enhance food and nutrition security and the good health and well-being of the people in Africa, the chapter makes the following policy recommendations:

- Researchers should appropriately interact with the end-users of their research outputs during the research initiation stage to enhance the uptake of agricultural technologies to increase productivity and enhance food nutrition and security in Africa.
- Government and private partners should invest in sustainable agricultural technologies and mechanisation to boost productivity.
- Government and private partners should build infrastructure such as irrigation facilities, agribusiness market systems, public warehouses for agricultural products and processing plants to increase food productivity and reduce post-harvest losses.
- To enhance farmers' access to credit, government should formulate policies to reduce the cost of borrowing through the appropriate interactions with financial institutions.
- Government should provide adequate funding for R&D to accelerate agricultural and biomedical research to increase innovations in the food–health nexus.
- Researchers in medicines and health technologies should invest in safe, effective, affordable and accessible health products to combat the poverty-related diseases in Africa.
- There is a need for government to train additional healthcare professionals to render indispensable health services in Africa to reduce the adverse effect of communicable and non-communicable diseases.
- There is a need for universities and research institutions to adopt innovative methods of teaching to train adequate numbers of healthcare professionals to promote the health of Africans.
- Government should institute a well-established intellectual property registration system and educate the industrialists and researchers about the application process to encourage technological innovations in Africa.
- Government and private investors should embark on infrastructural development to promote food security and the health of Africans.

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Chapter 3

Putting Community at the Centre of Health System Transformation in Africa

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Summary

Before colonisation, African communities relied on their natural environment to address health issues, a practice that continues in many indigenous societies across Central Africa. The introduction of Western medicine brought significant changes to healthcare delivery, reshaping the relationship between patients, doctors and caregivers. However, the COVID-19 pandemic underscored the vital role of community engagement in public health, as it often determined the success or failure of national response strategies. In Africa, where many health systems struggle with limited resources, placing the community at the forefront of health system transformation is crucial for achieving equitable access to quality healthcare and universal health coverage.

This chapter argues for a model that integrates traditional practices with modern technology and Western medicine to create a uniquely African healthcare system. Traditional medicine, still relied on by more than 80% of the population in Sub-Saharan Africa, must work in tandem with technological innovations and modern medical practices to ensure that high-quality healthcare is accessible to all. This integration not only respects cultural practices but also maximises healthcare outcomes by leveraging both local knowledge and modern advances.

By examining the challenges and opportunities of placing the community at the centre of health system reforms, this chapter highlights the potential for home-grown solutions that are sustainable and context-specific. Local leaders and communities must be empowered to take ownership of health system transformations, ensuring that reforms are grounded in local realities and meet

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the specific needs of the population. The insights drawn from this approach will contribute to policy changes across African nations, fostering innovations that prioritise community engagement and inclusivity. Ultimately, this chapter envisions a healthcare system in Africa where no one is left behind, and every individual has access to the care they need, driven by a blend of traditional and modern medical practices.

Introduction to Health System Transformation in Africa

Africa's health systems have faced numerous challenges over the decades, ranging from inadequate infrastructure to insufficient healthcare personnel and from fragmented service delivery to limited access to essential medicines. These systemic issues have contributed to poor health outcomes, particularly in rural and underserved communities. The goal of health system transformation in Africa is to address these deficiencies by creating resilient, equitable and sustainable systems that can provide quality health services to all, regardless of geographic location or socioeconomic status. Central to this transformation is the role of the community – its engagement, leadership and integration into the fabric of healthcare delivery. This chapter explores how placing the community at the heart of health system reforms in Africa can lead to more effective, culturally relevant and sustainable healthcare solutions.

Africa's health systems face numerous challenges, including inadequate infrastructure, insufficient healthcare personnel, limited access to essential medicines and fragmented service delivery. These systemic issues are compounded by financial constraints, political instability and the burden of infectious and non-communicable diseases. Rural and underserved communities are particularly affected, with disparities in healthcare access and quality contributing to poor health outcomes across the continent (Oleribe et al., 2019; World Health Organization, 2022).

The primary goal of health system transformation in Africa is to create resilient, equitable and sustainable healthcare systems that can provide quality services to all individuals, regardless of their geographic location or socioeconomic status. This transformation aims to address existing deficiencies by strengthening health infrastructure, enhancing the workforce, improving service delivery and ensuring universal health coverage. Ultimately, the objective is to build health systems that are capable of responding effectively to current and future health challenges.

The community plays a pivotal role in the evolution of health systems in Africa. By actively engaging community members in the planning, implementation and evaluation of health services, health systems can become more responsive to local needs and culturally relevant. Empowering communities fosters ownership and accountability, leading to better health outcomes and more sustainable health interventions. Community involvement also helps to bridge the gap between traditional and modern medicine, ensuring that healthcare delivery is inclusive and respectful of local practices and beliefs. In the field

Fig. 3.1. The Foundation of Global Health Success: The 4C Pyramid of Effective Collaboration. *Source:* Bélizaire et al., 2024.

of global health, effective collaboration is crucial for implementing inclusive projects that meet stakeholder goals and have a tangible impact on the communities they aim to enhance, ultimately improving quality of life. Collaboration is at the top of the four Cs pyramid and is built upon a foundation of trust (confidence), communication, understanding (comprehension) and the collective pursuit of a common goal (Fig. 3.1) (Bélizaire et al., 2024).

Therefore, building trust with the community is paramount in transforming the healthcare system in Africa.

Historical Context of Healthcare in Africa

Before the advent of Western medicine, African communities relied heavily on traditional health practices that were deeply rooted in their cultural and environmental contexts. Healers, herbalists and spiritual leaders played a pivotal role in addressing health issues, using a wealth of knowledge that was passed down through generations. These practices were holistic, often addressing not just the physical ailment but also the spiritual and social well-being of the individual.

The introduction of Western medicine during colonisation significantly disrupted these traditional systems. Western medical practices, which were often imposed through colonial policies, shifted the dynamics of healthcare delivery. The patient–doctor relationship became more formalised, often sidelining the community's role in care. This shift also led to a growing distrust between communities and healthcare providers, as the latter were seen as outsiders who did not fully understand or respect indigenous knowledge and practices.

In a study assessing the healthcare systems in Africa, the authors found that the first three challenges identified were inadequate human resources (34.29%), inadequate budgetary allocation to health (30%) and poor leadership and management (8.45%). The leading solutions suggested included training and capacity building for health workers (29.69%), increase budgetary allocation to health (20.31%) and advocacy for political support and commitment (12.31%) (Oleribe et al., 2019).

Therefore, the underdeveloped healthcare systems in Africa need radical solutions with innovative thinking to break the impasse in service delivery. For example, public–private initiatives should be sought, where multinational companies extracting resources from Africa might be encouraged to plough some of the profits back into healthcare for the communities that provide the workforce for their commercial activities (Africa CDC, 2025b; SDG Partnership Platform; Intellecap, 2018). Most problems and their solutions lie within human resources, budget allocation and management. These should be accorded the highest priority for better health outcomes.

Over time, however, there has been a gradual evolution in the relationship between the patient, the doctor and the community. In recent years, there has been a growing recognition of the value of integrating traditional practices with modern medicine, leading to a more collaborative approach that acknowledges the strengths of both systems.

The Role of Community in Health Systems

Community engagement is the active involvement of community members in the planning, implementation and evaluation of health services and programmes. It is crucial for ensuring that health interventions are culturally appropriate, accessible and sustainable. Effective community engagement can lead to improved health outcomes, greater trust in the healthcare system and increased ownership of health initiatives by the community.

Education and empowerment of community members are critical components of this engagement, particularly in addressing health-related stigma. For instance, in Cameroon, when community members were sensitised about Buruli ulcer (BU), a debilitating skin disease, there was a significant reduction in the stigma against patients suffering from it. This example highlights the importance of informed communities in promoting inclusive and supportive healthcare environments.

Several case studies highlight the success of community engagement in health initiatives across Africa. For example, in Uganda, the Village Health Team model has been instrumental in improving maternal and child health outcomes by empowering community members to provide basic health services and education at the grassroots level (Vanderslott et al., 2021).

Similarly, in Ethiopia, the Health Extension Programme (HEP) has successfully utilised community health workers (CHWs)to deliver essential health services, particularly in rural areas (Assefa & Getachew, 2022).

Community leadership plays a vital role in these successes. When community leaders are involved in health initiatives, they can mobilise resources, advocate for their communities and ensure that health services are aligned with local needs and priorities. The impact of community leadership on health outcomes is profound, as it fosters a sense of ownership and accountability that is essential for the sustainability of health programmes.

The study found that 55% of clinics in Cape Town in South Africa were linked to a health committee. The existing health committees faced sustainability and functionality challenges and primarily practised a form of limited participation. Their decision-making influence was curtailed, and they mainly functioned as a voluntary workforce assisting clinics with health promotion talks and day-to-day operational tasks. Several factors impacted health committee participation, including a lack of clarity on health committees' roles, health committee members' skills, attitudes of facility managers and ward councillors, limited resources and support and lack of recognition (Haricharan et al., 2021; Thipanyane et al., 2022).

To create meaningful participation, health committee roles should be defined in accordance with a primary healthcare (PHC) and human rights framework. Their primary role should be to function as health governance structures at facility level, but they should also have access to influence policy development. Consideration should be given to their potential involvement in addressing the social determinants of health. Effective participation requires an enabling environment, including support, financial resources and training.

Health committees contribute to community participation through holding primary health workers accountable, voicing their communities' concern and mobilising resources for health activities and projects. Decision-makers, health managers and advocates need to fundamentally rethink how health committees are selected, empowered and supported to implement their roles and responsibilities (Haricharan et al., 2021; Karuga et al., 2022).

In Ghana, it was found that patient and public participation (PPP) implementation was largely limited at higher health system levels (i.e. national, regional and district levels), but was functioning at the community level. PPP also improved access to health services, responsiveness to patient needs, community–health worker relationships, health-seeking behaviours, empowered healthcare users and improved health outcomes. The study, therefore, recommended the need to undertake PPP across all levels of the health system to maximise PPP's role in health system improvement. Finally, the study suggested prioritising PPP, especially for resource-poor countries, to complement

government's efforts in improving accessibility of healthcare services to many communities and also provide a more patient-centred healthcare system responsive to patients' and public needs (Ankomah et al., 2024).

Lessons from Epidemics and Neglected Tropical Diseases in Central Africa

The Role of CHWs in Emergency Response

In the Central African Republic (CAR), decades of armed conflict have crippled the public health system. This has left the population without timely access to life-saving services and therefore vulnerable to the numerous consequences of infectious diseases, including malaria. As a response, in 2008, an international non-governmental organisation started a network of CHWs in the highly malaria-endemic region of north-west CAR. The area has experienced years of violent clashes between rebel groups and seen hundreds of thousands of people displaced.

Data from routine patient registers from 80 CHWs working in the Paoua and Markounda sub-prefectures were entered and retrospectively reviewed. The time period covered December 2009 to April 2014 and hence different stages of conflict and unrest. Several indicators were measured over time, including malaria rapid diagnostic test (RDT) positivity rates, CHW reporting rates and malnutrition indicators.

Among nearly 200,000 people who consulted a CHW during this period, 81% were found to be positive for malaria parasites by RDT. In total, 98.9% of these positive cases were appropriately treated with artemisinin-based combination therapy (ACT). Only 1.2% of RDT negative cases were incorrectly treated with an ACT. Monthly data from each CHW were regularly reported, with more than 96% of CHWs reporting each month in the first three years of the project. However, since the coup d'état in March 2013, the number of CHWs reporting each month decreased as the programme battled the additional constraints of civil war. Although the political crisis affected the CHWs, the programme showed that it could reach those who were most vulnerable and continue some level of care at all times. In addition, this programme revealed that surveillance could be maintained in conflict zones. This is especially important for agencies that must often decide in a short space of time how to respond effectively to complex emergencies (Paintain et al., 2014; Ruckstuhl et al., 2017).

The COVID-19 pandemic brought the importance of community engagement into sharp focus. Countries that successfully engaged their communities in the pandemic response were able to achieve better health outcomes, while those that did not faced significant challenges. Community-based surveillance, risk communication and the distribution of essential supplies were all areas where community engagement proved critical (Fallah et al., 2024).

The experience of the COVID-19 response in Africa, particularly through the partnership to accelerate COVID-19 testing (PACT) initiative led by Africa

CDC, highlighted the crucial importance of community-based approaches in managing health crises (Cuen et al., 2022). The deployment of 29,000 CHWs across 29 African countries demonstrated that involving communities from the early stages of the response enhances the effectiveness of interventions, improves population adherence and facilitates the rapid dissemination of preventive measures. Among the notable innovations, the integration of CHWs into testing and contact tracing strategies enabled early case detection and a decentralised response, thereby reducing pressure on formal health structures. Additionally, the use of digital tools for real-time data collection and transmission improved epidemiological surveillance and decision-making. Through this approach, more than two million households were visited, strengthening awareness and better controlling the spread of the virus at the community level. The collaboration between CHWs, health authorities and technical partners also fostered more effective coordination and a multisectoral approach tailored to local contexts. These lessons emphasise the need to institutionalise and strengthen the role of CHWs within African health systems to enhance resilience against future health emergencies (Cuen et al., 2022; Fallah et al., 2024).

To address the Mpox outbreak that was declared Public Health Emergency of Continental Security (PHECS) and Public Health Emergency of International Concern (PHEIC) by Africa CDC and the World Health Organization in August 2024, countries like Burundi, Uganda and the Democratic Republic of the Congo (DRC) deployed more than 3,000 CHWs to bolster surveillance, vaccination, risk communication and infection prevention. Sierra Leone's 'Operation Find Them All' campaign, launched in February 2025, intensified active case searches in hotspot zones (Africa CDC, 2025a). In the DRC, contact listing surged sevenfold over three months, highlighting the effectiveness of CHW-led outreach. Supervised by head nurses and supported by epidemiologists, these CHWs conducted door-to-door visits to identify, isolate and monitor suspected cases. Their efforts were vital in breaking transmission chains and enabling early intervention, particularly in remote areas that were underserved by traditional health systems.

Mpox has further illustrated the need for CHWs to be embedded in epidemic preparedness plans. The response has shifted towards intensification, integration and legacy. In many countries, CHWs now simultaneously address multiple diseases: Mpox, Ebola, chickenpox and measles, proving their adaptability. Access to the appropriate digital tools and ensuring fair remuneration will be critical. Institutionalising CHWs within preparedness strategies will enhance early detection and equitable access to care.

In the CAR, the response to COVID-19, Mpox and malaria highlighted the strengths and weaknesses of community engagement. In the case of malaria, CHWs played a crucial role in distributing insecticide-treated nets and providing education on malaria prevention. However, the challenges of reaching remote communities and the lack of adequate resources hampered the overall effectiveness of these efforts. The pandemic also served as a catalyst for rethinking the role of communities in health systems. It underscored the need for stronger community-based health systems that can respond quickly and effectively to public health emergencies. The lessons learnt from COVID-19 and malaria in

CAR demonstrate that community engagement is not just a nice-to-have, but a critical component of health system resilience as seen in the management of Mpox and Dengue outbreaks in the country (Garba-Ouangole et al., 2023; Ruckstuhl et al., 2017).

Addressing Neglected Tropical Diseases Through Community Healthcare Workers

BU is a skin disease caused by *Mycobacterium ulcerans*. It is the third most common mycobacterial infection after tuberculosis and leprosy. CHWs hold the potential to support patients and their families at the community level.

Cameroonian scientists conducted a cross-sectional descriptive study to assess the participation of CHWs in the early diagnosis and treatment of BU in Ngoantet, Cameroon. The CHWs' performance was measured using: the number of cases referred to the Ngoantet Health Centre, the percentage of accomplished referrals and the percentage of cases referred by CHWs confirmed by the staff of Ngoantet Health Centre. Data were analysed using Epi-info version 3.4.1. and Microsoft Office Excel 2003. The study focused on 51 CHWs in the Ngoantet health area. The referral rate was 95.0%. Most of the suspicious cases (91.5%) referred were confirmed by health workers. Most CHWs (78.4%) declared that they had identified at least one presumptive case of BU infection.

This study concludes that the CHWs can play a key role in scaling up BU control activities using a referral system and confirms the role of home visits and inspections in the early detection and treatment of BU (Vouking et al., 2013). This was witnessed by Epicentre, Médecins Sans Frontières and CIRES while supporting the national programme for NTDs in BUs endemic regions of Cameroon.

Universal health coverage will not be achieved if healthcare worker shortages, estimated to increase to 18 million by 2030, are not addressed rapidly. Community-based health systems, which depend on effective engagement of CHW, may have an essential role in linking communities with healthcare facilities and reducing unmet health services needs caused by these shortages. The Canadian Red Cross (CRC) has partnered with different National Red Cross/Red Crescent Societies and health ministries in Africa in the implementation of programmes where CHWs contributed to the provision of various health services (Idriss-Wheeler et al., 2024).

Methodology

This study reports on key findings (i.e., beneficiaries reached, CHWs engaged, programmes implemented, intervention outcomes) and lessons learnt from CRC-supported CHW programmes in Africa over a period of 15 years, from 2007 to 2022. Qualitative methodology was employed to conduct document analysis on 17 sets of reports from each CRC-supported CHW project in Africa over these 15 years. The focus was on identifying challenges, facilitators and lessons learnt.

Integrating Traditional and Western Medicine

Traditional healers remain an integral part of healthcare in Africa, with more than 80% of the population in Sub-Saharan Africa relying on it for their PHC needs. Despite this, traditional medicine has often been marginalised in formal healthcare systems, viewed with scepticism by some healthcare professionals trained in Western medicine.

There are, however, growing examples of how traditional medicine can be effectively integrated with Western practices, particularly in the diagnosis and management of HIV. In Uganda, traditional healers have been recognised for their role in the early diagnosis of HIV, as highlighted in a study published in *The Lancet*. These healers, who are trusted figures within their communities, have been trained to identify symptoms indicative of HIV and refer patients to healthcare facilities for confirmatory testing and treatment (Ponticiello et al., 2021, 2022).

In South Africa, similar initiatives where traditional healers are collaborating with healthcare providers to increase the detection and management of HIV are increasing. These partnerships have been particularly successful in reaching populations that are otherwise hesitant to engage with formal health services (Boum et al., 2021b).

In Cameroon, plans are underway to train traditional healers to play a more active role in HIV diagnosis and referral, following the models observed in Uganda and South Africa. This integration not only helps bridge the gap between modern healthcare services and the cultural practices that are deeply embedded in African societies but also enhances the overall effectiveness of health interventions by leveraging the trust and accessibility that traditional healers command.

The impact of such integration on health outcomes is significant. Patients benefit from a broader range of treatment options, and healthcare providers can offer more culturally sensitive care. Furthermore, integrating traditional medicine can help increase access to healthcare in rural areas where modern medical facilities are scarce.

In a cluster randomised trial that took place in Uganda between 2 August 2019 and 7 February 2020, 17 traditional healers were randomly assigned as clusters (nine to intervention and eight to control), with 500 clients of unknown HIV serostatus enroled (250 per group). In the intervention group, 250 clients (100%) received an HIV test compared with 57 (23%) in the control group, a 77% (95% CI 73-82) increase in testing uptake, after adjusting for the effect of clustering ($p < 0 \cdot 0001$). Ten (4%) of 250 clients in the intervention group tested HIV positive, seven of whom self-reported being linked to HIV care. No new HIV cases were identified in the control group. Qualitative interviews revealed that HIV testing that had been delivered by traditional healers was highly acceptable among both providers and clients. No safety or adverse events were reported (Boum et al., 2021b; Sundararajan et al., 2021).

Delivery of point-of-care HIV tests by traditional healers to adults of unknown serostatus significantly increased rates of HIV testing in rural Uganda.

Given the ubiquity of healers in Africa, this approach holds promise as a new pathway to provide community-based HIV testing and could have a dramatic effect on uptake of HIV testing in Sub-Saharan Africa.

Beyond HIV, traditional healers are involved in the screening and management of many other diseases and are at the forefront of pandemics and epidemics, such as Ebola virus, where they have played an important part in Africa.

Neglected tropical diseases are also investigated and managed by traditional healers. Examples include diseases such as human African trypanosomiasis (sleeping sickness), BU and snake bites in Cameroon, where more than 80% of the patients seen at the hospital first consulted a traditional healer because of the established relationship of trust they had with their community.

Moreover, the COVID-19 pandemic has been an opportunity for African traditional medicine and healers to become involved in the management of patients facing many challenges. Several products issued from traditional medicine have been used by the population (e.g., Elixir COVID in Cameroon, Covid organic in Madagascar and BAELMBO Syrup in Mali), and some of them have eventually been considered and used for COVID-19 cases in many countries, including Cameroon (Boum et al., 2021b).

Technology, Innovation and Community Health

Technology has the potential to revolutionise health systems in Africa, particularly in community health. Mobile health (mHealth) initiatives, telemedicine, digital health platforms and microinsurance are just a few examples of how innovation can enhance the delivery of health services, especially in remote and underserved areas. These technologies not only improve access to healthcare but also create opportunities to protect community members financially, complementing the efforts towards universal health coverage that many African countries are striving to implement despite significant challenges (Boum, 2021).

Case studies from across Africa demonstrate the success of technology-driven community health initiatives. For example, in Rwanda, the use of drones to deliver medical supplies to remote areas has significantly reduced the time it takes to get life-saving medicines to those in need. In Kenya, the M-PESA mobile money platform has been used to facilitate payments for health services, making healthcare more accessible to low-income populations. Additionally, microinsurance schemes, often integrated with mobile platforms, have emerged as a critical tool in providing financial protection against health-related expenses. These schemes allow community members to pool resources and share the financial risks associated with illness, thereby reducing the burden of out-of-pocket payments and enhancing access to care (christian stadler, 2024).

However, the introduction of technology in health systems must be balanced with respect for traditional practices. While technology can enhance healthcare delivery, it should not replace the human touch and the deep cultural connections that are essential to effective healthcare in many African communities. Instead, technology should be used as a tool to support and complement

traditional practices, ensuring that healthcare is both innovative and culturally relevant. Moreover, by incorporating microinsurance, communities can better manage health risks and financial vulnerabilities, providing a crucial safety net that strengthens the overall health system and supports the goal of universal health coverage.

The use of information and communication technology (ICT) tools to improve professionalism at work is increasing all the time in a dynamic digital environment. Tools such as telemedicine, tele-education and health informatics are being incorporated in the health sector to enable easy access to essential services, for example, in medical areas from referral centres by the patients on one hand and enabling the doctor-to-doctor consultations for the benefit of patients. Unfortunately, observations indicate insufficient efforts and commitment to optimising use of the tools in the majority of the countries south of the Sahara. Sub-Saharan Africa has in some ways been left behind the rest of the world in terms of development after experiencing decades of economic exploitation by especially the West of its natural and human resources. These factors, as well as ethnic conflicts and ongoing wars, have continued to ruin Sub-Saharan Africa's socio-economic development. Information was obtained through a network of telemedicine practitioners in different African countries using internet communication, through email and reviewing the existing literature on their activities. This information was compiled from representative countries in each African region and the previous authors' experiences as telemedicine practitioners. Most of these countries have inadequate ICT infrastructure, which creates sub-optimal application. Sub-Saharan Africa, made up of 33 of the 48 global poorest countries, must extend its ICT diffusion and policy to match the ever-developing global economy. In some countries, such as Ethiopia and South Africa, there has been significant progress in telemedicine, while in countries such as Burkina Faso and Nigeria, the progress is slow because of a lack of political support. Almost all reference to Africa is made to Sub-Saharan Africa, which has big social, economic and political problems, with resultant high morbidity and mortality rates. This also highlights the under-representation of African researchers in the global realm of information system research. Though telemedicine in Africa has not attracted enough political support, it is potentially a useful conduit of healthcare given the fact that the continent is under-resourced and still enduring the effects of scarce human resources, especially in health. (Wamala & Augustine, 2013).

Microinsurance, as highlighted in *Emerging Practices in Mobile Microinsurance* by Camilo Téllez, has the potential to significantly improve the management of health in African communities. By offering affordable insurance options through mobile platforms, microinsurance schemes can protect low-income populations from the financial risks associated with health emergencies. These schemes enable communities to pool resources and share the financial burden, thereby enhancing resilience and ensuring more consistent access to healthcare services (Téllez, 2012).

The integration of microinsurance with mHealth initiatives can further streamline healthcare delivery, providing a comprehensive approach to managing health risks.

Mobile health (mHealth) has attracted much attention in the global health community as a technological fix that can short-circuit inadequate health-system infrastructure and build access. But like many other technology-based approaches to remedy structural health inequities, mHealth interventions can be overhyped. We discuss here MOS@N, an mHealth network launched in 2013 by the Centre de Recherche en Santé de Nouna (CRSN), Burkina Faso, with funding from the International Development Research Centre, Canada (Sawadogo et al., 2021).

Case studies from across Africa demonstrate the success of technology-driven community health initiatives. For example, in Rwanda, the use of drones to deliver medical supplies to remote areas has significantly reduced the time it takes to get life-saving medicines to those in need. In Kenya, the M-PESA mobile money platform has been used to facilitate payments for health services, making healthcare more accessible to low-income populations. Similarly, microinsurance schemes have emerged as a critical tool in providing financial protection against health-related expenses, as seen with initiatives like BIMA in Ghana and MicroEnsure in Kenya (Boum, 2021).

However, the introduction of technology in health systems must be balanced with respect for traditional practices. While technology can enhance healthcare delivery, it should not replace the human touch and the deep cultural connections that are essential to effective healthcare in many African communities. Instead, technology and artificial intelligence (AI) should be used as tools to support and complement traditional practices, ensuring that healthcare is both innovative and culturally relevant (Abernethy et al., 2022).

Despite the promise of these innovations, challenges remain, particularly in scaling up successful models to reach broader populations. For instance, the MOS@N project, which provided medical support to pregnant women in Africa, ran out of funding just three years into operation, underscoring the need for securing longer-term financial support to sustain mobile health initiatives. Similarly, social innovations such as BIMA (Ghana), MicroEnsure, AccessAfya (Kenya), Idocta (Cameroon) and Healthforce (South Africa) have used telemedicine to improve access to quality healthcare but have struggled to scale up to a level where they can have a broader impact on African communities (Boum, 2021).

Securing longer-term funding and support for these innovations is critical for their sustainability and for realising their full potential in transforming health systems across Africa. By addressing these challenges and scaling up successful initiatives, African communities can benefit from the full potential of technology and innovation, ultimately leading to more resilient and equitable health systems.

Designing a Community-Centric Health System

To design and build an effective community-centric health system, we must focus on empowering local communities to actively participate in shaping and delivering healthcare services. A community-centric health system places the needs, values and leadership of the community at the forefront of healthcare delivery. Built on the principles of equity, accessibility and sustainability, this approach ensures that healthcare is not just about delivering services but doing so in a way that is aligned with the cultural, social and economic realities of the people it serves. By prioritising these principles, a community-centric health system fosters a sense of ownership and accountability, empowering individuals and communities to take an active role in their health and well-being.

One of the central components of this system is the engagement of CHWs. These workers are pivotal to the success of community-centric health models, especially in diagnosing and managing diseases such as HIV, malaria and tuberculosis. CHWs, drawn directly from the communities they serve, have a deep understanding of local health challenges, cultural practices and language barriers that formal healthcare providers may not fully grasp. Their role is crucial in bridging gaps between formal healthcare systems and communities, ensuring that health services are accessible, equitable and culturally sensitive (Board, 2014).

To further enhance the capabilities of CHWs, technological tools such as **smartphones equipped with diagnostic algorithms** and **rapid diagnostic tests** are essential. In malaria-endemic regions, for example, CHWs equipped with these tools can diagnose and treat cases on the spot, ensuring immediate care with medications like antimalarials. This capability not only increases access to healthcare but also ensures that patients receive timely interventions, thereby reducing the risk of complications and improving overall health outcomes. Technology, therefore, is an enabler, allowing CHWs to deliver high-quality care in even the most remote areas and contributing to the sustainability and scalability of the health system (Diese et al., 2018; Paintain et al., 2014; Shrestha et al., 2024).

A key element in building a community-centric health system is the integration of community feedback in health policies. **Regular consultation** with community members and leaders ensures that healthcare initiatives are adaptable and responsive to changing local conditions. Policies informed by community experiences are more likely to succeed because they address real-world challenges in a culturally relevant manner (Manalili et al., 2022).

The **policy implications** of adopting this model are significant. Governments must formalise the role of communities in healthcare governance and allocate the necessary funding to support such systems. This involves training CHWs, investing in technology and ensuring that health infrastructure is in place to support community-led initiatives. Furthermore, international partners and donors must prioritise community engagement in their support of global health efforts, ensuring that local voices shape the development and implementation of health policies.

To design an effective community-centric health system, several strategies must be implemented:

- Community leaders must be at the forefront of health planning and decision-making processes. Their involvement ensures that health initiatives are aligned with local values and priorities and that they have the community's trust and support.
- Continuous training and capacity building are essential to enable CHWs to deliver high-quality health services. This includes leveraging technology to enhance their diagnostic capabilities and ensuring they have the resources needed to perform their duties effectively.
- Health policies must be informed by the experiences and needs of the community. This requires mechanisms for regular consultation and feedback, ensuring that policies are adaptable and responsive to changing local conditions.

In one of his famous speeches, Mahatma Gandhi said that 'Whatever you do for me, without me, is against me' (Mahatma Gandhi, 1942). This sentiment underscores the fundamental truth that any health system that is designed to serve a community must place that community and its leaders at the centre of the process. The policy implications of adopting a community-centric health model are profound. Governments must go beyond simply including communities in consultations – they must establish legal frameworks that formalise the role of communities and their leaders in health governance. This includes providing the necessary funding, infrastructure and training to ensure CHWs are empowered and supported.

Therefore, a community-centric health system is not merely an approach to delivering healthcare, it is a revolutionary model that redefines how health services are designed, implemented and sustained. It empowers communities by giving them the agency to take control of their health, ensuring that solutions are equitable, accessible and aligned with their realities. By leveraging the leadership of local communities, the expertise of CHWs and the power of technology, we can create a system that not only addresses health challenges but does so in a sustainable and culturally relevant way. This model has the potential to transform health outcomes, particularly in resource-limited settings, and should serve as a blueprint for health systems globally.

Challenges and Opportunities in Community-Centric Health Systems

Transforming health systems to be more community-centric is a complex process that brings both significant challenges and promising opportunities. A community-centred health system prioritises the involvement and leadership of local communities in shaping healthcare services, but achieving this model is not without hurdles. These challenges include limited resources, resistance from

established healthcare structures, the need for capacity building at the community level and difficulties in integrating technology with traditional practices. Despite these obstacles, there are numerous opportunities to innovate and strengthen health systems by leveraging the unique strengths of communities.

One of the primary challenges in developing community-centric health systems is the scarcity of resources, particularly in low-income regions. Many communities lack the financial, technological and human resources needed to build and sustain effective healthcare infrastructures. This shortage is often exacerbated by the underfunding of community health programmes, which limits their capacity to deliver essential services, especially in times of crisis. For instance, during pandemics like COVID-19 and Mpox, CHWs played a crucial role in response efforts, ensuring continuity of care and vaccine distribution in rural and underserved areas. However, many community health initiatives remain poorly integrated into national PHC systems and are often overlooked during budgeting and policy development stages (George et al., 2015).

Another challenge is resistance to change within established healthcare systems. Traditional healthcare models, particularly those dominated by top-down approaches, may be reluctant to shift towards a more community-driven model. This reluctance stems from concerns about losing control or undermining professional expertise. However, for a community-centric health system to succeed, there must be a deliberate effort to change the mindset of both healthcare professionals and policymakers, who may need to adopt a more inclusive approach to health governance (Boum et al., 2021a; DuBose & Mayo, 2020; Oleribe et al., 2019).

In addition, tensions often arise between traditional and modern healthcare approaches. Communities, especially in Africa, have longstanding healthcare practices that may not align with modern medical practices. Incorporating traditional medicine into a community-centric health system can be challenging, as it requires mutual respect, trust-building and careful integration of evidence-based practices. The difficulty lies in ensuring that traditional practices complement rather than conflict with modern healthcare services, particularly when addressing diseases that require standardised treatment protocols, such as malaria, tuberculosis and HIV (Marques et al., 2022; Thipanyane et al., 2022).

Moreover, the integration of technology into community health systems poses its own set of challenges. While technological advancements such as mobile diagnostics and telemedicine have the potential to bridge gaps in healthcare delivery, their implementation in remote areas may be hindered by a lack of infrastructure, digital literacy and access to electricity and internet. To fully leverage the benefits of technology, governments and partners must invest in building the necessary infrastructure and providing training to CHWs and community members.

Despite these challenges, the move towards a community-centric health system presents significant opportunities. One of the most promising is the potential to harness the strengths of communities, such as local knowledge, social networks and cultural practices, to build more resilient and responsive healthcare systems. During pandemics, for example, the involvement of communities in

designing locally tailored responses has been key to mitigating the spread of diseases like Mpox (Africa CDC, 2025a; Boum & Ndembi, 2024).

By engaging communities in health governance, governments can ensure that healthcare services are not only accessible but also culturally relevant and trusted by the population.

Another opportunity lies in the strategic development of the community health workforce across Africa. With partnerships like the Africa CDC and UNICEF initiative, which aims to grow the community health workforce to two million workers by 2027, African countries are making strides towards sustainably recruiting, retaining and equipping CHWs. This expansion would be a game-changer for healthcare delivery on the continent, particularly in rural and underserved areas. The strategic commitment to strengthening this workforce, made by African Union Heads of State in 2017, is crucial for addressing the continent's growing healthcare needs (Africa CDC, 2023).

Countries like Cameroon, Kenya and Ethiopia are budgeting for their community health initiatives, recognising the importance of investing in CHWs. Not only do CHWs provide essential healthcare services but they also act as trusted liaisons between formal healthcare systems and local communities, helping to ensure that healthcare is culturally appropriate and accessible. Prioritising investment in CHWs, especially women workers who often dominate the field, will be crucial for improving healthcare outcomes across Africa.

Additionally, the opportunity to share best practices, pool resources and coordinate activities at both national and continental levels cannot be overstated. The operationalisation of the Continental Coordination Mechanism (CCM) for community health will allow African Member States to maximise the impact of their health initiatives (Africa CDC, 23 C.E.). By collaborating, countries can reduce duplication of efforts, streamline resource allocation and improve overall healthcare delivery across the continent.

While the journey to establish community-centric health systems is fraught with challenges, it is also full of opportunities. The path forward requires commitment to investing in CHWs, integrating technology with traditional practices and prioritising community involvement at every stage of health system design. Acting now to strengthen Africa's health systems (Bobby Demiddie, 2020; Diese et al., 2018; Paintain et al., 2014).

By focusing on these elements, governments and international partners can build health systems that are more resilient and inclusive, as well as capable of meeting the diverse health needs of African populations.

Conclusion and Way Forward

The transformation of health systems in Africa is an ongoing and complex process, but it is one that holds tremendous potential for improving the health and well-being of communities across the continent. By placing the community at the centre of health system reforms, we can create healthcare systems that are more responsive, equitable and sustainable. The integration of traditional and

Western medicine, the empowerment of CHWs and the use of technology are all critical components of this transformation.

The examples from Uganda, South Africa and Cameroon show that traditional healers can play a vital role in the diagnosis and management of diseases like HIV when properly integrated into the healthcare system. Similarly, the use of AI-equipped smartphones by CHWs demonstrates how technology can enhance disease diagnosis and treatment, particularly in remote and underserved areas.

As we look to the future, it is essential that policymakers, healthcare providers and community leaders work together to design and implement health systems that prioritise the needs and voices of the community, as seen in CAR. This collaboration will be crucial in achieving universal health coverage and ensuring that no one is left behind.

A positive vision for the future of health systems in Africa is one where community engagement is not just an afterthought but the foundation upon which all health initiatives are built. By embracing a community-centric approach, Africa can lead the way in creating health systems that are truly inclusive, resilient, aligned with the UBUNTU concept and capable of meeting the diverse needs of its people. It is an imperative to decolonise global health and provide equity in access to quality healthcare services.

CHWs have proven indispensable to epidemic response and long-term disease control alike. As Africa's health systems evolve, three key policy priorities must be addressed:

(1) **Institutionalise CHWs** as being integral to both universal health coverage and emergency preparedness. Their deployment must be pre-planned, remunerated and supported with digital tools.
(2) **Define CHW deployment benchmarks**, both for routine services (e.g., 25 per 10,000 population for universal health coverage) and for outbreak scenarios. The Mpox response offers a provisional emergency benchmark.
(3) **Invest in community governance**, ensuring that local leaders, traditional healers and CHWs participate in health planning and accountability.

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Chapter 4

Bringing the Traditional Grains of Sorghum and Millet Back to the Dinner Table

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Introduction

Food insecurity has been the bane of Africa for some time now. With 20.4% of Africa's population experiencing hunger and 58% facing food insecurity, the continent is struggling to meet basic food and nutrition security needs. Further rising costs have made healthy diets unaffordable for 924.8 million people, exacerbating food insecurity and malnutrition on the continent (African Union [AU], 2024). Ironically, agriculture is the backbone of Africa's economies. Its contribution to gross domestic product averages about 30%–40%. Its role is even more critical as a provider of employment, ranging from 65% to 70% (World Bank, 2013).

The underlying cause of food insecurity can be attributed to the fact that the agricultural sector has been underperforming. Productivity has remained stagnant despite a fast-rising population. More crucially, Africa has failed to leverage agriculture to transform its economies and thus spawn new industries[1] and jobs and tackle poverty. To unlock the potential of agriculture, the AU has initiated the Comprehensive Africa Agriculture Development Programme (CAADP).[2]

[1]Agroprocessing value added is generally less than 20% of agricultural value added in Sub-Saharan Africa.

[2]At the Second Ordinary Session of the Assembly of the African Union held in July 2003 in Maputo, Mozambique, the heads of state and government launched the Comprehensive Africa Agriculture Development Programme (CAADP).

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This agriculture-led integrated framework of development priorities in Africa is aimed at reducing poverty and increasing food security in the continent (AU-NEPAD, 2003). A key cornerstone of CAADP is commitment by government to allocate 10% of the budget for investment in agriculture. However, the rhetoric has not been accompanied by action as only one country, Rwanda, has ever achieved this.

The challenge of underinvestment is being compounded by climate change, which will hugely impact productivity. It is now urgent that Africa accelerates efforts to tackle food insecurity and, more crucially, leverage agriculture to drive transformation. Innovation will be at the heart of this. Innovations to increase crop yields and also innovation in products to address emerging demand driven by rising incomes and urbanisation.

The low productivity has seen Africa food imports rise, and this has been accompanied by dietary shifts towards temperate crops, especially maize, wheat and rice, which dominate global food markets. And perhaps here lies the biggest challenge as the diet shift has seen Africa abandon its traditional crops, especially millet and sorghum, to adopt temperate crops.

Millet and sorghum have been the key contributors to calories in Africa traditionally, as they are native to the region and thus well suited to the agro-ecological conditions.[3] However, they have been steadily losing their share of contribution to calories, especially to maize and more recently to rice and wheat. For example, in Uganda, millet fell from being the second most important contributor to calories to 11, while sorghum fell from rank seven to rank 12. On the other hand, wheat rose form rank 12 to rank six, while rice rose from rank 14 to rank number nine (FAOSTAT data).

The falling of traditional grains from Africa's dinner tables can be attributed to socio-economic changes and failure of the traditional grains ecosystems to spur the needed innovations to stay competitive to other grains.

- It has been pointed that millet yields in Kenya are at 15% of their potential yields (Salasya et al., 2009). The reason attributed to this is neglect by agricultural research systems that have favoured maize and other 'modern' crops over traditional cereals.[4] The result of low yields is to make them uncompetitive in price. Innovations in better seeds have lagged compared to maize.

[3]The agrarian revolution is perhaps the biggest revolution that has happened to human kind, and Africa played a huge part in heralding it. Water has been harnessed in Egypt, making irrigation possible but more crucially the harnessing of seeds and crop rotation. Harnessing millet and sorghum was Africa's contribution to the agrarian revolution. Rice was harnessed in Asia, wheat in Europe and maize in the Americas.

[4]This can be partly explained by the colonial roots of agricultural research systems, where the initial researchers who came from Europe focused on crops they were more familiar with. As these research areas were developed, new researchers naturally gravitated to these new crops.

- Traditional grains are vulnerable to the quelea bird. This bird can devastate whole fields and has been referred to as a feathered locust (Ojina, 2019; The New Humanitarian, 2009). Without adequate ways to manage the quelea menace, many farmers have abandoned farming traditional grains. Innovation in bird management has lagged.
- Millet has been seen as the food of the poor, as it is generally produced and consumed by the poorer sections of the society (it tends to be grown in more marginal areas where other crops, e.g. maize, tend to do poorly). This image has dented demand. Innovation in marketing, to position traditional grains as modern foods and as desirable foods, has been absent.
- More importantly, as people have moved to urban areas, the demand for foods that are easy to prepare (time and energy) has increased. However, there has been no innovation of millet products to meet these new realities. Thus, as urban diets have shifted towards foods like rice and wheat, millet has become equated with rural diets, further compounding its image as the poor man's food. Innovations in product development to meet evolving markets have been low.

The rise of these 'new cereals' poses a number of challenges. Maize is the most widely grown staple crop in Sub-Saharan Africa (SSA) and serves an important role in food security (Bankole et al., 2017; Lunduka et al., 2017; Food and Agriculture Organization of the United Nations [FAO], 2021). Maize can also be linked to persistent food insecurity. An assessment of the impact of physical drought on maize revealed an alarming vulnerability in SSA (Kamali et al., 2018). Yet, on average, 5–10 drought events were experienced between 1970 and 2004 in most parts of SSA (Fisher et al., 2015). Indeed, 15%–20% of its yield is lost to drought each year, causing a large part of Africa to have an inadequate supply, which is met by imports. Climate change is expected to exacerbate the situation as it is projected to cause a reduction in maize production by almost 22% by 2050 (Barbosa et al., 2021; Schlenker & Lobell, 2010).

Wheat is increasingly becoming a staple in Africa. As this is a temperate crop, many parts of Africa cannot grow wheat. Wheat production in Africa has increased steadily at a rate of 0.52 million tons per year (Mt yr^{-1}) since 1980 to nearly 25.2 Mt in 2020. This increase in wheat production was accompanied by a sharp increase in wheat imports: since the mid-1990s, wheat imports have increased steadily at a rate of 1.45 Mt yr^{-1}, resulting in a gap between wheat import and production of 21.7 Mt in 2020. The result is that in 2020, Africa accounted for nearly 25% of the global wheat imports (FAO, 2021). Urbanisation, higher incomes, population growth and allied lifestyle changes are all driving increased demand for wheat. Many urban women are working, so families are transitioning to bread and other convenient wheat-based foods and processed foods (Listman, 2019). This trend is cause for concern:

- As the major wheat-exporting countries are limited in number, global wheat trade is highly concentrated. Indeed, wheat imports in Africa show a high trade concentration ratio, as 60%–70% of the wheat is imported from six

countries, namely Russia, France, Ukraine, the USA, Canada and Argentina. This concentration makes Africa highly vulnerable to unexpected shocks e.g. extreme weather events, disease outbreaks or conflicts in exporting countries (Silva et al., 2023), as the ongoing conflict in Ukraine has demonstrated. A food price shock has already been induced by Russia's invasion of Ukraine, which has already resulted in export restrictions covering more than 16% of internationally traded calories. This has surpassed the highest level of restrictions adopted during the food price crisis of 2007–2008 (Kleimann, 2022).

- A recent study by the International Maize and Wheat Improvement Center (CIMMYT) projects that wheat output in Africa and South Asia will suffer severely from climate change by 2050 (CIMMYT, 2023).

Rice is an increasingly important staple crop in Africa. It is a major dietary energy source for West Africa and the second most important source of calories in Africa (AGRA, 2025). Demand quadrupled from around 10 Mt to 40 Mt between 1990 and 2018 due to population growth and dietary shifts (De Vos et al., 2023). At the same time, Africa's rice production has been lagging behind demand, making the continent increasingly import-dependent. Out of 34 million tons of milled rice consumed annually in SSA, only 35% is produced locally (AGRA, 2025). This points to important food security challenges, especially given that a huge share of rice is currently imported from Southeast Asia (SEA) and India. This dependency makes Africa vulnerable to external supply and price shocks, as demonstrated during the 2008 food crisis, when rice prices spiked more dramatically than those of other cereals in Africa (De Vos et al., 2023).

The result of dietary shifts has been a steep rise in food imports, with the new cereals contributing a big share.[5] Africa food imports are expected to grow from $35 billion in 2015 to more than $110 billion by 2025 (Africa Development Bank (AfDB), n.d.). The huge imports mean not only lost jobs but also lost opportunity to import capital goods, which are key to driving transformation (Christiaensen, 2020).

The displacement of traditional grains has had a negative impact on food security in general while at the same time impoverishing the very poor, who grow traditional grains due to dwindling markets for traditional grains.

Yet millet and sorghum can rightly be called 'silver-bullet' crops for Africa. Millet can survive in areas with as little as 300 mm of rainfall (vs. 500–600 mm for maize). Millet is also better adapted than most other crops to dry, infertile soils, to high temperatures, short growing seasons and acidic soils with poor water-holding capacity. At the same time, millet grains can be stored for over 10 years without significant deterioration. Sorghum does equally well in drought and heat. Sorghum can be described as a physiological marvel: it is among the most photosynthetically efficient plants; it has one of the highest dry matter accumulation rates; it is one of the quickest maturing food plants – certain types

[5]Other key imports include sugar, soya beans and oils.

can mature in as little as 75 days and can provide three harvests a year (see NRC, 1996). It is not only good for food but also for fodder, the production of alcoholic beverages and biofuels.

These are important qualities in the face of climate change. As a heat-resistant and drought-tolerant plant, sorghum has the ability to adapt to a wide range of climates and is therefore likely to be a viable crop in even the most challenging of growing conditions. Sorghum is among the few crops that cope with climate warming and attendant water problems (Danforth Centre, nd; Hossain et al., 2022). Indeed, in a simulation scenario, where global warming is set to increase in Africa, UN experts estimate that average yields are expected to fall by 5% for millet and 8% for sorghum by the middle of the century, compared with larger declines of 12% and 21% for rice and wheat, respectively (International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), nd).

Beyond being well-suited to Africa's agro-ecological conditions, both millet and sorghum are very nutritious. Because traditional grains store an ample amount of proteins, essential amino acids, dietary fibre, vitamins, minerals, essential fatty acids, antioxidants and other phytochemicals, they can be placed in the group of nutraceuticals. Millet has a beneficial nutrigenomic role and contributes to human health through its hypoglycaemic, anti-tumourigenic, anti-atherosclerogenic, antioxidant, anti-hypertensive, anti-inflammatory and anti-microbial properties. The bulk antioxidants present in millet add to their nutritive value and provide protection from various degenerative diseases. Plentiful polyunsaturated fatty acids (PUFAs) in millet oil are helpful in chronic heart diseases, and its gluten-free nature makes it an excellent substitute for wheat for coeliac patients (Saleem et al., 2023). In summary, traditional grains are rich in many important micronutrients and have more protein than the cereals that are replacing then. A recent *Time* magazine article classified millet and sorghum as the next quinoa (touted as the most nutritious food crop).[6] Indeed, they are the superfoods of East Africa.

Traditional grains are also key to improving resilience of people, especially those living in arid and semi-arid areas. Traditional grains grow in marginal areas of East Africa, where pastoralism is the main activity. There is always a danger of overgrazing in these areas, especially as climate change increases and there is less fodder. Diversifying livelihoods is key, and demand of traditional grains can reduce dependence on livestock. Further, the millet and sorghum stovers are highly nutritious animal feeds and thus increased production of traditional grains can reduce dependence on grazing and pressure on land.

In summary, what makes these grains special includes that they:

- are highly nutritious;
- have a low carbon footprint;
- survive in high temperatures and with very little water;

[6]See '5 Grains That Will Overthrow Quinoa'. http://time.com/3340422/5-grains-that-will-overthrow-quinoa/.

- are often the last crop standing in times of drought;
- are climate smart;
- are a good risk management strategy for farmers;
- have multiple uses, from food, feed and fodder to brewing and bio fuels.

The rest of this paper highlights challenges and opportunities for reviving the traditional grains, drawing on four value chains studies in East Africa.[7] Section II explores emerging opportunities; Section III discusses the key challenges across the traditional grains value chain challenges, while section IV discusses potential intervention. Section V discusses the way forward and policy options.

A Window of Opportunity

Despite the fact that demand for traditional grains has fallen in favour of other grains, a window of opportunity is opening. The major opportunity is rising health consciousness and global food price inflation.

A Growing Base of Health-Conscious Consumers

There is potentially a big market for sorghum and millet, both domestically and in international markets, driven by growing demand for food seen as having healthy attributes.

- There is a growing global movement around healthy eating, and foods perceived to be highly nutritious now attract a significant premium. Quinoa is the quintessential example of such 'superfoods', which has seen demand and prices skyrocket. As this movement has grown, the search for new superfoods has begun, and sorghum and millet are being touted as some of the next superfoods based on their superior nutritional qualities. Millet is becoming appreciated as a wonder food in the same league as quinoa.[8]
- This movement is also strengthening in Africa due to an emerging health-conscious middle class, which presents an opportunity to rebrand traditional grains like millet and sorghum and develop premium products. Although sorghum and millet are primarily consumed by low-income consumers, studies in Kenya, Uganda and Tanzania point to both being perceived to be healthier by consumers. This perception is stronger for higher income compared to low-income consumers (African Centre For Economic Transformation (ACET), 2015, 2017). Consumption by the middle class sends an

[7]Done in Kenya and Uganda by the African Centre For Economic Transformation (ACET) under a grant from the Bill and Melinda Gates Foundation and a study that was funded by USAID under the Resilient Africa Network (RAN). For more details, see ACET (2015a–e).

[8]Even in the United States, an unlikely consumer market for millet, the state of Colorado is marketing millet as an alternative to the popular and very healthy quinoa seed.

important signal to other consumers, fuelling demand for these grains among consumers who have historically viewed sorghum and millet as food for the poor.

Rising Global Food Prices and the Need to Improve Resilience

Surging global food prices are changing life-long habits and forcing people to switch to cheaper staple foods. Liberia, which imports 90% of its rice, has also seen roadside chefs substituting rice with spaghetti made from millet (WATs 2013(2)).[9]

There is a growing desire to diversify diets globally to improve the resilience of people, especially in the face of ongoing climate change. As pointed out by the *National Geographic* magazine, today, the world has more than 50,000 edible plants, yet just three commodity crops – rice, maize and wheat – provide 60% of the plant-derived calories eaten. With such heavy reliance on so few foods, the consequences of crop failures due to disease, drought, floods and other catastrophes that could be driven or exacerbated by climate change mean more food insecurity for the planet.[10]

Traditional grains are adapted to grow on marginal lands without irrigation, pesticides or fertilisers, and are therefore more sustainable and resilient than modern commodity crops are. By promoting traditional grains, we are also promoting a crop that has low water intensity.[11]

Urbanisation

Urbanisation is changing food markets and creating a new, dynamic and profitable market for those who are able to tap them. Now 50% of all food produced in Africa is sold in urban markets (ACET, 2017). East Africa has also seen the rise of regional supermarkets, which are making it possible for those who are able to participate in these chains to instantly access the regional market.

All the same, capturing this opportunity can be problematic. Grasping the new opportunities requires strong value chains that are able to deliver quality

[9]The 2007-8 global food crisis saw Guineans shift from rice to *attieke* (a granular from of cassava that has texture similar to rice). *Attieke* is also making inroads in Burkina Faso and Mali. *Attieke*-making technology is spreading from Cote d'Ivoire, where it originates, to the region (WATs 2013(1)).

[10]What's the Next Quinoa? Farmers, Foodies Revive Heritage Grains. http://news.nationalgeographic.com/news/2014/07/140708-ancient-grains-quinoa-fonio-food-africa/. Also, it has been pointed out that around the world, countries are 36% more reliant on the same staple crops than they were 50 years ago. Just 50 crop commodities provide more than 90% of calories, protein and fat around the world. http://www.slate.com/articles/health_and_science/feed_the_world/2014/04/crops_for_the_future_quinoa_amaranth_teff_bambara_groundnuts.html.

[11]Millet has a significantly lower water footprint than most of the modern cereals, needing three times less water than rice.

and consistently to a strong processing sector that can develop products for the new market and meet the exacting demand of these new marketing channels in terms of quality, variety, packaging and price point.

Traditional Grains Value Chain Challenges

The traditional grains are produced mainly by smallholder farmers. For example, in Kenya, there are approximately 240,000 small-scale sorghum farmers with farm sizes ranging from 0.4 to 0.6 ha (1–1.5 acres) in the country (Demissie et al., 2020). In Uganda, a typical plot size for growing millet, particularly finger millet, is around 0.5–1 acre (Hamba et al., 2024).

While many traditional grains are processed to flours and consumed in the form of porridge or traditional mealie meal (called *ugali* in Kenya and *kalo* in Uganda), a significant proportion of traditional grains is consumed as alcoholic beverages. Women tend to be the main processors of traditional grains for traditional food products.

Traditional grains are also being processed into modern food products driven mainly by small businesses. For instance, in Uganda, *obushera*, a millet malted drink, is now manufactured by Multiline International Ltd. and sold under the brand name Bessa in 330 ml cans in supermarkets.

The market in beer is huge and has even attracted formal breweries. For example, SABMiller, the world's second-largest brewer, has an opaque traditional beer under its flagship beer brand, called Chibuku. Chibuku is already sold in 10 African countries. Breweries are also replacing barley with sorghum to manufacture clear, modern beers.

The traditional grains value chains are highly underdeveloped and plagued by many challenges.

Many of these are similar to the challenges faced by farming in Africa, including low use of quality inputs and subsequent low productivity, low use of equipment and thus poor quality and high post-harvest losses, high cost of equipment and high energy costs and poorly functioning markets. However, three challenges stand out for traditional grains: (i) the quelea bird problem, (ii) the product development challenge and (iii) the image problem.

The Quelea Bird Problem

The quelea bird is one of the biggest challenges faced by millet and sorghum farmers in East Africa. The birds, which are endemic to large parts of the African savanna, number in the range of two to five billion. While the quelea consumes many crops, small-seeded grains, especially millet and sorghum, are the most vulnerable. Queleas are capable of destroying entire crops over areas of up to 1,000 ha. Studies in Kenya and Uganda point to the quelea bird as presenting the biggest challenge to sorghum and millet farmers in those countries.

Quelea bird is the key threat to sorghum and millet farmers, with only drought being seen as a bigger threat. For about two thirds of the farmers

surveyed in Kenya, the birds are a regular threat as they attack every season, unlike drought, which might not occur every season. Indeed, a head of a farmer scheme interviewed pointed that the quelea are usually ranked number one as an obstacle for farming despite the drought. Losses vary tremendously and can reach 100% (ACET, 2015).

The current method farmers use to repel the birds is guarding the crops for about two months. This entails using catapults and making loud noises to scare the queleas. Traditionally, this has been done by children; however, most children now go to school, so farmers must instead employ labour to fend off the queleas. Hiring labour is costly at around $128 per farmer per month (Efron & Gatune, 2015).

> ... When they come, you are left with nothing. They 'harvest' five acres in half an hour. So what's the point in planting to begin with? Farmers are not fools... (A farmer in Kibwezi, Kenya)

The impact of the birds is such that many farmers have simply stopped growing these traditional grains and shifted to other crops: maize,[12] in particular, because it is more resistant to quelea attacks.

Product Development Problem

Studies have pointed to the need for greater efforts to develop products to satisfy urban markets. The millet study in Kenya indicated that millet is seen as more nutritious than other grains, yet consumption of millet remains low, mainly due to lack of a variety of products made from millet. Millet is largely consumed in the traditional way, as it lacks the range of products needed to address modern markets (ACET, 2015b,c).

Interviews with processors indicated the constraints faced by most of the processors, including a lack of processing equipment and an underdeveloped market. Processors also lack the requisite skills to process higher-value products, underscoring the challenges involved in moving up the value chain. This would require developing the necessary skills to create new products and raising awareness about them (ACET, 2015b,c).

[12]Maize was introduced to Africa by the Portuguese. Though it originated in Latin America, it is thought to have been established in India before then being exported to East Africa, hence the Swahili name *mahindi*, which means 'from Indians'. This new crop was quickly adopted due to its natural protection from the quelea bird due to its sheath covering, which is fairly resistant to attacks. See James McCann's book *Maize and Grace,* which chronicles the rise of maize.

The Image Problem

Image building and rebranding are key to changing the perception of people so that traditional grains are seen as still relevant in the modern age. There is a need to shed the image of a poor man's food (ICRISAT, 2022). The perception can be traced to the fact that due to its drought resilience and nutritional value, it is the food of choice for marginal areas where no other foods are able to thrive.

Hence, traditionally, millet is cultivated by vulnerable groups, including women and the youth, and is used as food security crop during times of scarcity. Furthermore, millet receives limited attention and investment for research and development, innovation and value addition, policy and political support and is often referred to as the poor man's crop (Bombom et al., 2023).

Interventions

Quelea Bird

Quelea bird is an East African problem, and a regional approach is the most effective way of managing them. Currently, the Desert Locust Control Organization of East Africa (DLCOEA), in conjunction with the pest control departments of agriculture ministries, has been tackling this challenge. The methods used include spraying the roosts with chemicals. This approach is expensive and also environmentally harmful, as the chemicals can leak into food systems. Aircraft are also very expensive to run, and control measures are hampered by a lack of funds. Farmers complain of a slow response by government to sightings of quelea.

An innovative approach has looked at drones to manage the bird threat. Drones can be made to look like the birds' predators, namely, eagles and falcons. Further, drones can be equipped to emit scary noises, such as those of the above-named predators or the sounds birds make when they are distressed.

A field study in Kenya found that drones were acceptable to farmers (Efron & Gatune, 2015). Compared to current approaches, drones can be a very cost-effective intervention. Drones are not new to the region, and they are currently being used in Kenya to monitor poaching activities. However, there are concerns for security, especially Al-Shabaab terrorists, and privacy concerns saw the government issue a temporary ban on drones (Andae, 2020) and later fairly restrictive regulation on use of drones. However, well thought-out regulation could provide a fairly cost-effective tool for managing this pest.

Technology Innovations

Product Development

The traditional cereal products are limited to flours. Yet to meet market demand, a variety of products are needed. Indeed, wheat is rarely sold as flour or grain in developed markets but in the form of a variety of products including cereals, breads and pasta. There is low product diversity, and a key challenge is that

processors lack the skills and the equipment to diversify their product range (ACET, 2015). Processors also lack the requisite skills to process higher-value products, underscoring the challenge of moving up the value chain. It is noteworthy that in many agro-processing sectors, consistent supply is usually the biggest challenge.

Usually, millet is processed into flours. The common processing equipment for flours tends to be optimised for maize and wheat and therefore is not efficient for traditional grains. Also, with cereals such as wheat or maize, the bran may be removed by a simple milling followed by sieving the flour. In the case of millet and sorghum, on the other hand, such a process is not possible. The pericarp of a millet or sorghum grain has the peculiarity of disintegrating into fine particles when the grain is crushed. These particles of bran are then impossible to separate from the rest of the flour by sieving. For this reason, to remove the bran from millet or sorghum grain, a separate hulling process is required (FAO, 1998). Specialised equipment is thus needed for traditional grains.

Some of the more sophisticated equipment needs to be imported, while some of the simpler machines can be made locally. A two-pronged policy is needed to help processors acquire the necessary equipment. For imported machinery, duty exemption to lower the cost and financing support are required. Financing support can be through the development of specialised funds for importing machinery that can be supported by tax on imported foods.

Stronger support can also be given to local manufacturers to upgrade their capacity so that they can produce food-processing machines locally. This would require the development of a strong innovation system that allows close collaboration between researchers and equipment manufacturers (discussed later).

Product Innovations: Upgrading Traditional Products and Moving them into the Modern Era

Artisanal processing of traditional cereals is mainly confined to traditional drinks, both alcoholic and non-alcoholic. The potential for this market is huge. Modern beer is consumed in Africa by a small percentage of urban dwellers with good incomes, while the continent's 'informal alcohol market' accounts for around 74% of all alcohol consumed. In 2009, the market for African home brew was estimated at about $3 billion (ACET, 2015c).

Though this is a fairly lucrative business, especially for women in rural areas, there is a need to upgrade products to reflect the realities of changing markets. The biggest challenge for the products is poor quality control measures applied and products that spoil quickly, i.e.,[13] they are not shelf-stable. This limits their markets to the locality of where they are produced. Significant innovation is helping to bring traditional products into modern era. In Uganda, for example, the Makerere University Food Science and Nutrition Department is developing

[13]While millet grains can stay for very long without spoiling, traditional millet beverages will spoil quickly if not stabilised by other additives.

improved versions of local brews that are more hygienic and also shelf-stable. Closer integration between the research and traditional brewers can help them upgrade their products and also increase the range of products. The key ingredient of the process, malt, can be used to produce many products, including baby food.

The emergence of an upgraded traditional brewing sector will require the active support of governments, as brewers will need duty exemptions on equipment, financing (for equipment and further innovations), capacity building and other types of investment. The support of development partners will also be crucial. This will require a significant lobbying effort to get governments and donors to change their perception of this sector.

Business Model Innovations

As pointed to above, the traditional grains sector is modernising and moving from traditional products that have been mainly a women's business to modern products produced by mainly male-owned small and medium-sized enterprises (SMEs) and also large multinationals. In essence, upgrading is happening at the expense of women as artisanal processors get replaced with SMEs and multinational processors. While upgrading the traditional grains value chain is needed, this upgrading should be inclusive. What is needed is a new business model that is inclusive and allows women to capture the value created from upgraded traditional grains value chains.

One model that is proving versatile in resolving these challenges involves tighter integration between rural artisanal processors and urban SME processors. Rural processors have solved the problem of supply (as they are also farmers), but lack skills in product development and navigating food marketing regulations. SME food manufacturers have skills in market and product development and in managing regulations, but have difficulties sourcing consistent supply. A model in which an artisanal processor is able to supply a product in bulk to an SME, which then packages and markets it, is mutually beneficial. Adopting this model, the Ghanaian food manufacturer, St. Bassa, stopped sourcing cassava and now uses a women's processing group based in rural Ghana to supply its bulk processed product (*gari*), which it packages and markets to African stores in Europe. It provides support to the rural processing group to help it meet quality standards (see Gatune, 2018).

There is a need to rethink industrialisation policy and provide incentives to strengthen these types of linkages. Tax breaks and subsidies on equipment should be extended to firms that have developed contracting models with rural processors.

Social Innovations: Rebranding Traditional Grains

Much as price and incomes drive diet shifts, people's perceptions of foods are key in shaping the image they have of a food and in driving diets shifts. Research is

pointing to new drivers that provide important levers that are shaping how people view foods. Globally and in particular in the United States, the following have been observed as important drivers of food trends:

- *Chef-driven food trends*, e.g. a well-known chef creates something that other chefs emulate.
- *Agricultural food trends* founded by farmers who grow a new product.
- *Health and diet trends* e.g. gluten-free diets.
- *Cultural food trends* e.g. cupcakes went from being the children's birthday treat to sexy single women living in the city and eating cupcakes.

There is also an emerging trend that combines both the concern for sustainability (what footprint does that food have in terms of water demand and carbon emissions to get it to the dinner table?) and the need to eat healthy food. There is thus a growing class of consumers who care about:

- environmental sustainability;
- natural ingredients/minimally processed food;
- local sourcing of food;
- food waste reduction/management;
- gluten-free cuisine.

These trends have resulted in the emergence of highly desired foods that deliver on these attributes (at least some of them). These foods have been labelled as superfoods. Quinoa is the quintessential superfood, and its elevation to this status has seen demand rise so much that many farmers who grow it can no longer afford to eat it – they would rather sell it.

Part of the reason for the rise of quinoa is its superior health attributes; however, endorsement by celebrities has also been key. After being featured in the popular Oprah Winfrey show, demand for quinoa skyrocketed. More recently, the rise in popularity of kale as a superfood is partly due to its superfood qualities and partly due to endorsement by the celebrity Gwyneth Paltrow.[14]

Globally, there is a clamour for healthy foods, and this has given rise to the superfoods movement. As quinoa prices have gone up, the search for new superfoods is gaining momentum. The traditional African grains are now being touted as the new superfoods.[15] Indeed, products are now starting to boast that they contain ancient grains, e.g. the popular Cheerios cereal, and they are

[14]The popularity of cupcakes has also been attributed to the famous *Sex in The City* television series.

[15]A recent *Time* magazine article classified millet and sorghum as the next quinoa. See '5 Grains That Will Overthrow Quinoa'. http://time.com/3340422/5-grains-that-will-overthrow-quinoa/.

fetching a premium (50–300%) in the US food markets compared to regular cereals that have no ancient grains.

Effective branding does not only attract buyers but also provides a price premium. For example, in Senegal, it was found that consumers were willing to pay an average price premium of 44% for branded quality Senegal Valley Rice (SRV)[16,17]. Therefore, building the image of products should be a key part of efforts to increase their value.

The power of branding in creating value is demonstrated by the price differentiation among different sorghum products offered in Kenyan supermarkets. Despite the fact that all the products are basically flour, mainly used for porridge, marketers have been able to create significant value. There is also evidence that manufacturers are leveraging branding to broaden sales. For instance, a study in Kenyan supermarkets found that the price for millet flour varied by as much as 150%, mainly due to branding (ACET, 2015c).

Branding is therefore key to bringing traditional grains back to their customary central place on East African dining tables. The fact that there is a global movement towards superfoods, and this trend is also catching up in East Africa, provides an opportunity for rebranding traditional cereals as East Africa's superfoods. Branding them as superfoods also has the potential to open these grains up to export markets, much as teff in Ethiopia has been able to do. Two initiatives in Kenya and Uganda have sought to rebrand traditional grains, with some success and useful lessons.

Rebranding Traditional Grains as Superfoods

Under the Resilient Africa Network (RAN) project,[18] a pilot project to rebrand sorghum and millet in East Africa as superfoods was run. It was mainly implemented through a cooking competition, which showcased different ways of preparing traditional grains, using the skills of top chefs, with accompanying messages on the nutritional value of these grains (The Monitor, 2015).

The goal of the cook-off competitions was to increase consumer awareness of the nutritional value of millet and sorghum, to increase awareness of the varied ways in which they can be prepared and eaten and to improve consumer perceptions of the grains by rebranding them as high-end products. In addition, a

[16]http://www.rural21.com/english/news/detail/article/marketing-local-rice-to-african-consumers-0000657/.

[17]Demonta, M., Rutsaertb, P., Ndoura, M., Verbekeb, W., Abdoulaye Seckc, P & Tollens, E., 2012. Experimental auctions, collective induction and choice shift: Willingness-to-pay for rice quality in Senegal. Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August 2012.

[18]The Resilient Africa Network (RAN) was funded by USAID as a partnership of 20 African universities in 13 countries. The RAN project sought to strengthen the resilience of communities by nurturing and scaling innovations from different universities (See https://www.ranlab.org/about-us/what-is-ran).

secondary aim of the competition was to encourage food manufacturers and supermarket chains to use the recipes generated by the competition to develop innovative new products. It was expected that the proposed intervention would support the traditional grains growing communities by providing new premium markets and improving the overall image of the grains, thereby increasing the general demand for traditional grains.

Three rounds of competition were done. The top three winning professional chefs from the first two competitions were invited back to compete against each other. However, a level of difficulty was added in to the final competition: each professional chef was partnered with a street food vendor from Kampala, and all pairs were expected to prepare foods that could potentially be sold by vendors. This meant that the competing pairs needed to balance taste, nutrition and innovation with portion size and overall cost so that the final products were feasible for street vendors to sell.

About 40 innovative recipes based on traditional grains were developed by the professional chefs. Further, many street foods were also developed. These were mainly modifications of currently popular street foods, including vegetable samosas with sorghum, millet rolex (a popular flour-based street food), matooke katago with vegetables and sorghum and chankitta with cabbage. One chef made a notable entrée with incredible millet linguini noodles.

A media strategy was put in place that involved local celebrities and popular restaurants devoting a traditional grains week and showcasing the recipes developed, with media interviews and social media engagements accompanied by the cookery competition. The events generated good media coverage and indeed showcased that traditional grains are as versatile as any grain. It demonstrated that, with a well-planned campaign, traditional grains can be rebranded as superfoods. However, this is not straightforward, as many stakeholders will need to be recruited and appropriate policy support provided. The key stakeholders will be the private sector, as they drive the branding and retailing of foods. Influencers in society are also key as they shape how people think. Religious leaders can be important, for example, if they make the point that millet is the manna that God gave to Africa and use the traditional grains as the ingredient for the sacrament. Superstars can be recruited to inspire children and the youth. Policies that can support this include:

i. mandating traditional grains to be mixed with wheat to make bread and
ii. creating a fund to teach chefs and food SMEs new skills to prepare foods.

Smart Foods Initiative[19] and TV Show

The Smart Food show was a joint initiative of ICRISAT and the Kenyan media, whose aim was to raise awareness on drought-tolerant crops (sorghum, millet and legumes), educate the public on their nutritional value and demonstrate

[19] https://www.smartfood.org/the-initiative/.

different interesting ways of cooking them. The 13-episode show was a reality and drama series that highlighted the use and importance of smart food through a cooking competition. Nine cooking enthusiasts battled it out for the big prize in a dramatic cooking challenge. The show was a success and attracted a rating of 800,000 viewership per episode (ICRISAT, 2017).

Policy Innovation

Currently, the traditional grains processing sector is largely informal. The potential of traditional grains to become feedstock in the formal industry is huge. Both sorghum and millet have very good malting qualities and can play an important role in the food and beverages industry, as happens in Nigeria. Sorghum is the key malt input in Nigeria in popular foods and beverages (including all clear beers). In fact, large food manufacturer Nestlé operates one of the biggest malting plants in Nigeria.

Industry can be incentivised through tax breaks to use traditional grains as input. However, developing new supply chains is a fairly challenging task, and many companies may not have the stomach for it. Development partners and government can work with the private sector under public–private partnerships (PPPs) arrangements to lower costs. However, beyond incentives, government can also use mandates, especially where the supply chains are sufficiently developed – for example, mandating that 10% of flour in bread includes sorghum or millet can create huge markets.[20]

Sorghum is now being used in the brewing industry. This has largely been driven by incentives given by governments in the region, mainly removal of excise duty on sorghum to incentivise industry to replace barley with sorghum. However, this policy has become contentious as essentially governments are losing revenue. However, it has helped breweries extend their markets to lower-income groups, although largely at the expense of informal local brewers (who happen to be women, mainly). In essence, government is subsidising multi-national corporations (MNCs) to open new markets and expand their sales while essentially kicking out the informal sector.[21] The sale of cheaper versions of regular beers based on sorghum further sends the image of sorghum as the poor man's food. Nigeria, which has used a different approach, i.e. banning imports of barley, has forced breweries to use sorghum only. Breweries have relied on traditional marketing and branding to create different beers based on sorghum for different market segments. The image of sorghum cannot be compromised.

Government policy can do a lot to stimulate demand. Incentives and, when the time is right, mandates, are strong tools that the government has. Going hand in hand with this should be support for marketing and branding, including

[20]Nigeria is using this approach to unlock the potential of cassava.

[21]Informal brewers operate in very uncertain environment as their legal status is very fragile. Usually, they are seen as flouting health regulations and other regulations which many find too unrealistic. They also do no pay taxes.

directing part of the government agriculture budget to advertising firms that can help promote products from the more innovative companies.

Policy Recommendations

The interventions discussed in the previous section straddle the agricultural and trade and industry policy domains. There is a clear need for more alignment of agricultural, industrial and trade policies if the potential of the traditional cereals is to be unlocked. The yields of traditional grains need to go up so that they can be competitive to other grains and also of sufficient quantity to support an agro-processing sector. The huge imports of wheat, rice and maize can be leveraged by say charging and extra import duty that can then be used to support the development of a modernised traditional grains agro-processing sector.[22] The emergence of an upgraded grains value chain strongly depends on having a strong innovation system that can support research and development.

Strengthening the Traditional Grains Innovation System

Traditional cereals have failed to compete effectively with 'new' cereals due to weak innovation systems. In Uganda, Makerere University's Food Science and Nutrition Department has an incubation laboratory that has developed innovative millet and sorghum products, but many of the products remain on the shelf. The key challenge of the formal innovation system is a failure to commercialise innovations. As a result, the traditional cereals innovation system has failed to deliver food products made from these grains that meet the demands of new markets. These have emerged with urbanisation and an emerging middle class where there is demand for cheap and convenient foods for the many urban poor and a range of well-packaged nutritious and shelf-stable foods for a growing middle class.

It is a series of innovations by actors across the whole chain, rather than one innovation, that builds true competitiveness. This occurs when there is a healthy innovation system that is able to link researchers to the private sector, including farmers, ensuring that successful innovations are commercialised and backed by sound public policies. There is a need to link the informal sector to the formal innovation system in ways that will exploit the potential synergies between them.

Upgrading agricultural systems will require attention to building a strong innovation system, the so-called triple helix that can link policymakers, researchers and entrepreneurs, the three key actors needed for a thriving innovation sector that offers practical and affordable solutions. Agricultural and industrial policies should explicitly address how to support the emergence of the triple helix.

[22]Ghana had at one time set-up a fund (EDIAF) to support the development of agro-processing sector. The fund was supported through levy on food imports (https://www.modernghana.com/news/515753/trade-minster-sworn-ediaf-board-members-into-office.html).

Policy Framework

A policy framework that employs a range of tools is needed to ensure that there are opportunities. The framework will need to include a mix of incentives, mandates and public–private collaboration partnerships.

I. *Incentives*: Tax breaks to encourage equipment upgrade and encourage local development of equipment, and subsidies to support emerging innovators.
II. *Mandates*: Implement local content laws, e.g. mandate that bread should use 10% sorghum at the beginning, rising to 30%. Also, tax wheat imports and use the funds generated for the development of a strong traditional grains ecosystem.
III. *Triple helix platforms*: Establish platforms that bring government, the private sector and researchers/academia together to collaborate on research innovations and the commercialisation of innovations and incubating new enterprises.

A holistic value chain approach is needed to ensure that policy does not address a bottleneck in one aspect of the chain only to create another bottleneck in a different part. For instance, higher yields, if not managed well, can create challenges of logistics and processing.

Policies should be keenly focused on making the markets work better so that demand becomes the primary driver of production. Supported production structures should allow the agricultural sector to respond effectively to demand, especially as new markets are being spawned rapidly in the wake of urbanisation.

Policy should also use both mandates and incentives as needed. Mandates, such as requiring that flour producers use a certain amount of sorghum in wheat flour, can create significant markets, which can attract investors to set up processing plants. However, producers may also need incentives to develop the supply and logistics needed to effectively utilise the installed processing capacity.

At times, this may require government to become more involved in the form of partnerships, especially where uncertainty around the venture is such that private investors shy away, even in the face of good returns.

Conclusion

The quest for ending food insecurity and, more crucially, using agriculture to drive larger economic transformation will hinge on strong food systems and innovation systems that can upgrade the whole value chain, from production to food products (from farm to fork). For Africa, the food system that needs great attention is the traditional grains food system, for the simple reason that they are not only healthy but also resilient to drought and thus climate change. However, traditional grains have been neglected and as a result the research needed to drive the innovations to keep them competitive has not been done.

However, this is changing. Research systems even in the Western countries are starting to pay attention to this crop, especially as climate change increases and the need for resilient crops is recognised. For example, researchers at the University of Copenhagen have developed a new technique that increases the pace of research and the breeding of sorghum, driven by the need to more efficiently cultivate sorghum in both the Global North and the Global south. These new techniques promised to fully unlock the potential of sorghum by producing varieties that can support new plant-based food products (Mason et al., 2024).

Demand for gluten-free and healthy foods and so-called superfoods is on the rise, creating new markets for traditional grains as millet and sorghum are now seen as the new global superfoods.[23] As markets drive investments, this demand will drive investments (local and foreign direct investment) in upgrading traditional grains value chains. This will be very welcome, as Africa has the largest unutilised arable land remaining. This demand will be comfortably met, and Africa will feed its people and the world with healthy foods.

What is now needed is to put in place a strong innovation ecosystem that will be able to capitalise on the changing landscape. This will build on the nascent ecosystem that is in place. It will require having the right policies to stimulate innovation. A combination of mandates is necessary to stimulate demand, with incentives to attract investments and build collaboration platforms that bring research, the private sector and government together to work in concert.

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Chapter 5

Innovation, Informality and Cultural Heritage: Lessons from a Study of Informal Apparel Businesses in South Africa

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Introduction

More than 70% of the population in Africa depend on informal livelihoods, whether in agriculture, manufacturing, trade or services (International Labour Organization [ILO], 2023). The innovation potential of the informal sector[1] is now seen as important to drive industrial transformation on the continent in an inclusive and sustainable way (Kaplinsky & Kraemer-Mbula, 2022; Mustapha et al., 2021; Tregenna, 2016). How can African countries harness the innovation potential of the informal sector? African countries are encouraged to focus interventions on areas where they have an advantage and can leverage local knowledge, skills and talent.

The creative industries present a unique opportunity to bring together Africa's rich cultural heritage, creativity and innovation in a way that preserves and shares cultural identities, local knowledge and values and at the same time, contributes to wealth and job creation. The creative economy has been described as one of the fastest growing sectors, contributing more than 3% to global GDP and accounts for over 6% of employment (The UN Educational, Scientific and Cultural Organization [UNESCO], 2023). While many African countries have recognised the potential of the creative industries, such as textiles and apparel, it

[1]Following the ILO definition, the informal sector refers to economic activities by economic units whereas the informal economy is broader to also include the activities of workers.

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is still largely untapped (World Bank, 2020). In Africa, textiles and apparel are rooted in culture and religion. Historically, the use of colour, symbols and designs in fabric, garments and accessories have reflected rich cultural heritage, social structure and gender differences in status and age (Kalu et al., 2024). In precolonial times, the raw materials were drawn from nature and production was limited and in harmony with the environment. Today, fashion increasingly reflects combinations of traditional cultural heritage with modern designs and practices.

Africa's creative economy is characterised by informality, fragmented innovation ecosystems and weak links into global value chains (England et al., 2021; UNESCO, 2023). The challenge is to grow local capabilities in a way that facilitates participation in national and global value chains. From an innovation studies perspective, it is argued that this can be achieved through strengthening local ecosystems for innovation and stimulating learning networks that enable forward and backward linkages across production value chains.

Drawing on a local innovation and production systems (LIPS) approach, this chapter investigates the extent and nature of innovation in informal apparel businesses in a peri-rural area in KwaZulu-Natal, a leading region in the textiles and apparel industry in South Africa.[2] The chapter draws out lessons for building local ecosystems that nurture 'innovation-oriented entrepreneurship' (Hoffecker, 2018, p. 10) and contribute towards strengthening the capabilities of informal businesses to link into formal value chains. Similar to other African countries, the South African apparel industry was negatively impacted by trade liberalisation in the 1990s and the local industry has struggled to compete against the large volumes of imports (Ajayl, 2017 in Kalu et al., 2024; Molala, 2024). Relative to other countries, there has been an increasing focus on high value-add activities, making it an interesting case from an innovation perspective. Also, a large proportion of the sector is informal. The case study focuses on a local area where the informal sector is large and has received government support in recent years, but the focus tends to be on support to formalise, with little attention given to creating an enabling environment for innovation and learning. The rate of innovation is high, as informal businesses constantly implement changes to compete, but innovation is often overlooked (Mustapha et al., 2021). The local area is under traditional authority where cultural beliefs, knowledge and practices are deep-rooted and valued. The chapter engages with three key inter-related questions: What is the nature of innovation activities and learning in the informal apparel businesses? How can informal apparel businesses, located in resource-poor local settings, leverage their locally based knowledge and networks to build innovation capabilities? How can linkages across the production value chain and with knowledge and intermediary organisations be built to better harness the potential of innovation?

[2]Parts of this chapter have been published in CeSTII (2021a).

Cultural Heritage and Innovation in Textiles and Apparel: Opportunities for Africa

Digital technologies and sustainability imperatives are transforming the global textiles and apparel industry (Dana et al., 2024; Deepthi & Bansal, 2024). New digital technologies such as 3-D printing, the Internet of Things and mobile commerce are changing how things are done and the kinds of goods and services produced, as well as business position and the meanings attached to products (Barnes, 2019). Some have reported improvements in production efficiency, access to markets (Chrimes & Heim, 2024) and marketing innovations (Salamzadeh et al., 2024). The second-hand 'vintage' clothing market is growing and spreading via social media (Braune & Anne-Laure Boncori, 2024; Salamzadeh et al., 2024). Environmentally conscious design using recycled materials (Salamzadeh et al., 2024), natural colours and raw materials is a growing trend (Akram & Dana, 2024).

Therefore, in the current context, firm competitive advantage depends on the ability to comply with sustainability principles and harness digital technologies. It is not surprising that the sector is dominated by large firms in the Global North.

For countries in the Global South, textiles and apparel, particularly the mass market segment, is of strategic importance for employment given the labour-intensive nature of the sector. Geographically, production is concentrated in a few Asian countries led by China and Bangladesh. However, as a growing body of research shows, this trend is shifting, spurred by digitalisation. Participation in global value chains is increasingly linked to local and national technological capabilities. For example, leading brands are shifting focus from Bangladesh, which serves the needs of mass-market production, to India, which offers higher-skilled but still affordable labour (López et al., 2021, in Pereira et al., 2024). Also, due to the COVID-19 pandemic, leading international markets are seeking shorter, more resilient value chains (Whitfield, 2022).

Another driver of change is the 'slow fashion' movement, which is shifting values and practices from the dominant mass-production of lower-quality, fast-changing clothing at affordable prices ('fast fashion') to customisation and ethically produced quality clothing. There is increasing interest in goods produced locally, by indigenous communities and local artisans, incorporating elements of local traditional cultures and design (Hoskins, 2015; Levin, 2006). Success cases reflect new collaborative arrangements between leading international luxury brands, fashion designers and indigenous communities. A notable example is the collaboration between Louis Vuitton and the Basotho community in Lesotho that led to a new garment inspired by traditional Basotho blankets (Kalu et al., 2024). This trend opens up opportunities for local fashion designers and producers, including in the informal sector, in Africa.

Textiles and Apparel in Africa

Textiles and apparel in African countries is shaped by Africa's unique development trajectory and challenges. The 1990s brought new challenges related to

deindustrialisation (Morris & Fessehaie, 2014), declining infrastructure and trade liberalisation, resulting in large volumes of cheap imports, mainly from China and other Asian countries (England et al., 2021; Fakude, 2000; Palmi, 2008). African textiles and apparel industries have declined over the years as businesses struggle to compete against Asian countries offering the advantage of low wages and flexible and adaptable production. In South Africa, the largest supplier of intracontinental imports of apparel (Whitfield, 2022, p. 4), local industry is further challenged by increasing, often illegal, imports produced in other Sub-Saharan African countries (RAATS, 1998 in Rogerson, 2000). Firms have relocated to neighbouring Lesotho and other lower-income African countries that are able to benefit more from the Africa Growth and Opportunities Act (AGOA). To prevent further losses, the national government introduced a quota system and support programmes, such as cluster development programmes, to build local capabilities (South African Department of Trade and Industry [DTI], 2018/19: 21). Ethiopia, on the other hand, with the help of the AGOA programme, is rising in production capabilities and growing exports (Dura & Bizuneh, 2024).

The emerging body of research on African countries highlights the importance of leveraging traditional artisanal knowledge and creativity in cultural goods as well as building local capabilities to link into global value chains (England et al., 2021). Growth potential lies in the production of high value-added goods to better serve high fashion and niche markets such as African ethnic fashions (Salinger et al., 1999) or *shweshwe* markets (DTI 2018/19). Spurred by the Afrocentric movement in the African diaspora, and to some extent, the slow fashion movement, the international market for traditional African and African-inspired fashion is growing. Major cities such as Abidjan, Casablanca, Dakar, Johannesburg, Cape Town, Lagos and Nairobi are 'nexuses for fashion and design, as well as being financial and commercial hubs' (UNESCO, 2023). South Africa, Nigeria and Senegal are three of more than 30 African countries that now host a fashion week each year, reflecting the recent growth, national support and increasing visibility in domestic and international markets (Palmi, 2008; UNESCO, 2023).

The textiles and apparel industry therefore offers potential for African countries to harness strengths related to creativity and cultural heritage to build local technological capabilities and extend reach into international markets in a way that promotes cultural norms and values as well as traditional knowledge. Such a strategy can also contribute to the inclusive industrialisation agenda (Tragenna, 2016). Building stronger design capabilities and linkages between fashion designers and the supply chain are crucial for the kind of restructuring needed to overcome constraints imposed by the dominance of multinational firms and international brands from the Global North (England et al., 2021; Palmi, 2008). Building local production capability, including in the mass market segment, is crucial for competitiveness in domestic markets to leverage local advantage such as being able to better respond to domestic customer needs (e.g. Asian import sizes are smaller than South African market sizes) (Rogerson, 2000).

The development of the industry in Africa is, however, constrained by the lack of skills and quality formal education and training, high costs and weak infrastructure (UNESCO, 2023). High levels of informality are another major constraint.

Informality in African Textiles and Apparel

In many African countries, including South Africa, the survival of the textiles and apparel industry is partly attributed to the interdependent relationship between the formal and informal sectors. Informality is a way for the formal sector to survive in the face of challenges related to trade liberalisation and other major events. Informal businesses form an important part of formal value chains, such that the informal segment has been described as a 'safety valve' for the sector (Salinger et al., 1999, p. 9). As part of competitive strategies, formal businesses subcontract production to informal cut, make and trim services (CMTs) to save costs while maintaining design and quality standards. Informal, mainly home-based, apparel production operates alongside formal apparel manufacturing. This is a growing trend in major South African cities and in township areas, with immigrant-owned informal businesses also increasing (Rogerson, 2000).

Integration into formal value chains comes with opportunities for growth but also challenges, such as more direct exposure to global competition. As recent research shows, the informal sector may be more vulnerable to macro-level challenges and shocks than originally thought (see, for example, Rogan and Skinner, 2020, who describe the impact of the COVID-19 national lockdown regulations in South Africa on the informal economy). Increasing demand for shorter production times at cheaper costs leads to competition among informal businesses to offer their services at lower prices, leaving employees with lower wages and often harsher working conditions (Palmi, 2008). In addition, informal businesses are challenged to compete against formal businesses. For example, in South Africa, formal producers and retailers increasingly endeavour to serve low-income markets that have been historically dominated by the informal sector (Competition Commission, 2019). Rather than competing with informal businesses or relying mainly on cost-saving strategies, there is potential in building formal sector innovation capabilities in collaboration with informal businesses to grow niche markets.

In order to produce for the formal sector, informal traders may be required to comply with formal regulations and thus be registered for tax, for example. Labour brokers or intermediaries that are compliant often fill the gap by linking informal businesses to formal producers or retailers (Salinger et al., 1999; van der Westhuizen, 2006). Subcontracting then takes place via the intermediary. Intermediary organisations such as nongovernmental organisations (NGOs) and other community-based organisations (CBOs), often with funding from development agencies, play a role in supporting informal businesses to access financial support and capital to purchase equipment, as well as networks to produce for

formal markets. Palmi (2006), for example, describes how an informal business in South Africa benefited from an initiative that was facilitated by a religious organisation, aimed at producing custom-made industrial clothing to sell to sugar companies.

For informal businesses to grow, they need to improve their productivity and competitiveness, which depends on their skills and capabilities to innovate. As Rogerson (2000: 712–713) shows, many 'high-growth' small and medium-sized businesses start out in the informal sector, operating from 'the bedroom, the garage or backyard', and undergo major growth through building '(d)esign capability' or introducing innovative products (Rogerson, 2000, p. 706). Competition would be based on quality and responsiveness (Salinger et al., 1999) and thus innovation capability.

The integral role of the informal sector, particularly in the traditional African fabric-based apparel (*shweshwe*) market, is beginning to be promoted in policy (e.g., DTI 2018/19). However, in many African countries, including South Africa, policy support has been patchy, and not enough attention is given to building ecosystems for innovation in a holistic way (UNESCO, 2023). For example, support to informal sector operators should consider their reliance on high levels of social capital and the transfer, from generation to generation, of specialised technical skills, norms, values and practices (Hoskins, 2015; Rogerson, 2000). The informal and formal rules guiding behaviour and practice, that is, the institutional context, matters. There is also little understanding about the nature of innovation and learning.

Building Local Innovation Ecosystems in Africa in a Holistic Way

In this chapter, it is argued that a LIPS (Lastres & Cassiolato, 2005; Cassiolato et al., 2020) perspective is useful for assessing and developing local ecosystems for innovation in resource-poor African contexts. Based on empirical analysis in a highly unequal developing country, Brazil, the LIPS approach integrates key ideas from innovation and development studies and has been used to explore innovation activities in the informal sector in Africa (Kraemer-Mbula & Wunsch-Vincent, 2016; Petersen & Kruss, 2021). A LIPS is defined as follows:

> . . .groups of economic, political and social agents localised in the same area, performing related economic activities, in which formal and informal interdependence and consistent linkages usually result in cooperation and learning processes, with a potential to generate the increase of productive and innovative capabilities (Lastres & Cassiolato, 2005, p. 7).

The LIPS approach relates to innovation systems approaches that emphasise the territorial nature of innovation (Asheim et al., 2011; Cooke, 2001; Ferretti & Parmentola, 2015). It considers the distinct, locally embedded nature of innovation in the informal sector and the ecosystem actors and networks that are

important for building capabilities for production and innovation in such contexts. In her analysis of 300 innovations in local, resource-poor contexts, Hoffecker (2018) shows that the innovations are typically introduced by individuals in response to challenges or needs related to everyday life experiences, using mainly resources found in the local area, and are likely to take place in everyday settings that are typically informal and community-based (e.g. homes and gathering spaces). In such contexts, innovation is mainly necessity-driven (Bureau for Economic Research [BER], 2016), typically takes place at the local level and tends to be new to the individual business or local context only (CeSTII, 2021b).

The literature on informal sector innovation shows the prevalence of incremental, 'imitative' and non-technological innovation (Hoffecker, 2018; Kraemer-Mbula et al., 2019). The typical forms of innovation found in the informal sector may not stimulate radical change but are integral to business evolution and survival (Mustapha et al., 2022). Interventions and support for innovation in the informal sector need to consider the distinct nature of innovation, which involves specific forms of knowledge and learning, and actors and networks.

Importance of Local Knowledge and Experiential Learning

Informal businesses often gain competitive advantage from their intimate knowledge of the local market. To develop suitable support systems, it is useful to identify the specific forms of local knowledge that are valued to inform a better understanding of the typical innovation and learning processes. One common form of local knowledge relates to what Lundvall (2016: 112) refers to as 'know-who', which is important for building social capital and to identify actors with useful knowledge, resources and capabilities. A second form of local knowledge relates to traditional knowledge: 'symbolic knowledge' has a high degree of place specificity, is based on 'the cultural meaning of ideas, images and design' and has most resonance in cultural industries where the aesthetic/design content of goods and services is high (Asheim et al., 2011, p. 882). Symbolic knowledge is grounded in humanities or the arts and indigenous/traditional knowledge systems.

Know-how, which is highlighted in the informal business literature, is typically developed through experiential learning or learning based on doing, using and interacting (DUI) (Jensen et al., 2007). As a tacit form of knowledge, know-how is embedded in people and usually developed through work experience in a relevant industry, making it difficult to codify. Interaction is therefore crucial.

Since DUI modes of learning tend to foster mainly incremental change, science, technology and innovation (STI) modes are required to bring about more radical or transformative change that opens up alternative pathways (Lundvall, 2016). Petersen and Kruss (2021), for example, show how symbolic and know-who knowledge become more useful when combined with relevant

know-how. The importance of knowledge combinations or complexity is also highlighted in their relation to the degree of novelty of innovation (Bell & Figueiredo, 2012; Kraemer-Mbula et al., 2019). The dominance of DUI modes and weak linkages restrict diversity and local economic development (Petersen & Kruss, 2021).

Non-Traditional Actors and Networks

For innovation complexity, interaction with a range of knowledge actors is crucial to access knowledge and other resources from inside and outside of the local area, as Ferretti and Parmentola (2015:10) explain:

> The local economy gains evolutionary momentum through the generation of innovation, produced by recombining various types of endogenous knowledge with externally sourced new knowledge... the degree to which the actors in a local economy can access, understand and convert leading-edge knowledge to new products and services determines their capacities to generate new pathways and renew old ones.

Technical knowledge centred on facts ('know-what') and scientific knowledge ('know-why') (Lundvall, 2016, p. 112) is usually developed through interaction with universities, research institutes and other formal knowledge producers. In local settings with weak entrepreneurial systems, government actors tend to take the lead in building the local system, whereas universities play more prominent roles in contexts where the entrepreneurial system is more developed (Ferretti & Parmentola, 2015). The role of traditional knowledge actors such as research institutes and universities tends to centre on education and training rather than research and development (R&D) activities (Petersen & Kruss, 2021). Intermediary actors such as NGOs and CBOs may provide training and other support services (Cozzens & Sutz, 2014; Kraemer-Mbula & Wamae, 2010).

Institutional Context Shaping Innovation

To date, there has been little research on institutions and how these shape innovation in the informal sector (Petersen & Kruss, 2021). One distinction highlighted in the literature is the importance of collective action, which facilitates resource sharing and cumulative knowledge or collective learning processes that shape path dependencies and opportunities (Cooke, 2001; Cozzens & Sutz, 2014).

A major constraint to harnessing the potential of innovation in informal businesses is the approach to innovation, which tends to be reactive and driven by the need to meet basic needs (i.e., 'necessity-driven') rather than proactive, to take up new opportunities (i.e., 'opportunity-driven') (Petersen & Kruss, 2021). Shifting deep-rooted norms, values and practices associated with necessity-driven entrepreneurship (BER, 2016) is an important part of building local capabilities and can be as important as building physical infrastructure (see Hoffecker, 2018).

In conclusion, one way for informal businesses to compete and grow is to leverage their local knowledge and networks to build innovation capabilities that enable a shift in trajectory from mainly necessity-driven to more promising development pathways. To achieve this, it is necessary to build local ecosystems for innovation and production. Drawing on a case study, the discussion that follows looks at three key components of an innovation system: actors and networks, infrastructure (physical and knowledge) and institutions. The specific questions guiding the discussion include: *What is the nature of innovation and learning? To what extent have the innovation activities contributed to strengthening linkages and bringing in new actors, towards building stronger forward and backward linkages across the value chain? How have the innovation activities contributed to building a 'culture' of innovation-orientated entrepreneurship* (Hoffecker, 2018)*, specifically innovation towards more promising local development pathways?* Informed by a LIPS approach, the case study data analysed was collected through a mix of methods, which yielded in-depth data on the nature of innovation and learning in informal apparel businesses.

Mixed Methods Case Study Design and Methodology

The case study forms part of a larger research study aimed at measuring innovation in the informal sector in South Africa (CeSTII, 2021b; Mustapha et al., 2021). Aligned with a LIPS approach and following best-practice guidelines for conducting a small area census (Charman & Petersen, 2018), a small local area, Ward 1 and surrounds in Msunduzi, KwaZulu-Natal, was selected as the empirical focus as the municipality was one of the first to implement an informal economy policy and has established an informal sector business chamber. Another factor is that the area falls under the authority of traditional Zulu leadership, which oversees economic and social activity in partnership with local government. Social structure, norms, values and practices are deeply entrenched in Zulu customs. At the time of the survey, the area had a population of approximately 18,500, with a working age population of 59% (Community Survey, 2016; Stats SA, 2011).

With the use of mobile technology, an innovation survey instrument was administered to the informal businesses through face-to-face structured interviews with informal business owners at their business premises and at times convenient for them, yielding a sample of 996 businesses. The survey was conducted in 2019, with the reference period 2017–2018, and used the standard definition for innovation:

> (...) innovation is a new or improved product or process (or a combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process). (OECD/Eurostat, 2018, p. 32).

Following the quantitative survey, a set of case studies was conducted to enable a more in-depth exploration of innovation. This case study includes the 73 informal apparel businesses surveyed. Interviews were conducted with six of these businesses and six local intermediaries (local government, NGOs and CBOs) to inform an understanding of the local context.

Innovation in Informal Apparel Businesses in South Africa

The South African apparel industry is dominated by a small group of large formal retailers that account for most (70%–85%) of the domestic market (Palmi, 2008; DTI, 2018/19). Activity is concentrated mainly in two provinces: the Western Cape, which is best known for its capabilities in fashion design and focus on the high fashion market, and KwaZulu-Natal, which focuses more on producing for the mass market. KwaZulu-Natal has capabilities across different segments of the value chain, including textiles production (Chaddha et al., 2009) and shoe manufacturing. The KwaZulu-Natal apparel industry is the largest employer within the provincial manufacturing sector (Vlok, 2006). Technological development and innovation are highlighted as key for improving competitiveness but tend to be low, particularly in mass-market production hubs where clothing manufacturers have been slow to adopt new machinery (Rogerson, 2000; Salinger et al., 1999; Vlok, 2006). Informal businesses are typically approached to help keep costs low rather than for building niche markets. Reflecting the trend in Africa, large retailers have reported the lack of business skills as a major challenge to building the design and manufacturing segment of the value chain (Palmi, 2008). In line with global trends, South African designers are reportedly pushing boundaries through new approaches, including combining global influences with traditional dress to reflect the country's unique history. Examples include small businesses emerging in townships (see for example, King, 2016) as well as partnerships with well-established local designers (Levin, 2006).

Description of the Informal Apparel Businesses

The main economic activities include manufacture, repair and retail of homeware and clothing. In accordance with other research on South African informal apparel businesses, the businesses engaged in more than one economic activity at any given time (see Palmi, 2008). Almost half of the businesses identified dressmaking as their primary economic activity. Fig. 5.1 indicates the sub-contracting relationships, which may be direct linkages or through intermediary actors that tend to be friends or family members working for formal manufacturers and retailers or who run their own formal businesses. Some of the informal CMT-type businesses also made and sold apparel accessories, such as bags, and homeware accessories, such as cushions and fabric couch covers. The dotted lines indicate informal links between the different sets of economic activities.

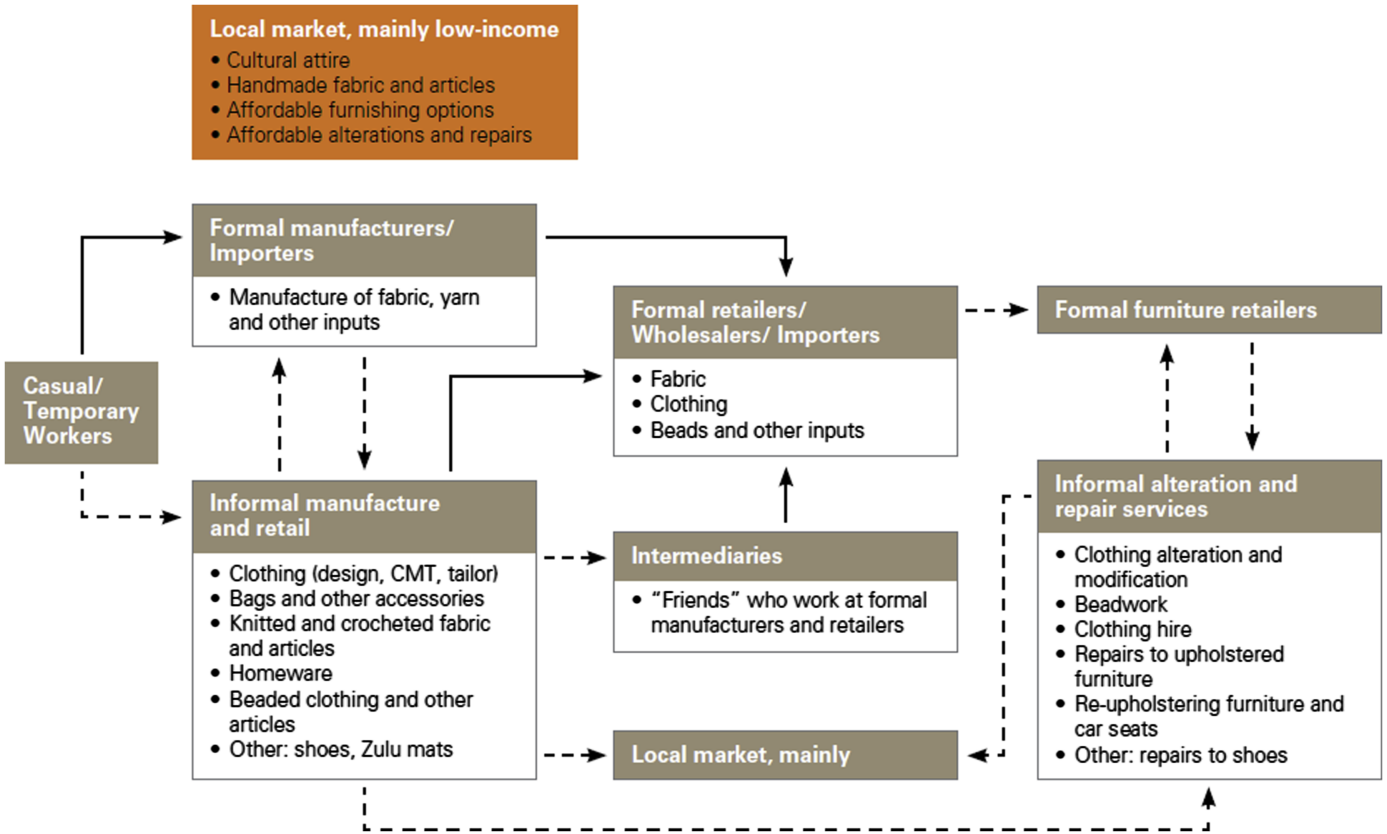

Fig. 5.1. Informal Apparel and Homeware Production Value Chain. *Source:* CeSTII, 2021a, based on van der Westhuizen, 2006. *Note:*1. The arrows indicate the flow of resources. 2. The solid lines indicate formal relationships (i.e. following formal sector rules and practices). Informal lines indicate informal relationships.

The production, sale and hire of traditional attire and accessories was a key focus. Under traditional Zulu leadership, traditional Zulu knowledge, identities and practices were preserved and expressed through clothing and accessories. Skills for producing traditional dress, beaded jewellery and other hand-made crafts are passed down through generations. The designs, patterns and colours used reflect more than just style; they reflect social status, lineage and identity, values and attitudes, and deep-rooted cultural symbolism, as well as history and cultural exchange (Hendrickson, 1996; Levin, 2006; Rovine, 2015).

The deeply rooted symbolic knowledge is an advantage and creates potential for the inclusion of the informal sector in initiatives aimed at building niche markets. However, for such initiatives to succeed, it is crucial to consider the necessity-driven nature of innovation. For the informal businesses, the craft skills passed down from family members, neighbours and others in their communities, provided a means to make a living. As shown in Table 5.1, most of the businesses were started because the owner 'liked the activity', and many had the basic skills. Most business owners were female and unemployed and had low levels of education. The businesses tended to be unregistered and to operate from the business owner's home, with some access to basic amenities.

The fact that the majority of the businesses were in operation for more than five years, and many for more than 10 years, indicates the long-term nature of informality. The informal apparel businesses were mainly own-account operators, with very few employing paid workers. The business owners interviewed described their businesses as being "hand-to-mouth" (Interview Informal Business VID411) and "...not like the other business, it's not big... I sometimes run out of resources" (Interview Informal Business VID149). Like Palmi (2006), we found that the business owners desired to grow their businesses into sustainable formal businesses when "things start working out", as one informal business stated (Interview Informal Business, VID149).

The characteristics of the businesses reflect local embeddedness. As shown in Table 5.1, supplies were mainly sourced locally. The businesses mainly served the low-income markets in their local neighbourhood and surrounding areas, particularly affordable traditional attire, school and church uniforms, handmade clothing, shoes and accessories markets. The businesses tended to be constrained by the low-income market. They often offered flexible payment options to suit the financial circumstances of their customers, and it was not uncommon for customers to refuse to pay when the job was done, as one business owner explained: 'Some people would ask me to create something for them and they would only pay month end. Sometimes they pay the full amount and sometimes they don't... it is not easy at all' (Interview Informal Business VID1168). The lack of access to finance and credit was a significant constraint due to the small and informal nature of the businesses and the lack of social networks that could offer financial support and credit (Competition Commission, 2019; Charman & Petersen, 2018). Only 7.3% of the businesses reported receiving financial support, and this was mainly from friends or family, with none reporting access to finance from commercial banks.

Table 5.1. Profile of the Informal Apparel Businesses.

Necessity-driven	I liked the activity (59%) Unemployment or having no alternative source of income (54%) I had the basic skills (38%) To take care of my family (37%)
Informality was long-term in nature	More than five years (60%) More than 10 years (36%)
Mainly home-based and unregistered	Operating from a designated space within the home (37%) Operating from an occupied room within the home (34%)
Some access to basic amenities	Access to water and sanitation services (98%) Access to piped water within their business structure (35%) Access to a toilet, but not a flush toilet on site or offsite (55%) Access to a flush toilet on site (31%)
Mainly own-account workers	Average number of employees (1.3) Average growth in employment per business (2017 and 2018) (0.32) Paid employees (52%) Females (55%)
Low levels of education among business owners	Junior certificate (intermediate/ Grade 9/junior or equivalent) (69%) Secondary school (21%) University degree (10%)
Main economic activities	Dressmaking/tailors (46%) Clothes seller (11%) Fashion design (1%) Beads selling and beadwork (9%) Shoemakers/repairers and selling (16%) Bags selling (6%) Upholstery repairing (6%) Retail of linen (4%) Manufacture of traditional rugs/ carpets (1%)
Mainly local suppliers	Informal sources (57%) Informal businesses (12%)

(Continued)

Table 5.1. *(Continued)*

	Individuals and households (45%) Formal businesses (35%) Main city in the province (29%)
Marketing activities rely strongly on 'know-who' forms of knowledge	Word-of-mouth (82%) Telling family and friends (56%) Moving the business closer to customers (23%) Use the internet or cell-phone applications (14%) Use bigger and newer signs (5%)
Few use the internet or social media for business	WhatsApp (24%) Facebook (16%) Instagram (4%) Twitter (2%) Internet search (using Google) (1%)

Source: Authors, based on the 2017-18 IIS Survey data, CeSTII, 2021a.

Other constraints included limited access to the internet and data. The businesses mainly advertised via word of mouth and through family and friends. It was common practice to demonstrate their work through making samples that they showed to schoolteachers, asking friends and family to share with others or sharing at street markets (Informal Business VID1296). Few made use of the internet or social media, other than WhatsApp, to market their businesses. Some accessed resources via the local library.

Other challenges to doing business related to the seasonal nature of the apparel industries as sales tend to be low in some seasons. The second most important challenge was high levels of competition from other businesses in the area, and related to this, having too few customers, as this quote illustrates: 'The most difficult thing is the fact that there are a lot of us that are doing the same thing so you have to make sure that you do your job correctly in order for you to get business' (Informal Business VID609). One of the business owners reported the challenge of a lack of adequate market space to reach customers (Informal Business VID1296). Other major challenges were access to transport and crime in the local area.

The informal businesses reported economic and financing-related challenges as the only major barriers to innovation. Specific barriers that hindered innovation activities for at least a year included the high cost of acquiring modern technology and tools (35.6%) and ensuring quality and complying with national standards (27.4%); the unavailability of funding from family or friends (37.0%); lack of access to finance and credit from banks and other formal organisations (43.8%) and difficulty in getting loans from commercial banks due to the business

not being registered (30.1%). Other barriers reported included lack of access to basic infrastructure and shared facilities (30.1%), distance from sources of raw materials (32.9%) and high levels of crime (32.9%).

Innovation and Learning in the Informal Apparel Businesses

Table 5.2 indicates the high rate of innovation, with 83% of the businesses reporting innovation, that is, product (goods or services) and/or process innovation, as defined by the international innovation measurement guidelines (OECD/Eurostat, 2018, p. 34).

Based on the types of innovation activities shown in Table 5.2, the high rate of innovation and innovation intensity was driven by the need to survive rather than for taking up new opportunities for growth or technological upgrading. Innovation was mainly customer-driven and new-to-the-firm and -local area.

Table 5.2. Patterns of Innovation and Learning in the Informal Apparel Businesses.

High levels of mainly process innovation activity	Process (81%) Product (64%)
Innovation with a very local [a]degree of novelty	New to local area (37%) New to local industry (27%) New to the business (34%)
Doing, using and imitating modes of innovation prevail	Learning by using (76%) Doing everyday working tasks (60%) Imitating products of formal enterprises (45%) Learning through interaction (29%) Using scientific and specialised knowledge (10%)
Innovation activities centred on customer demand	Responding to customer demand, based on their feedback (64%) Acquiring tools, machinery and equipment (48%) Finding new suppliers of raw materials and tools (47%) 'Happy accidents' (42%) Changes to buildings, vehicles or other infrastructure (19%) Training staff to introduce changes (16%) Searching for new knowledge (25%)

(Continued)

Table 5.2. *(Continued)*

	Bringing in know-how or other types of knowledge (22%) Using indigenous knowledge (27%) Change or upgrade technology (tools) (21%) On-the-job learning (17%) Engaging in a formal apprenticeship system (12%) Bring in internet and digital devices (16%) No innovation activity (7%)
Informal learning and few collaborative linkages	Working with new equipment or raw materials (56%) Observing and copying other businesses (46.6%) Learning to meet quality standards (34%). Work with employees to develop skills through formal channels (15%)

Source: Author, based on the 2017–2018 IIS Survey data, CeSTII, 2021a.

[a]Note that this variable had a very high rate of missing responses.

Bringing in tools, equipment and machinery was an important innovation activity but was focused on low technology. For example, a business may shift from using a manually operated sewing machine to a domestic electric sewing machine (Informal Business VID411).

The data on collaboration and sources of information show that linkages across the value chain were weak. Reflecting the demand-driven nature of the economic activities, the strongest linkages reported were with customers. Linkages with formal knowledge producers and intermediaries were virtually non-existent. In comparison to other informal businesses in the study area, the apparel businesses used scientific and specialised knowledge to a lesser extent. Less than a third of the businesses reported learning through interaction and few used technical and scientific knowledge for their innovations (Table 5.2). In general, they did not make use of the specialist technical training colleges located in the nearest town, about 12km away, or the two universities offering apparel-related qualifications. This finding suggests that the informal businesses did not benefit from scientific and technical knowledge that could be shared, for example, through student projects or university–community engagement initiatives.

The businesses reported linkages with other businesses, but interaction was not frequent, taking place once or twice a year. They seldom shared knowledge, and less than a quarter (23%) were involved in clusters. Rather than working

with other businesses to learn new processes, the businesses often observed and copied the processes of other businesses and, by themselves, experimented with adopting methods and practices found to be useful (34.3%). The goods and services produced by other businesses were copied to a lesser extent (20.6%).

The 'duplicative' (Kraemer-Mbula et al., 2019, p. 6) nature of innovation is reflected in the origin of the innovation. More than a quarter of the business owners described their product (27.4%) and process (38.4%) innovations as based mainly on common knowledge. The findings reflect capabilities to produce innovations of a low level of complexity. There were few examples of more sophisticated innovations.

The interview data were used to further explore the level of novelty of the innovations. It is clear from the examples, shown in Table 5.3, that the innovation activities typically led to innovations of a low or intermediate level of novelty (Bell & Figueiredo, 2012, p. 21). This means that the innovation activities resulted in the implementation of mainly *minor* changes to *existing* products, often based on imitation or informal experimentation and requiring a low amount of new investment (see Bell & Figueiredo, 2012; Miner, 2010). An example of a low-level innovation is a shoe manufacturer introducing a traditional Zulu shoe in a new colour or different colours to the traditional natural leather. In increasing the level of novelty to the intermediate level, the shoe manufacturer may, based on informal skills training, change the stitching and the way the shoe is put together to increase the comfort level of the shoe to better meet the needs of a specific market.[3] We found few examples of intermediate or advanced types of innovations involving the integration of *new features* into *existing* products or processes (see Miner, 2010).

Constrained by the nature of the low-income markets they serve, it is common for informal business owners to add additional businesses to keep growing (see Petersen et al., 2023) rather than investing in developing more sophisticated products that they may sell at a higher cost. This type of business strategy benefits the business owner but may not contribute much to building the LIPS or shifting local development trajectories.

In conclusion, the findings show the ability to innovate with very little resources, helping these enterprises to compete at the local level and sustain their businesses for several years. An advantage for this group of informal businesses is their geographical, social and cultural proximity to the local traditional context required for building niche markets based on traditional African dress and knowledge. However, there are few examples of businesses combining different types of knowledge leading to low levels of sophistication and novelty. Weak linkages with other businesses and innovation support organisations were a constraint. The modes of innovation and learning tended to be experiential and focused inward. The informal businesses saw themselves as 'small', with limited resources. Business was uncertain, with there being no customers or income some

[3]This example is based on a description provided by one of the informal apparel businesses included in the survey.

Table 5.3. Examples of Innovation Reported by the Apparel Businesses.

Type of innovation activity	Description of innovation based on the interviews	Level of sophistication	Examples from the interviews
Customer demand	*Changes to designs of apparel*, in response to customer demand and seasonal trends	Low	'When you are making outfits for kids, you always have to change so that they are not seen in one thing all the time.' (Informal Business VID149) 'Yes. I change, I don't have a problem, and at times I design things according to clients' requirements.' (Informal Business VID1191) '...the beads also change as the times go on. It also depends on the...season and also what will attract people.' (Informal Business VID1296)
	Demand-driven customisation of apparel ('international brands') *by adding traditional fabric and design*	Intermediate	'I normally get to re-do my customers' clothes. They like international brands, so they bring them to me so that I alter them and add African print material.' (Informal Business VID411)
'Happy accidents'	Creating *new designs or modifying designs through experimentation*	Intermediate	'So, it's the traditional skirts and pants...I taught myself. I used to use old clothing and sails to put outfits together.' (Informal Business VID149)

Using indigenous knowledge	Using knowledge on traditional practice of producing traditional attire and fabric. Involves producing *new or modifying designs through combining traditional and modern dress*	Intermediate	'I normally get to re-do my customers' clothes. They like international brands, so they bring them to me so that I alter them and add African print material' (Informal Business VID411)
Search for new knowledge	Using designs and information available via the internet or media (mainly television or newspapers) to inspire *changes to clothing and accessories, to keep up with trends*	Low	'So, I don't go to anyone for assistance in my business, I get to figure things out on my own. Sometimes, when I see something that I like on TV, I try it out on my own until I get it right.' (Informal Business VID149) 'I sometimes get designs from newspapers and cut them out and sometimes I buy them. Some of the designs are seasonal." (Informal Business VID509)
Bringing in know-how or other types of knowledge	Approaches others in the industry, mainly friends, neighbours and family, to learn new skills or improve skills to implement a *change in apparel design*	Low, intermediate	'. . .if I want to start working on a new pattern...I go to school and other fellow seamstresses.' (Informal Business VID149)
Change/upgrade technology, tools and equipment	*Upgrading equipment*, such as sewing machines, from manually operated to electric (domestic) machines	Low, intermediate	'...I started with the manual machine and then bought the electric one...I would love to get an industrial machine so that I can do more things.' (Informal Business VID411)

(Continued)

Table 5.3. *(Continued)*

Type of innovation activity	Description of innovation based on the interviews	Level of sophistication	Examples from the interviews
Bringing in internet facilities and other devices	*Getting a smartphone to be able to use social media for advertising*, usually through creating a Facebook page or advertising via WhatsApp, enabling the business to attract more customers. Also, to be able to search the internet for useful information to inform changes in the business	Intermediate	'...we advertise, like my Facebook, my picture is a lounge suite... Yes, it is helping because I have people contacting me and asking me how much is it to do a lounge suite...' (Informal Business VID828)

Authors, adapted from CeSTII (2021a, pp. 30–31)

months. As shown by the findings on interaction and collaboration, collective learning that the literature highlights as important in such contexts, was missing.

Conclusion: Lessons and Recommendations for African Countries

The case study findings indicate a high rate of innovation, of mainly low complexity, that is crucial for business survival but limited for unlocking growth potential and opening up new pathways for local development. Therefore, a key goal for promoting innovation in resource-poor local settings in Africa is to build capabilities to produce innovations of a variety of levels of sophistication and novelty. The goal is inter-firm diversity of innovation that can drive the evolution of industry, which depends on increasing the complexity of knowledge and expertise within businesses (Marsili & Salter, 2005, p. 87, based on Dosi, 1988; Nelson & Winter, 1982). Here, the emphasis is on shifting from the dominance of low complexity to include more innovation at the intermediate and advance levels. The intermediate level typically involves a degree of creative imitation rather than duplication and may involve advanced modifications towards incremental changes (Bell & Figueiredo, 2012, p. 21). The challenge is how to build innovation capabilities to achieve higher levels of innovation complexity at the system level, considering the necessity-driven nature of innovation. This requires a change to how the informal sector is supported.

One important way to intervene is through strengthening linkages with knowledge producers to support skills development and creative combinations that build on the strong symbolic knowledge (Asheim et al., 2011, p. 882) possessed. The case study illustrates the potential to leverage the strong symbolic knowledge (Asheim et al., 2011, p. 882) and traditional know-how passed on through generations. Since these forms of local knowledge are place-specific, staying close to the local origin is crucial for exploiting such niche markets. However, to produce more sophisticated forms of innovation, their local forms of knowledge need to be combined with other forms of knowledge, including technical know-how and scientific knowledge. As Salinger et al. (1999) show, businesses that have been able to take advantage of niche market opportunities tend to be larger businesses with the resources to acquire information about niche markets and access to useful networks, such as manufacturers with the relevant capabilities. Considering the resource-constrained context, it is difficult for informal businesses to harness the value of their local knowledge without external support.

Government actors play an important role as public intermediaries, promoting linkages and market access and enabling informal businesses to take up opportunities that they may not be able to take on by themselves (Palmi, 2006). The findings indicate spaces for policy intervention related to reducing barriers to finance and credit, creating new funding instruments to support innovation in the informal sector, providing basic infrastructure and combatting crime. Also emphasised is the promotion of collective action and learning, through co-operatives and business clusters, for example (DTI IPAP 2018/19-2020/21; Rogerson, 2000). However, these initiatives tend to have limited impact if not

targeted at individuals with industry work experience or basic business management skills. Programmes aimed at providing skills training opportunities for unemployed, unskilled individuals would have more impact by facilitating mentorship and coaching by formal businesses or informal businesses in the same industry. Cooperative support programmes could include formal mentorship and 'co-op shadowing' that involves informal businesses meeting regularly with well-established formal apparel businesses or successful co-ops. Research shows that participants in such programmes benefit from having a role model, gaining the necessary know-how as well as an understanding of required norms and practices (Rogerson, 2000). The role of informal business chambers could also be strengthened to facilitate the setting up of co-ops and interaction to build the local production value chain.

Government initiatives could have greater reach and impact if based on models that are implemented in partnership with well-established formal businesses and civil society. NGOs and CBOs have played a key role in promoting development, including providing basic skills training, such as sewing skills for unemployed rural women. However, the success of support initiatives depends on improvement of access to reliable information and support services in townships, rural towns and other underserved areas.

Furthermore, the analysis of the major barriers to innovation reported by the informal businesses indicates the interrelatedness between production, innovation and socio-economic conditions in the local context. Improving local conditions reduces barriers to innovation and is important for building production capabilities, indicating the need to build, not only the knowledge infrastructure but also the physical infrastructure (Hoffecker, 2018). For example, the cost of internet access was a challenge to marketing and innovation. Improving internet access and connectivity, via free Wi-Fi hotspots in the community, such as the library, is crucial. Besides catalysing the building of roads and improving access to basic services, initiatives may create market spaces for informal businesses and well-equipped skills development centres. In the current study, one informal business owner reported that the community had such a centre, but without sufficient support from government and business, it was closed.

Building local ecosystems for innovation, in a holistic way, requires a coordinated approach across different levels of government—national, provincial and local—in partnership with the private sector (formal and informal), education and training organisations and civil society towards LIPS. In this way, the informal sector can be supported, alongside formal sector businesses, to build innovation capabilities for contributing to the growing international market for African-inspired fashion that is locally produced and ethnically sourced.

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Chapter 6

Exploring Firm-Level Classification of Innovation Behaviours in Agricultural Businesses: An Input–Output Modes Approach

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Introduction

Innovation in agriculture is widely acknowledged as an important contributor to productivity growth, sustainability and competitiveness in firms, particularly in developing economies where a lack of sufficient resources, market inefficiencies and infrastructural and structural barriers all present significant challenges (Adomako & Ampadu, 2015; Freeman, 2008; Lundvall, 2011; Schumpeter & Swedberg, 2021). Over the past few years, innovation in agriculture has been shown to be highly complex, often consisting of both knowledge-intensive and process-based activities, as well as incremental modifications of existing products and business processes (Dolata, 2009; Jensen et al., 2007; Tidd & Bessant, 2018). In this sector, the distinction between radical and incremental innovation (Schumpeter, 1934) is much more evident, given that agricultural businesses must navigate long innovation cycles, environmental unpredictability and capital-intensive investments (Rosenberg, 1982). Despite the critical importance of agriculture in developing countries, there remains a limited understanding of how agricultural firms innovate, particularly from the perspective of innovation modes. While existing studies have explored knowledge flows, institutional linkages and market access (Dolata, 2009), little attention has been given to innovation strategies employed by agricultural businesses—whether knowledge-driven, activity-driven or incremental—and how they shape their innovation outcomes.

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In this regard, the concept of innovation modes provides a useful framework for analysing how firms develop, modify and implement new technologies.

Using data from AgriBIS 2019–2021, this chapter applies the innovation modes approach to analyse how agricultural businesses innovate. Given that the modes-based approach considers a broader range of innovation dimensions, including non-technological innovations and the interplay between different innovation activities, it provides a more holistic view of how agricultural businesses can be categorised based on their unique innovation strategies. This allows for the gaps left by traditional innovation indicators to be addressed and offers a deeper insight into the different innovation strategies employed by agricultural businesses.

This study contributes in part to policy debates and learning by describing and analysing opportunities for development and informing evidence-based policy-making grounded in the classification of how agricultural businesses innovate using the modes approach. The remainder of the chapter is organised as follows: first, a review of the literature on the topic of innovation in agricultural businesses; second, the analytical framework of innovation modes guiding the study; third, the methodological approach is discussed. Empirical results are presented together with subsequent discussions before the chapter is concluded with implications for policy and practice.

Understanding Innovation Capabilities in Agricultural Businesses

Agricultural firms often have unique innovation capacities due to several factors. Firstly, the nature of agricultural production involves biological processes that are inherently variable and influenced by environmental conditions (Knickel et al., 2009). This variability requires agricultural firms to continuously adapt and innovate to maintain productivity and quality. Unlike industrial sectors, where processes can be tightly controlled and standardised, agriculture must contend with unpredictability in weather and soil conditions, as well as pest pressures (Pant, 2012). This necessitates a greater emphasis on research and development (R&D) focused on breeding resilient crop varieties, developing sustainable farming practices and integrating advanced technologies like precision agriculture (Yost et al., 2019).

Bjerke and Johansson (2022b) argue that strengthening in-house knowledge capacity in agricultural firms can significantly enhance their ability to innovate. This involves investing in human capital, promoting a culture of continuous learning and facilitating knowledge transfer within the firm. Through the building of a strong base of internal expertise, agricultural firms can better leverage external innovations and collaborate more effectively with research institutions, universities and technology providers.

Collaboration is another critical aspect of agricultural innovation that has received attention in the literature. The complex and multifaceted nature of agricultural challenges often requires a collaborative approach to innovation (Yost et al., 2019). Partnerships with other firms, research institutions and public

agencies can provide access to new knowledge, technologies and resources. These collaborations can lead to the co-creation of innovations that are better suited to the specific needs of the agriculture sector (Dodgson, 2018). Collaborative projects between farmers and agricultural researchers have led to the development of climate-resilient crops and sustainable pest management practices that address local environmental conditions and farmer needs (Krishnan et al., 2021).

Innovation Modes

The concept of innovation modes has gained considerable attention in the literature in the past few years for its structured approach to the analysis of how firms engage in innovation activities across different industries and contexts (Janger et al., 2017). Early contributions to this discourse, such as Laursen and Foss (2003), focused on Human Resource Management (HRM) practices, foregrounding the role of HRM strategies in shaping innovation performance in firms. Similarly, Tether and Tajar (2008) discussed the importance of organisational innovation, particularly in service firms, affirming that innovation extends beyond technological advancements to include structural and managerial changes.

Using the modes approach, several studies have sought to classify firms based on their innovation behaviours and strategic orientations. However, most scholars have taken a different approach to their analyses. Hollenstein (2003) identified five innovation modes among Swiss service firms. Hollenstein argued that innovation can take multiple forms depending on sectoral and institutional factors. On the other hand, Jensen et al. (2007) distinguished between two knowledge-based innovation modes: one driven by science, technology and R&D investment and the other built on learning-by-doing, adaptation and incremental improvements.

The distinction between technological and non-technological innovation was further studied by Evangelista and Vezzani (2010), who explored the relationship between these two innovation pathways. Their findings suggest that while technological innovations remain critical, non-technological forms of innovation, such as business model adjustments and process improvements, also play a key role in firm productivity. This perspective mirrors the findings by Frenz and Lambert (2009), who found that non-technological innovation modes exerted a stronger influence on productivity than previously assumed, challenging the traditional emphasis on R&D-intensive innovation models.

The work of Srholec and Verspagen (2008, 2012) also expanded the scope of innovation mode research by exploring innovation heterogeneity across 13 European countries. Using a modes approach, Srholec and Verspagen (2012)'s factor analysis further confirmed the role of firm-level heterogeneity in innovation strategies. This work in particular drew attention to the context-dependent nature of innovation while reinforcing the idea that firms in different economic contexts adopt different innovation strategies based on institutional settings,

industry structures and market conditions. Frenz and Lambert (2009) concluded that non-technological innovation modes significantly influence productivity and output.

Similarly, Arundel et al. (2007) analysed innovation behaviours across European economies. Their study argued that firms engage in distinct patterns of innovation depending on their access to resources, networks and policy support structures.

Analytical Framework

Linking Innovation Modes to Agricultural Innovation

As was shown in the previous section, much of the literature on innovation modes has primarily focused on services, manufacturing and cross-industry comparisons. However, their application to agriculture remains underexplored. The agriculture sector, particularly in developing economies like South Africa, operates within a unique innovation landscape where firms engage in both knowledge-intensive and activity-driven innovation strategies. This means that the distinction between R&D-driven and learning-based innovation, as proposed by scholars like Arundel (2007) and Jensen et al. (2007), is particularly relevant for agriculture, where some firms invest in formal research and new technological development while others focus on incremental improvements through experiential learning, adaptation and process optimisation.

Moreover, given the agriculture sector's dependence on natural resources and environmental conditions, the findings of Frenz and Lambert (2009) on the role of non-technological innovation in productivity improvements are also particularly applicable. This suggests that policy frameworks aimed at promoting agricultural innovation must account for both technology-driven and process-based innovation approaches in order to ensure that incremental innovations, such as improved farming techniques and sustainability practices, receive equal attention alongside advanced technological innovations.

Our analytical framework builds on existing scholarship on innovation modes, particularly the foundational work of Arundel and O'Brien (2009), which developed a framework for categorising firms based on their innovation inputs and outputs. Their approach established the importance of distinguishing between knowledge-driven and activity-driven innovation processes, allowing for a more granular analysis of how firms allocate resources, develop capabilities and generate innovation outcomes. Moreover, we also draw on the recent contributions of Kruss et al. (2024), as well as empirical evidence from the Centre for Science, Technology and Innovation Indicators (CeSTII, 2024), which used a taxonomy designed by Arundel and Hollanders (2008, 2011) and the Organisation for Economic Co-operation and Development (2009) to map patterns of innovation modes across manufacturing and services firms, with a particular focus on understanding how South African businesses engage in different innovation strategies.

Input Modes

In this study, for the input modes, agricultural businesses were classified based on two primary dimensions: (a) the types of innovation activities and (b) collaboration status. Knowledge-driven innovation activities are those that were highly knowledge-intensive, such as in-house R&D and the development of new intellectual property. Activity-driven innovation involved less knowledge-intensive activities, such as training, design work, marketing and process improvements.

Collaboration status was used to distinguish between firms that collaborated with other businesses or institutions in their innovation projects and those that undertook innovation activities independently.

The combination of these elements resulted in four mutually exclusive groups of firms: (1) knowledge-driven collaborators, (2) knowledge-driven non-collaborators, (3) activity-driven collaborators and (4) activity-driven non-collaborators (see Table 6.1).

Table 6.1. Summary of Input Modes.

Classification	Types of Innovation Activities	Collaboration Status
Knowledge-driven collaborators	Highly knowledge-intensive activities such as in-house R&D and the development of new intellectual property	Firms collaborating with other businesses or institutions in their innovation projects
Knowledge-driven non-collaborators	Highly knowledge-intensive activities such as in-house R&D and the development of new intellectual property	Firms undertaking innovation activities independently without collaboration
Activity-driven collaborators	Less knowledge-intensive activities such as training, design work, marketing and process improvements	Firms collaborating with other businesses or institutions in their innovation projects
Activity-driven non-collaborators	Less knowledge-intensive activities such as training, design work, marketing and process improvements	Firms undertaking innovation activities independently without collaboration

Output Modes

The output modes were classified based on three primary dimensions: (a) market reach, (b) novelty of product innovations and (c) the origin of innovations. Market reach was used to differentiate firms operating in international markets from those that operated only in domestic markets. The novelty of product innovations distinguished between new-to-market products and modifications of existing products. The origin of innovations identified whether innovations were developed in-house or adopted from other businesses or organisations, with further distinction if adopters are part of an enterprise group. This classification resulted in six mutually exclusive groups of firms: (1) new-to-market international innovators, (2) new-to-market domestic innovators, (3) international modifiers, (4) domestic modifiers, (5) adopters and (6) adopters part of a group (see Table 6.2).

Table 6.2. Summary Description of Output Modes.

Classification	Market Reach	Novelty of Product Innovations	Origin of Innovations
New-to-market international innovators	International	New-to-market	In-house
International modifiers	International	Modification	In-house
New-to-market domestic innovators	Domestic	New-to-market	In-house
Domestic modifiers	Domestic	Modification	In-house
Adopters	International/ domestic	Adopted	Other businesses/ organisations
Adopters part of a group	International/ domestic	Adopted	Part of enterprise group

Methodology

Data and Variables

This study used AgriBIS data covering the period 2019–2021. The survey covered three main subsectors of commercial agricultural businesses at the higher level of classification: the agriculture subsector (e.g. animal and crop farming); the forestry subsector and the fisheries subsector. This study was limited to innovation-active businesses in the agriculture (animal and crop farming) subsector. These businesses belonged to the South African agriculture sector's Standard Industrial Classification (SIC) number 11. The exclusion of the forestry and fisheries subsectors was

justified by the fact that their small number of observations may have led to inaccurate classifications.

Specific variables were used to identify the types of innovation activities and collaboration status. Knowledge-driven innovation was indicated by variables such as in-house R&D and the development of new intellectual property. Activity-driven innovation was represented by variables including access to training, improvements in farming production processes, logistics, information processing, business practices and methods to address climate change effects. Collaboration status was determined using variables such as collaboration on product and business process innovations.

To analyse the data, Python programming language was used. The Pandas library for wrangling was used. The implementation of this methodology began with data preparation, where the AgriBIS data were loaded into a Pandas DataFrame. The relevant columns for this analysis were identified based on the variables for innovation activities and collaboration status. Specific conditions were then defined for each of the four input modes. For instance, knowledge-driven collaborators were identified as firms engaging in high-level, knowledge-intensive activities and collaborating with other entities.

In contrast, knowledge-driven non-collaborators engaged in similar activities independently. Similarly, activity-driven collaborators and non-collaborators were classified based on their engagement in less knowledge-intensive activities and their collaboration status.

Using the above defined criteria, each firm was assigned to one of the four input modes. Variables for market reach included variables indicating whether a firm operated in markets such as the Rest of Africa, Europe, the United States, Asia or South Africa. The novelty of product innovations was represented by whether the firm introduced a new product to the market. The origin of innovations was indicated by variables showing whether the firm modified existing products or adopted innovations from other firms and whether the firm was part of an agricultural enterprise group.

Specific criteria were defined for each of the six output modes. For instance, new-to-market international innovators were firms with new-to-market innovations operating in international markets while domestic modifiers were firms modifying existing products operating only in domestic markets. Using these conditions, each firm was assigned to one of the six output modes. The presence of all defined modes in the dataset was verified to ensure completeness. The frequencies of firms in each category were then calculated and converted into percentages. These percentages were illustrated using bar graphs to provide a clear visual representation of the distribution of firms across the different modes.

Results

Input Modes

As illustrated by Fig. 6.1, the analysis of the input modes showed that the largest share of firms fell into the *knowledge-driven non-collaborators* category (43.16%),

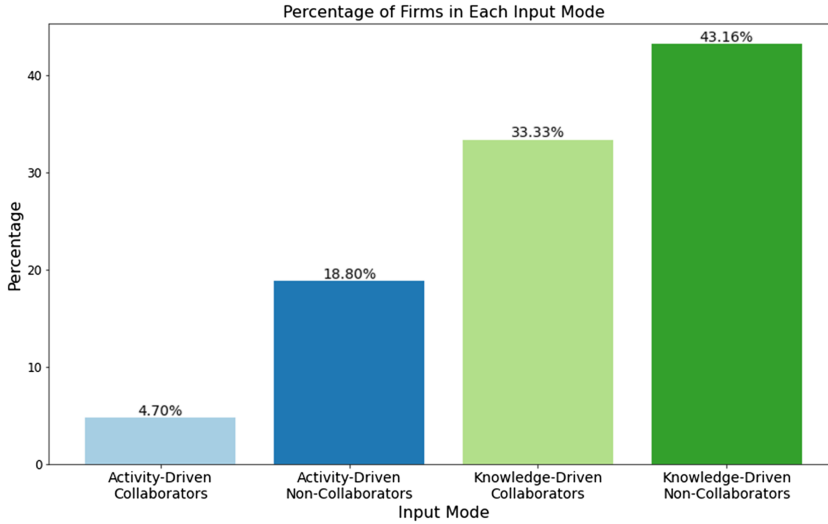

Fig. 6.1. Input Modes Results.

suggesting that nearly half of the firms pursued knowledge-intensive innovation activities, such as in-house R&D and the development of intellectual property, without engaging in formal collaboration. This means that while these firms invested in innovation, they may have relied primarily on internal capabilities, possibly due to certain collaboration barriers, such as limited access to collaborative networks, or a preference for maintaining control over innovation processes in order to protect their intellectual property.

The second-largest category, *knowledge-driven collaborators* (33.33%), included firms that similarly engaged in high-level knowledge-intensive innovation but did so through collaborative partnerships with other firms or institutions. This relatively high proportion highlighted the presence of innovation ecosystems where firms actively sought external knowledge, resources or expertise to complement their internal innovation efforts. The significant representation of this category suggested that a considerable number of agricultural firms recognised the benefits of collaboration in enhancing their innovation capabilities.

By contrast, *activity-driven non-collaborators* accounted for 18.80% of firms, which are firms that engaged in less knowledge-intensive innovation activities, such as training, process improvements and marketing, without external collaboration. It is likely that these firms focused on incremental innovation aimed at improving operational efficiency rather than breakthrough technological advancements. The lower share of firms in this category compared to knowledge-driven modes suggested that innovation in the agriculture sector tended to be more structured around knowledge-intensive activities than process-based refinements.

Finally, *activity-driven collaborators* represented the smallest share of firms (4.70%). These firms engaged in process-orientated innovation and sought external partnerships to support their innovation efforts. The relatively low representation of this category implied that firms engaging in activity-driven innovation were generally less inclined to collaborate, possibly due to such innovations requiring fewer external inputs or the absence of strong incentives for firms to establish partnerships for incremental improvements.

ICT Adoption Across Input Modes

After classifying firms into input modes based on their innovation strategies, we examined how firms in each category adopted and used advanced ICTs for innovation. This analysis provided insights into whether firms engaging in knowledge-driven or activity-driven innovation, as well as those collaborating versus working independently, differed in their adoption and use of digital technologies. Table 6.3 presents the results of this analysis.

As reflected in Table 6.3, across all input modes, *sensor/IoT technologies* emerged as the most widely adopted ICT, with usage ranging from 21.05% among *activity-driven non-collaborators* to 67.95% among *knowledge-driven collaborators*. This suggests that firms that engaged in high-level knowledge-intensive innovation, particularly those collaborating with external partners, were more likely to leverage IoT technologies innovation. *Precision agriculture* was another widely adopted technology, with a majority of *knowledge-driven collaborators* (70.51%) *and knowledge-driven non-collaborators* (62%) using it. This reinforced the view that firms engaged in knowledge-intensive innovation placed a strong emphasis on efficiency-enhancing technologies that optimise agricultural production.

On the other hand, *blockchain technology* was the least popular across all input modes, with adoption rates below 8% in every category. The highest adoption was recorded among *knowledge-driven collaborators* (7.79%) whereas both *activity-driven firms* showed no engagement with blockchain technology at all. This suggested that despite its potential for improving transparency in supply chains and financial transactions, blockchain had not yet been widely integrated into agricultural innovation strategies. Similarly, *artificial intelligence (AI)* adoption remained relatively low, with *knowledge-driven collaborators* leading at 31.17% and *activity-driven collaborators* showing no adoption (0%). This indicated that AI-driven decision-making and automation had yet to become mainstream, with adoption largely concentrated among firms engaged in knowledge-intensive innovation.

Several interesting patterns emerged when comparing ICT adoption across the four input modes. Knowledge-driven collaborators stood out as the most technologically advanced group, leading in the adoption of sensor/IoT technologies (67.95%), precision agriculture (70.51%), and drones/robotics (46.15%). Their comparatively higher adoption of AI (31.17%) and blockchain (7.79%) suggested that collaborative knowledge-intensive firms were more likely to integrate emerging digital solutions into their innovation processes.

Table 6.3. Input Mode and Advanced Technologies Adoption.

Input Mode	Sensor/IOT Technologies	Artificial Intelligence	Blockchain Technologies	Precision Agriculture	Drones/ Robotics	Smart Plant/Animal Breeding
Activity-driven collaborators	33.33%	0.00%	0.00%	44.44%	22.22%	42.86%
Activity-driven non-collaborators	21.05%	7.89%	0.00%	28.95%	10.53%	18.42%
Knowledge-driven collaborators	67.95%	31.17%	7.79%	70.51%	46.15%	38.46%
Knowledge-driven non-collaborators	53.47%	22.00%	2.97%	62.00%	30.69%	30.30%

Output Modes

The output modes analysis painted a clear picture of a sector largely shaped by adoption strategies, where most firms integrated existing technologies rather than developing new ones. As shown in Fig. 6.2, the output modes analysis showed that the majority of firms (44.87%) were classified as *adopters*, indicating that they primarily integrated existing innovations without significantly modifying or developing new products or processes. A smaller subset (4.27%) fell into the *adopters part of group* category, suggesting a collaborative adoption approach, possibly influenced by industry networks or cooperative structures.

By contrast, *domestic modifiers* (12.39%) and *international modifiers* (20.51%), a category that represented firms that adapted existing innovations to suit domestic or international markets, respectively, had an inclination towards incremental rather than radical innovations. Notably, *new-to-market domestic innovators* (15.81%) introduced novel innovations to the national market while *new-to-market international innovators* (2.14%) pursued innovation on a global scale, albeit with significantly lower representation.

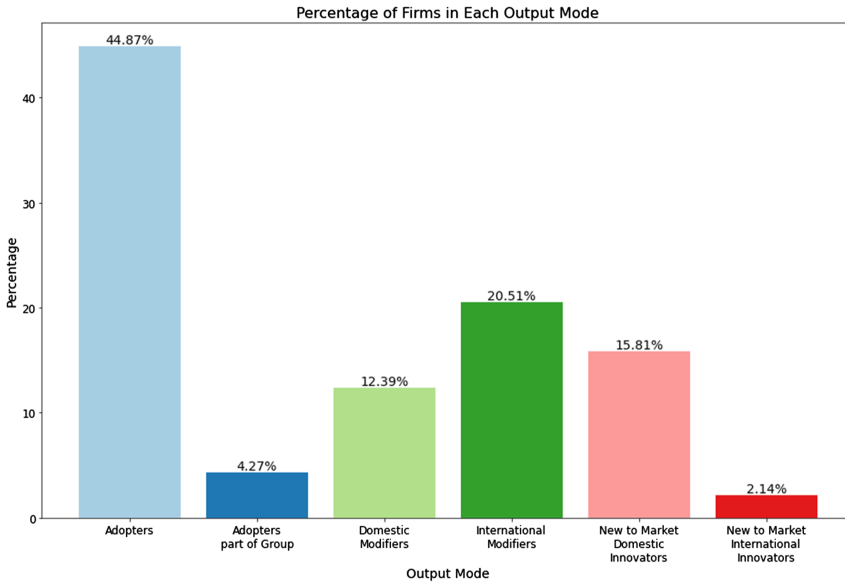

Fig. 6.2. Output Modes Results.

ICT Adoption Across Output Innovation Modes

After classifying firms into six distinct output modes based on their innovation strategies, we sought to understand how firms in each category adopted and used advanced ICTs for innovation. This analysis allowed us to explore whether

certain advanced ICTs were more prevalent within specific innovation modes and to identify broader trends in digital technology adoption across the agriculture sector.

To achieve this, we grouped firms by their respective output mode and calculated the percentage of firms within each category that reported using various advanced ICTs, including sensor/IoT technologies, AI, blockchain, precision agriculture, drones/robotics and smart plant/animal breeding. The data were structured as binary indicators (1 = technology used, 0 = technology not used), and mean values were computed to determine the proportion of adopters in each mode. Table 6.4 presents the summary of advanced ICT and output modes analysis.

The findings showed that across all innovation modes, *sensor/IoT technologies* emerged as the most widely adopted ICT, with uptake ranging from 51.55% among *standalone adopters* to 80% among *new-to-market international innovators*. This high level of adoption suggests that firms, regardless of their innovation mode, increasingly recognise the value of real-time data collection and automation in improving efficiency and decision-making. *Precision agriculture* was another commonly adopted technology, with adoption rates exceeding 50% in all categories, except for new-to-market international innovators, indicating its integral role in enhancing productivity and resource management across various innovation strategies.

By contrast, *blockchain technology* was the least popular across all innovation modes, with adoption rates remaining below 7% in every category. Its highest adoption was observed among *standalone adopters* (6.25%) while firms in other modes reported negligible engagement, with *adopters part of a group* and *new-to-market international innovators* showing no adoption at all. This suggests that despite the growing interest in blockchain applications for supply chain transparency and digital contracts, its implementation within the agriculture sector remains minimal, possibly due to limited awareness, perceived complexity, or the lack of clear regulatory frameworks.

Discussion

The empirical evidence provided by this chapter has shown that agricultural innovation is highly diverse and comprises knowledge-driven, research-intensive processes and incremental, practice-based adaptations (Jensen et al., 2007; Tidd & Bessant, 2018). Existing empirical literature distinguishes between formal innovation systems, where structured R&D and institutional collaborations drive knowledge generation (Casper & van Waarden, 2005; Freeman & Soete, 2009) and informal, experiential innovation, which is often embedded in tacit knowledge, on-the-ground problem-solving and adaptive learning (Van der Veen, 2010). This duality is particularly evident in innovation modes, where firms adopt distinct strategies based on their resources, technological capabilities and market conditions (Powell et al., 1996). The distinction between radical and incremental innovation (Schumpeter, 1934) has been well-documented across

Table 6.4. Output Mode and Advanced Technologies Adoption.

Output Mode	Advanced ICTs					
	Sensor/IOT Technologies	Artificial Intelligence	Blockchain	Precision Agriculture	Drones/ Robotics	Smart Plant/Animal Breeding
Adopters	51.55%	20.83%	6.25%	52.58%	26.80%	31.25%
Adopters part of group	70.00%	0.00%	0.00%	60.00%	30.00%	22.22%
Domestic modifiers	37.93%	28.57%	3.45%	62.07%	17.24%	17.86%
International modifiers	60.42%	25.00%	2.08%	64.58%	39.58%	36.17%
New-to-market domestic innovators	45.95%	21.62%	2.70%	66.67%	45.95%	40.54%
New-to-market international innovators	80.00%	20.00%	0.00%	40.00%	60.00%	20.00%

sectors, but in agriculture, the balance between these modes is shaped by high uncertainty, long innovation cycles and strong path dependency in technological adoption (Rosenberg, 1982). In this context, the findings of this study align with and contribute to the empirical discourse on how firms in agriculture organise their innovation processes, either independently or collaboratively, and how these approaches shape their innovation outcomes.

Input Modes and the Organisation of Agricultural Innovation

With respect to input modes, the findings showed that the majority of agricultural firms were predominantly engaged in knowledge-driven innovation, with the largest proportion classified as *knowledge-driven non-collaborators* (43.16%), followed by knowledge-driven collaborators (33.33%). This aligns with broader evidence suggesting that knowledge-intensive innovation in agriculture often stems from internal R&D capabilities, particularly when firms seek to maintain competitive advantage through proprietary knowledge and intellectual property (Chesbrough, 2003; Freeman, 2008). However, the significant share of knowledge-driven collaborators seems to suggest that innovation networks play a complementary role, particularly in contexts where inter-firm cooperation, public–private partnerships and research linkages are key drivers of knowledge exchange (Chesbrough, 2003). This finding reflects patterns observed in other technology-intensive sectors where open innovation models facilitate access to cutting-edge research and market insights (Klerkx & Leeuwis, 2009; Lundvall, 2011).

By contrast, activity-driven non-collaborators (18.80%) and activity-driven collaborators (4.70%) represented a smaller share of firms. This finding nonetheless indicates the continued importance of non-R&D-based innovation in the agriculture sector. These firms are often engaged in less knowledge-intensive activities, such as process improvements, training and experiential learning. These activities typically involve incremental improvements, such as optimising existing processes, improving product quality and implementing new practices based on experiential knowledge. Such incremental innovations are necessary for maintaining competitiveness and improving operational efficiency in agriculture (Bjerke & Johansson, 2022a; Van der Veen, 2010). The particularly low proportion of collaborative activity-driven firms suggests that while some firms benefited from external engagement in process-oriented innovation, most relied on autonomous, firm-specific adaptation strategies.

The dominance of knowledge-driven modes also confirms the notion that scientific knowledge and formal research processes are critical for firms that engage in high-level innovation (Hall et al., 2006) while activity-driven innovation remains crucial for firms focused on operational efficiency and incremental innovations. These findings support the argument that agricultural innovation should not be viewed as a linear process but rather a continuum between structured R&D-driven knowledge creation and informal, practice-based improvements (Tidd & Bessant, 2018).

Output Modes and the Nature of Innovation in Agricultural Markets

Innovation in agriculture has been shown to be more evolutionary than disruptive due to factors such as high costs, long development timelines and the risk-averse nature of agricultural markets (Hall et al., 2006; Klerkx & Leeuwis, 2009). The findings from the analysis of output modes support this view, as most firms were engaged in incremental modification rather than radical innovation.

The dominance of adopters (44.87%) reflects the role of technology diffusion rather than in-house innovation in agricultural firms. The high proportion of adopters suggests that many firms rely on external sources of innovation, reinforcing previous findings that agriculture remains highly dependent on knowledge spillovers and externally developed technologies (Lundvall, 2011). This finding also aligns with Rogers' (2003) diffusion of innovation theory, which suggests that agricultural technologies are often transferred through peer learning, extension services and supplier networks rather than through firm-led R&D efforts.

With respect to the modifiers categories, the findings showed that agricultural firms have a keen orientation towards adaptation and refinement rather than the pursuit of entirely new technologies or products. This mirrors findings in other research that indicate that agricultural businesses typically modify existing technologies and practices to better fit local conditions, regulatory environments and market needs (Bjerke & Johansson, 2022b; Klerkx et al., 2012). Incremental innovation allows firms to reduce risk, lower costs and achieve steady improvements in productivity and sustainability (Tidd & Bessant, 2018).

The relatively low representation of new-to-market innovators (2.13% internationally and 15.81% domestically) highlights the systemic barriers that firms face when introducing entirely new innovations to the market. The literature suggests that agricultural innovation is constrained by high R&D costs, complex regulatory frameworks and uncertain market demand (Freeman, 2008; Jensen et al., 2007). Furthermore, the high-risk nature of agriculture, driven by climate variability, supply chain disruptions and commodity price fluctuations, creates additional obstacles to radical innovation and market expansion (Rosenberg, 1982).

Comparative Discussion of ICT Adoption Trends Across Input and Output Modes

The clear disparities in ICT adoption and its role in innovation across input and output modes corroborates broader empirical research on the heterogeneous nature of technological diffusion in agriculture (Klerkx et al., 2019; Wolfert et al., 2017). The findings confirm that firms engaging in knowledge-intensive R&D-driven innovation, particularly knowledge-driven collaborators and new-to-market international innovators, were more likely to integrate advanced digital technologies such as IoT, AI and blockchain. This is consistent with the innovation systems literature, which argues that firms embedded in collaborative networks and global markets benefit from knowledge spillovers, shared resources

and greater incentives to adopt emerging technologies to maintain competitiveness (Jensen et al., 2007; Powell et al., 1996). Meanwhile, firms in activity-driven non-collaborators and standalone adopters showed significantly lower ICT adoption levels, which aligns with previous empirical findings, which suggest that small-scale agricultural firms tend to rely on traditional, low-risk innovation strategies due to a lack of financial resources, digital literacy gaps and uncertainty regarding the return on innovation investment (Eastwood et al., 2017). The relatively stronger adoption of precision agriculture and sensor/IoT technologies among domestic and international modifiers suggests that firms engaged in adaptation-based innovation tend to prioritise efficiency-enhancing technologies over high-risk, advanced ICTs, a trend similarly observed in sectors where innovation is driven by smaller incremental changes rather than radical transformation (Freeman & Soete, 2009).

These findings further align with diffusion of innovation theory, which argues that technology adoption follows a staged process, with firms integrating established digital tools before transitioning to more complex, data-driven technologies, such as AI and blockchain (Rogers, 2003). The limited engagement with AI and blockchain across all modes, despite relatively strong uptake of IoT and precision agriculture, supports existing arguments that agriculture remains in the early-to-mid stages of digital transformation, where firms first adopt automation and efficiency-enhancing technologies before integrating advanced predictive analytics and decentralised data solutions (Klerkx et al., 2019). Moreover, the higher ICT adoption rates observed among collaborative firms across both input and output modes highlight the role of inter-firm learning and institutional support in lowering adoption barriers (Hall et al., 2006; Tidd & Bessant, 2018).

Conclusion

Despite the critical role of agriculture in developing economies, especially in countries such as South Africa, where agriculture contributes to the economy through employment, food security and rural development, there remains a limited understanding of how innovation manifests within the sector. Existing empirical studies have examined the role of knowledge flows, institutional linkages and market access in shaping agricultural innovation (Freeman, 2008; Hall et al., 2006; Martin, 2012), yet few studies have explored how agricultural businesses innovate from the perspective of innovation modes – both in terms of input and output strategies. This gap is particularly significant given the increasing pressures faced by the sector, including climate change challenges such as droughts, greenhouse gas emissions and environmental degradation, as well as the management of scarce natural resources (land and water) and rising global competition. Understanding the dynamics of innovation in agriculture is therefore essential for improving firm-level performance as well as for ensuring the sector's long-term sustainability and resilience in an evolving global landscape.

The findings from the input and output modes analysis provided a detailed view of the innovation landscape within South African agricultural firms.

The distribution of different firms across different modes showed the diversity and complexity innovation activities and the varying degrees of collaboration and knowledge intensity that occur in this sector. From an input modes perspective, the importance of both knowledge-intensive and less knowledge-intensive activities in driving innovation revealed that a significant proportion of firms engage in high-level, knowledge-intensive activities either independently or in collaboration with others. This highlights the critical role of R&D and intellectual property development in driving agricultural innovation. The presence of activity-driven collaborators and non-collaborators also signals the importance of training, process improvements and incremental innovations. These activities are necessary for maintaining competitiveness and improving operational efficiency.

The findings from this study underline the importance of a mixed-policy approach that supports the different innovation strategies of agricultural businesses. As such, creating an environment that supports innovation across all levels and innovation modes in the agriculture sector, as shown in this study, can help developing countries such as South Africa progress towards achieving its goals of economic growth, food security, job creation and a reduction in income disparities. The section to follow discusses key implications for policy that can be derived from the findings of this study.

Policy Implications

Recently, South Africa made the decision to prioritise innovation as a central component of its economic development strategy. Key policy frameworks, through its policies and strategies such as the 2019 White Paper on Science, Technology and Innovation and the 2022–2032 STI Decadal Plan, set the stage for this transformative agenda. These policies stress the essential role of technological innovation in modernising critical economic sectors such as manufacturing, mining and agriculture and the need to enhance global competitiveness. In particular, the adoption and diffusion of new technologies like precision agriculture, robotics and ICTs, together with sustainable farming practices, are considered paramount to the transformation of the agriculture sector in order to move South Africa's agriculture sector to a more sustainable and competitive future. Moreover, the policy intents outlined by South Africa's innovation policy documents signal the need to increase agricultural productivity, minimise environmental degradation and reduce greenhouse gas emissions. However, traditional innovation approaches often fail to capture the full spectrum of activities and outcomes that are specific to agriculture and in a holistic way, leading to an incomplete understanding of innovation dynamics in this sector (Arundel, 2007; Arundel et al., 2019).

Literature on innovation in agricultural firms has shown distinct innovation capabilities and outputs when compared to firms in other sectors of the economy (Gault, 2018; Hall et al., 2006; Klerkx et al., 2019). This differentiation is critical for understanding the specific needs of the agriculture sector and for formulating policies that address these unique challenges and opportunities. Some authors

argue that designing innovation policies to fit the agricultural context is essential for improving productivity, sustainability and competitiveness (Hall et al., 2006).

Through an alignment of policy interventions with the identified innovation modes, policymakers can introduce targeted instruments that support firms' innovation capabilities. This can help increase the overall contribution of the sector to economic growth and increase food security and job creation in line with national objectives. For example, given the predominance of incremental innovation and modification strategies among agricultural firms, a new innovation support grant could be introduced to support experimentation with transformative solutions, particularly among new-to-market innovators and knowledge-driven collaborators. This fund would not provide general R&D grants but rather supply competitive financing linked to achieving national policy objectives, such as carbon-neutral farming, water-smart agriculture and biodiversity-positive food systems. This fund could be used to encourage cross-sector collaboration between large agribusinesses, emerging commercial farmers and smallholder cooperatives. This initiative would connect knowledge-driven innovators with activity-driven firms to ensure that advanced innovation does not remain concentrated within high-capacity firms but instead diffuses through the entire sector. For example, firms engaged in new-to-market innovations and knowledge-driven R&D could be required to co-develop and test solutions in real farming environments with activity-driven innovators in order to ensure that technological innovations are practically applicable and scalable across the sector. Agricultural businesses that integrate regenerative agricultural models through these collaborations and end up developing circular bioeconomy solutions would receive tiered funding based on measured environmental and productivity outcomes.

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Chapter 7

Innovation Through Educational Arts in Under-Resourced Communities in South Africa

Sean MacGinty and Linda Daniels

Lalela, Zimbabwe

Introduction

> . . .creativity – more than rigor, management discipline, integrity or even vision – is the most essential leadership skill in an increasingly complex and interconnected world. (Gallagher, 2013)

This paper explores how the educational arts, implemented by Lalela, are a catalyst for transformative innovation within the context of under-resourced communities. By focusing on the lived experience of a single participant who participated in Lalela's after-school programme, this narrative inquiry examines how young people's engagement with creative practices nurtures not only individual growth but also how that growth spills over into collective community resilience and productivity. The argument presented is that educational arts are not merely a form of enrichment but serve as a dynamic input for unlocking potential and driving innovation in under-resourced settings. This research contributes to the broader discourse on the arts as a foundational element and catalyst for social innovation, particularly in environments that are impacted by structural inequalities.

A simple interpretation of social innovation is 'new ideas that work'. It distinguishes innovation from improvement, which signifies only gradual change, and from creativity and invention, which are key to innovation but do not encompass the effort required for implementation and widespread adoption that

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turns ideas into practical solutions. Social innovation, in particular, refers to new ideas that effectively address social goals. Thus, social innovation emphasises 'innovative activities and services driven by the aim of addressing a social need, primarily developed and disseminated through organizations with social goals as their core purpose' (Mulgan et al., 2007, p. 8). Edquist (2001, p. 2) defines innovation systems as all relevant economic, social, political and organisational factors influencing the development and use of innovations. While innovation systems have traditionally been linked to science and technology, Lalela demonstrates how educational arts drive innovation and productivity in under-resourced contexts.

In terms of environments with structural inequalities, school-age youth living in Cape Town's townships[1] face numerous material challenges that negatively impact their educational journey, including their limited access to resources and infrastructure. These challenges include a lack of opportunities for employment after completing their schooling (Hoffman & Huang, 2014), given that unemployment is one of the undisputed economic challenges that South Africa is grappling to solve. Furthermore, 'of the 10.2 million persons aged 15–24 years, 32.4% (approximately 3.3 million) were not in employment, education or training – implying that close to one in three young South Africans between the ages of 15 and 24 years were disengaged from the labour market in the first quarter of 2021' (Statistics South Africa, 2021).

Using narrative inquiry, this case study looks at the productive impact of a youth-focused after-school arts education programme provided in low-resource settings to transform the outcomes experienced by participants in the programme. This research study traces the transformational influence of the programme offered by the NPO Lalela on one individual from Imizamo Yethu, Cape Town, South Africa, and the interconnected narratives involving the young person, his caregivers, educators and community members in general in Imizamo Yethu who have borne witness to his trajectory over the years. The individual actively participated in the programme from primary school until graduating from high school and is now 25 years old.

Lalela serves youth in low-resource settings with its educational arts programmes in the South African provinces of the Western Cape and Gauteng as well as in Zimbabwe. Lalela offers visual arts, which include painting, drawing, sculpture and collage.

The after-school educational arts programme that Lalela offers takes place in both primary and high school settings. During the after-school hours, while many parents and caregivers are still at work, children are at their most vulnerable, and the programme is considered a safe space where the participants are kept occupied and are provided with a meal. It is well documented that the unsupervised time that children have after school is when they are most at risk for risky behaviour, such as drug use (Weisman & Gottfredson, 2001; as cited in Durlak & Weissberg, 2007). Due to food insecurity in many of the communities Lalela operates in, the meal offered in the programme is often the only food the participant may have access to. Furthermore, the Lalela after-school programme is aligned with many other after-school programmes in general, given that it

complements school-day learning and keeps youth enroled in the programme productive and active, allows them to build life skills and connects them to the community (Afterschool Alliance, 2020). Youth are usually recruited into Lalela's programmes through partnerships with schools, where Lalela facilitators advertise and present the programme to learners, who then choose to join. Lalela's classes typically comprise 20 to 30 learners per class.

Additionally, the educational arts programme is based on a curriculum designed by arts curriculum experts who are part of the Lalela staff. This curriculum is aligned with the Curriculum and Assessment Policy Statement (CAPS)[2] taught in South African schools. Furthermore, the Lalela curriculum is based on various themes that are aligned with the organisation's Theory of Change goals, which include among others active citizenship, problem-solving skills, making healthier choices and nurturing a more positive attitude and behaviour towards self and others. Other curriculum goals also include art-making skills.

Both terms 'education' and 'educational arts' used in this paper are framed by Paulo Freire's social justice writings (1970), which seek to improve education in an inclusive way, and which, among other aspects, aim to reduce the teacher's role of delivering information to students who passively receive knowledge. This paper is thus framed in a way that values this sense of student-centred, dynamic learning practices.

Literature Review

The beneficial role of arts education in shaping the developmental trajectories of school-aged children has been well documented in global educational research. The studies highlight the positive impact of arts education, such as enhanced cognitive abilities, improved academic performance and the development of critical social and emotional skills. However, much of this research is centred on the Global North context, leaving a significant gap in our understanding of how these benefits translate to young people in low-resourced settings in the Global South and notably Africa.

Gormley and McDermott (2016) assert that

> researchers have found that the creative arts positively influence children's learning and success in school because they stimulate their imaginations (Csikszentmihalyi & Schiefele, 1992; Hartse, 2014). Others explain that the arts foster children's ability to think critically (Burton, Horowitz & Abeles, 1999) and offer them ways of expressing their ideas and feelings that are not easily presented with alphabetic texts (Kagan, 2009). Additionally, theorists have explained that the arts provide children with opportunities for using culturally based sign systems for examining and representing their worlds to others (Burton, Horowitz & Abeles, 1999; Harste, 2014).

> There is some evidence suggesting that the arts improve children's academic achievement in specific disciplines as well. Specifically, researchers have argued that the creative arts improve language development (Chappell & Faltis, 2013; Winner, Goldstein & Vincent-Lancrin, 2013), reading comprehension (Shanahan et al., 2010), students' classroom engagement (Csikszentmihalyi & Schiefele, 1992) and their overall academic achievement (Catteral & Waldoff, 1999; Greene, 1994; Heath & Wolf, 2005; Lee, Patel, Cawthon & Steingut, 2014; Walker, Tabone & Weltske, 2011).

Arts education has been shown to enhance many components of social and emotional learning, findings that are explored directly in the Discussion and Analysis section of this paper.

Arts education is also linked to innovation and entrepreneurship. Gallagher (2013) cites Stanford University Business School professor Steve Blank, who argues that entrepreneurship aligns more with an arts curriculum than a traditional business one. Creativity, collaboration, risk-taking and resilience – taught through art – are core innovation skills.

It is worth clarifying a difference between the term 'arts education' and 'educational arts', a clarification which arose spontaneously from the interviews for the narrative inquiry in terms of understanding Lalela's approach. Arts education 'may be loosely understood as teaching and learning in or through the arts within a variety of formal and informal environments' (Clapp & Ho, 2022, p. 134). The literature review describes arts education and its practices according to the definition of 'educational arts' from Firdous Hendricks, executive director of Lalela, who said during interviews for this research:

> Why we say educational arts is because we are using art as a tool to educate about so many other things [like] the way that art can make commentary or voice concerns or educate in order to create an understanding of how young people can advocate with their own rights, or they can use their voices to create change… [so] they're not voiceless… they have agency. We're using art as a tool for them to understand that and that then encourages them to become active citizens.

She further notes that through developing skills like painting or drawing, students achieve mastery, which helps achieve the broader goals Lalela aims for. In this sense, Lalela's approach incorporates social-emotional learning, experiential and student-centred pedagogies, learning through play and 'learning by doing' (Dewey, 1916). This resonates with 'issues-based art education' (Johnston, 2018).

This paper uses 'educational arts' as the preferred term, although 'arts education' appears in this and the next section as it remains more common in the literature.

The educational arts enable democratic practices in classrooms. Nicky Du Plessis and Marit Bakken assert that, in South Africa's context, 'both formal and informal art education have been important in the negotiation of new cultural

and communal identities that are essential for the transformation from a socio-political system based on discrimination and exclusion, to one that aims for inclusion and fair representation' (2015, p. 311). Arts education enables collaboration, expression, dialogue and leadership.

In low-resourced settings in South Africa, school-going children face significant challenges, including poor infrastructure and socio-economic hardship. In Imizamo Yethu – the focal community for this paper – 2011 Census data show that 79% of households earn R3 200 or less monthly, only 23% of households live in formal dwellings and 38% have piped water inside the home (City of Cape Town, 2013). However, literature on the impact of visual arts programmes on these students in the context of Africa remains limited. Existing studies often ignore how these programmes cultivate both individual growth and broader community transformation.

This study explores interconnected narratives of students, caregivers, educators and community members to understand how visual arts education facilitates a localised innovation system where each participant contributes to improved outcomes.

In terms of how this relates to similar cases from African countries, '[t]here can hardly be a more poorly resourced academic discipline than Arts Education in Africa today' (Schneider et al., 2022, p. 24). Many African countries lack robust arts education policy. Sirayi and Nawa (2016) discuss the urgent need to enhance the extent of arts education in South Africa, to include cultural policy and to give it a position of prominence from school through to tertiary education. Walsh and Sutherland (2024) caution that arts participation doesn't change socio-economic realities directly but catalyses critical reflection and reimagining of those realities for students.

In South Africa, only 5% of schools offer art as a matric subject[3] (Art and Ubuntu Trust, n.d). This clearly indicates that the subject is low priority, and there is a lack of interest in it in South Africa's secondary schools; moreover, the Creative Arts subject also suffers from a lack of discipline-specific educators, pointing to the fact that it is not prioritised (Magagula et al., 2022, pp. 373–383). (See Hendricks' comments in the final paragraph of the Discussion section for further details of this situation.) In 2023, arts received just 1% of South African corporate social investment funding (Trialogue Knowledge Hub, 2024), reflecting its low priority in general.

Enamhe (2013) describes Nigeria's long-standing neglect of arts education across all schooling levels and highlights the cost of materials as a barrier. She advocates for compulsory arts education in all schools.

The United Nations Conference for Trade and Development (UNCTAD, 2008) observed that the possibilities of arts education in developing nations are constrained by limited entrepreneurial skills, institutional backing and policy advocacy. Shule (2010) says a lack of political will is preventing arts education in Tanzania and argues for it to become compulsory across primary and secondary schools there. Chilala (2015) identifies an absence of arts education training policies, placing Africa at a global disadvantage. Furthermore, Murori (2022, p. 239) stresses the need to treat arts like maths and sciences so as to change the perception that it is for less capable students.

Methodology

This paper uses qualitative methods, relying on a strategy called narrative inquiry. The primary focus of the study is to investigate the impact of educational arts (through the programme of the NPO Lalela) on the life of an individual, Sihle.[4] He participated in the after-school programme for nearly his entire school career, and his experience is presented through his narrative, and the narratives of four people close to him. He shared his experiences with educational arts, including the wider impact on his community, Imizamo Yethu, and the need for these people to progress in innovative ways. The methodology uses purposive sampling and includes interviews with Sihle (as well as a follow-up interview); with his mother, Grace[4]; with a teacher from the high school where he studied, Ms Moyo[4]; with Firdous Hendricks, executive director of Lalela (who also previously taught him educational arts classes for Lalela) and with Siyabonga,[4] a young person on whom Sihle himself has subsequently had a positive influence. From here, the interviews were coded for emerging themes.

Non-probability sampling was selected as the most appropriate sampling approach for this study. This refers to the subjective judgement of the researcher selecting the sample for the study (Elfil & Negida, 2017 as cited in Berndt, 2020). There are different non-probability sampling methods, and purposive sampling was selected for this study, given that the selection process of persons was based on the researchers' judgement.

Before expanding on the themes, it is worth discussing the significance of narrative inquiry as a methodology for an investigation such as this one. Jerome Bruner argued (1990, as cited in Rabelo, 2022) that we experience the world through narrative; our experience is organised by, and mediated through, narrative, and narrative ultimately constructs our reality.

Narrative inquiry as an approach 'shows great potential for bringing new meanings to past experiences and reformulating future practices' (Rabelo, 2022, p. 25). It allows us to pick out details in the experiences and stories of people who, in this case, have been part of an educational arts programme, particularly around the impact of such programmes, details that are possibly harder to see in quantitative analysis. It allows us to see how these mechanisms work, bringing them into uncommon focus.

It should be noted that narrative inquiry is particularly suited to policy reform, as noted by Pino Gavidia and Adu (2022, p. 5): '. . .narrative inquiry has the potential to inform policy because it is attentive to lives first. A significant contribution of narrative inquiry is to reform policy through a better understanding of how people live, and how they make sense of the world by storytelling.'

Discussion and Analysis

When asked who he is, and to talk about his life growing up, Sihle is hesitant and reflective before answering, then declaring:

> I'm just [a] young, individual, single being, growing up and just trying to figure life out and just connecting the dots.

From this opening, it seems that part of his very self-definition is narrative, or at least contains the drive to use narrative to understand his life and search for meanings, 'to connect the dots'. He describes growing up, initially with his mother and father, then in a single-parent household after his parents' separation. He locates this in Imizamo Yethu, a township, mentioning that it is a '*very disadvantaged community'*, that there is not much employment, that people '*resort to crime in order for them to be able to provide for themselves and their families*'. He further qualifies this, mentioning the presence of drugs and gangs in the community. His mother, Grace, confirms the presence of drugs in Imizamo Yethu, but adds that Sihle never disappointed her by taking drugs and saying he was '*always listening'*. It is perhaps apt that he would join an educational arts after-school programme from an organisation named Lalela, whose name translates to 'to listen' from isiZulu to English. In terms of positive behaviour, Bamford and Wimmer write that implementing arts education in a 'sustained, high quality manner' (2012, p. 21) leads to strengthening the social environment of the school, decreasing anti-social behaviour and promoting 'communication and emotional development not generally part of other school subjects' (2012, p. 21).

Today, Sihle successfully sells his own artwork and has also launched his own clothing brand, which is providing him with an income. Back in 2010, Sihle joined the programme while he was still in primary school, in Grade 6 (remaining in Lalela until completing high school) and admits that he did not know much about art, assuming that painting was something for the walls of a house and clarifying that some children attended the programme in order to eat the sandwiches provided (for many, the meal was crucial given food insecurity in low-resourced settings). His mother similarly says she did not think much about art before hearing about his participation in Lalela, or what kind of employment options it could lead to. Sihle participated largely because he was following what his friends were doing (he was part of a class of 30 other students), but once he showed up, he began to attend regularly and confirms that what kept them there was the Lalela facilitators.

His first facilitator, Hendricks, describes him as '*quiet, but extremely naughty… definitely … one of the rebels in the class'*. However, this quickly changed when he discovered his love of art. She elaborates that Lalela:

> ...gave him like this space to explore something that actually he really, truly enjoyed, and found a talent in himself that he maybe didn't know. And then the class itself created a different kind of community. So instead of it being this, like, you know, environment where at that age boys are trying to like assert themselves, and it's, you know, the egos are really developing, suddenly, there is the space where it's completely just safe. And you can be soft, and you can talk about your feelings, and you can talk about your opinions… I think that changed, creating an environment like that was good for him.

She mentions that once Sihle found his love of art and realised his talent, '*it absolutely became a part of his identity*'. Further to this, Sihle mentions that he would be '*constantly coming here [to Lalela] and doing the same thing over and*

over and over again'. This commitment to repetition, to 'learning the craft' one could say, speaks to the mastery that Hendricks mentioned as one of the aims of the programme (see Literature Review above).

Unsurprisingly, one of the principal motivating factors for Sihle, he asserts, was the programme facilitators, among them Hendricks:

> I loved walking into class and seeing the facilitators' faces, and just . . . being welcomed by them.

This takes on particular relevance because he mentions that in his community, not many people have mentors, or someone to look up to ('*In a community where like I come from, there's not a lot of us who have mentors, not a lot of us who will see the importance of having a mentor')*. Lalela, through its educational arts programme, thus offered him a space he may not otherwise have had:

> The main reason I stayed at Lalela was because of the facilitators, and the way they made us feel at home, be it in the classroom, or during the holiday programme. Being able to speak to facilitator [s] about things that were troubling me, to go for help and guidance, knowing that I can be able to go and find guidance and advice. It really helped me and shaped me. . . especially. . . as a creative. . . it helped me become a role model to a younger group of artists in the community, people who came after me and who look up to me.
>
> I believe Lalela helped me to become a role model to other people. How did Lalela do this? It was by providing a space for me to be able to be expressive, and share my story in my own way, but also have guidance and advice from people who have walked the journey before I did.

Educational arts, through Lalela, provided Sihle with a welcoming, non-threatening space, a space with a sense of belonging (in a way that perhaps other educational spaces did not), a space where he had the freedom to experiment and be creative, where he could share and develop his story or narrative. Expressing himself and his story seemed to be critical for him to develop his identity, where educational arts allowed him to communicate the story of his individual experience (Fargas-Malet et al., 2010; Vindrola-Padros et al., 2016; Fargas-Malet et al., 2010; as cited in Van Der Riet et al., 2020), and to grow as a person to the point where he could become a mentor to others. This presents an example of positive impact in the story of one individual's life travelling through him, beyond the programme, to other young people in his community.

Sihle believes that Lalela shaped him and the way he sees things. It played a big role in influencing his behaviour, such as being disciplined and making healthy, productive decisions, focusing on his schoolwork and wanting to be a leader. He clarifies this as being the way he respects people, behaves around people and how he '*reads the room'*. This relates to the work of Mogro-Wilson and Tredinnick (2020) that the arts '. . .create a powerful presence in the lives of

young people. Skills gained from participating in the arts can better facilitate social and emotional learning (SEL) such as improving goal setting, increasing empathy, building relationships, and improving decision making.' Sihle feels much of that was from seeing how other Lalela leaders acted as models of behaviour he looked up to. He has now in turn become a positive role model for others younger than him, specifically a group of young designers. He helps them with their designs, and he takes them to wholesale stores for their fabrics and to print shops:

> They got inspired by the works I was doing, actually wanted to do the same. So I'd say yeah, there's a lot and my age, older than me, younger than me, who look up to what I do.

One such young person is Siyabonga, who is 18 years old and says he is proud to call Sihle his role model:

> I wouldn't be who I am today if it wasn't for him.

Sihle showed him that doing drugs and joining gangs was pointless, and instead, one can do '*productive things like art'*. Sihle modelled behaviour that he admired such as knowing how to engage with people, being respectful, to show care and even entrepreneurial skills like painting on a T-shirt, networking and being proactive ('*Sihle gets up and goes to get what he wants, he doesn't just wait for things'*). Siyabonga is inspired by Sihle and has similarly adopted an entrepreneurial mindset and mentorship role to his peers, thus sustaining a generation of mentors in Imizamo Yethu. He feels that Sihle has lived the Lalela values that he is mirroring:

> I am about to make change; I will try to motivate young people the same age as me. To take opportunities that are there, to use what you want to get what you want.

Siyabonga goes further, saying that if one has been taught about showing care and showing love, then one will also show love. '*Wherever I go, I always listen to other people, and I listen to understand, to know*.' This echoes Leah Bassel's idea of the politics of listening, of listening intentionally and listening as a social and political act (2017) that can lead to greater deliberative democracy and structures of equality within such democracy. It speaks too to the type of listening we as inquirers attempted to enact during this process and its interviews.

Sihle has not left the community he grew up in and proudly showcases his own clothes as a demonstration to others that money can circulate in the township without it having to leave by residents spending money elsewhere. During his process of creating his clothes and buying fabric (for his own clothing brand, which he launched, as mentioned above), he posts videos of it on his social media so people from his community can see how he does it. Hendricks adds:

> It's about, 'I want to be successful, and… I want it to be something that enriches my community. And I don't want to run away from a community… my success is their success.' I think it's that kind of thinking.

Sihle's mother, Grace, qualifies this, describing how people in the community notice his impact and congratulate him. Sihle discusses how the acts of painting and drawing, apart from his future entrepreneurial efforts, helped his sense of emotional self-regulation and the resultant behaviour changes:

> ...the paintings, the drawings become something that I can monetise, that I didn't know. It was basically me trying to manage… my behaviour or my anger. So yeah, in that way, it would help a lot.

This echoes research on art-based community work with youth in low-income neighbourhoods, demonstrating that art-based programmes can influence social skills such as 'relationship building, conflict resolution, and teamwork skills' (Wright et al., 2013; 2006 as cited in Mogro-Wilson & Tredinnick, 2020, p. 112). The fact that the paintings and drawings encouraged emotional self-regulation and reflection is an example of Dewey's (1938, as cited in Lindsay & Schwind, 2016) idea of deliberate reflection leading to learning or educational outcomes, as well as dovetailing neatly with the idea of narrative (and narrative inquiry) fostering such reflection.

Hendricks elaborates on these social and emotional skills, which Lalela aims to elicit from its students:

> I think for him [Sihle], he found a natural talent in a space that was just like ripe for nurturing that exactly. And, what's something that we develop very strongly is confidence. He was part of our Leadership Programme. So it's confidence, the ability to dream into the future, something for yourself, and then the skills and the resilience, and the grit, to be able to work towards it.

This is supported by Deer et al. (2023, p. 2) that participation in arts education develops students' '…self-esteem, self-concept, self-efficacy, peer-relationship, emotions, which cannot be enhanced by other teaching instruction'. Hendricks goes further, stressing how the aim is to provide the space or the platform to draw out such skills in the students, which already exist in them latently:

> I hate the word 'empowered' because our young people are already powerful, they already have voices, they already have something to say. They already have talents, the passions; it's about providing a space where that can be nurtured. And where

> that can be shone a light on, where that can be celebrated, where that can be pushed and challenged.

Hendricks touches on the mechanics of how, in her experience and opinion, educational arts engenders such social and emotional learning in students, especially the skill of problem-solving:

> When you're doing an art programme, or any kind of creative development, you have to think critically, and you have to think differently, when you come across challenges. If you bring it down to a page and creating an artwork, there are going to be a lot of challenges and crises that you're gonna confront on that page. And there's going to be mistakes that you make and ways that you need to correct it and push past it or go through it without having to start over and over again. And that skill is transferable to everything... Because, you know, I mean, we have... a mantra that mistakes are... an opportunity to learn. And that also... your mistakes become the most beautiful part of your artwork.

This emphasis on persistence echoes how '... both visual arts and music have been found to employ the habits of mind of persistence (i.e., keep going at practice and working through a problem)' (Hetland et al., 2007, 2015; Hogan & Winner, 2019 as cited in Holochwost et al., 2021, p. 3). Hendricks stresses how '*this skill is transferable to everything*, i.e. transferable to a multitude of different disciplines and subjects. She speaks emphatically about how art, or educational arts, develop the whole person, emotionally, spiritually and physically, and talks about how educational arts bridge social divides by allowing students to express themselves through art, fostering connections and sharing their stories with others. Siyabonga echoed Hendricks' sentiment about art offering a means of connection and relatability.

Siyabonga says:

> It gives opportunities to young people, you can make better choices, and you can see the world in a different way. It gives you positive energy. A depressed person might stop being depressed because of the power of art. Art opens doors for people. It opened doors for me.

He believes '*art should be put as a law'* and that people who do not participate in the arts do not see the world the way artists see the world. They do not see the stories that artists see. This situates art as an expression of the narratives of people's lives or their realities. It implies that people engaging in arts have a more nuanced ability to understand and recreate their worlds through narrative.

Hendricks recounts how Sihle for a short while became entangled in gangsterism when his high school, Silikamva, was first established. However, he quickly turned around after being influenced by Lalela's values in the

after-school programme he attended and instead became part of the school's efforts to end the violence. She adds:

> I think being a part of a programme that is so meaningful . . . does give young people an alternative reality of what's possible for them, it's easier for them to see the other side, it's easier for them to turn away from peer pressure. And to see like the long-term vision of their lives.

Siyabonga feels these qualities reveal how art can change a community, along with changing many aspects in the community, which is a view that is supported and acknowledged. For example, according to Talley (2024): 'Art has the power to change the way we see the world, awakening us to new perspectives, ideas, and values... Art is not only a form of expression but also an invitation to problem-solve and grow within ourselves and our communities. Whether creating or experiencing it, art provides unique ways for understanding different points of view while inspiring citizens to create meaningful social change.'

Siyabonga reflects that art allows one to be vulnerable, and this has redirected the course of his life away from drug addiction, which he believed was almost inevitable. Active citizenship is echoed by Sihle, who has intentionally established his entrepreneurial efforts to promote identity and heritage:

> [W]ith the message or the narrative I'm trying to share with my clothing [it] is basically trying to remind people of... the roots... where they come from, and just trying to keep them connected to where they come from.

Giving an interesting example, Sihle mentions that there are many people who are very political but very shy, and that involving oneself in art can help with this:

> People will create art to have a voice.

Giving people a voice, and developing their agency, is part of why Sihle feels that educational arts should be accessible across many communities, particularly communities such as his own:

> I think art can actually help to develop the agency of young people by making it accessible to them. A lot of people don't take part because it is inaccessible or out of reach. So if it would be introduced to schools or communities... where you can enable people to participate and contribute and actually teach and be taught about what is happening in their communities, being able to tackle social issues, through art, through a medium that is really not [taken] seriously in communities such as mine... transforming one's perspective through art.

These ideas mirror the outcomes of Kim Berman's Artist Proof Studio (2024) in Johannesburg, which helped individuals find their voices and honour their stories, ultimately nurturing their agency to participate in societal transformation. They also speak to various projects where participants are empowered through creativity, leading to pride, engendering leadership and resulting in income (Berman, 2009).

For Sihle, creating art is also an entrepreneurial act:

> It's by actually creating stuff, coming up with ideas, and moving away from the idea of going to apply for a job, or waiting for a job, or waiting for the government to provide you with stuff. One way that leads to innovation is by creating and making stuff from our [artists'] hands, that will later become a business, that can generate income, that one can then live from. To be able to see your ideas come to life.

UNESCO (2001, p. 8) says the arts play 'a central and increasing role in the economy, especially in the cultural industries (mass media, cinema, video, the sound – recording and publishing industries, etc), tourism, cultural entertainment and advertising. In these sectors the arts make a vital contribution to economic growth.'

Grace admits that she did not think it was possible to sell art or drawings before Sihle joined Lalela. Lalela changed her mind, as she realised that art is '*a good thing, and he [Sihle] can sell his drawings'*. Grace believes that art should be in schools as it gives many opportunities to children:

> I think [art] should be in school because it's mostly giving lots of opportunities to the kids. So if the art can be in the school, I think it's gonna be good for every kid that really likes to do art, because it's also an opportunity to them. They're gonna learn how to do it. You're gonna learn everything [you] want to learn, how to make money out of the art...

Siyabonga says that educational arts should definitely be integrated into the school curriculum. Art is not a subject being taught at his school, and he feels that if children could learn about art, they would have a brighter future. '*With Lalela, you learn to respect other people around you, to have care, and to have confidence in what you are doing*.'

Hendricks expounds on teaching arts in the Foundation Phase:

> For example, sometimes the grade one [...learners] come in, and they don't really have a foundation for the grade they should have. So art is a way to bridge that. And then we [do] things like holding a pencil or understanding shapes or fine motor skills... [which] is so foundational, at that age.

Probine (2022, p. 795) discusses how

> '[t]hese formative experiences can have a lasting effect on how children develop images of themselves as art makers and can impact the degree to which the visual arts play a part in their lives as they mature' (Veale, 2000). One of the most profound influences on how children experience the visual arts is the bidirectional interactions that occur through their everyday lives, in particular with their families, teachers and peers. Through these interactions, children become familiar with the cultural tools, including those related to the visual arts that are valued by their cultures, communities and educational settings (Bodrova & Leong, 2007 as cited in Probine, 2022). What is concerning, then, is the persistent discourses that fail to recognise the potential that the visual arts hold in supporting young children's learning (Lindsay, 2017).

In terms of other school grades, Hendricks believes that one needs to teach the arts in a way that is community-led and engages in experiential learning:

> We need to understand that the world is different... [for] the children of today. Things move so quickly, like creativity is a core skill that you need in today's world, because... [in] every single industry, the way that you need to adapt to things is like this. You need to be critical and creative in your thinking. So just doing traditional ... subjects, it's not enough when you go out into the industries, and you need to just be so adaptable. And every career in the future requires some kind of creativity. And I think that's important in the way that we teach all of our subjects.

Hendricks highlights the problems with static, rigid learning methods:

> [T]hat's why a lot of our schools are so behind, like standing in front of people and lecturing them. And like, giving them knowledge. It's not community-led, it's not opening learning up for... other ways of thinking.

She believes that educational arts should undoubtedly be taught in all schools:

> I think it absolutely was a space... for those who learn differently, firstly, and to explore subjects in a way that is... that's experiential, you know, that also pulls from what their experience is, art is something that comes from within so ... I think art education is integral in, in our curriculum, but it must be taught properly, it must be taught by somebody who understands it.

Herein lies a warning, because Hendricks mentions how, even among schools that offer an arts subject, many do not provide enough resources or time during

the school day. She cites not just the lack of drawing materials but also the use of desks that are inappropriate or too small for arts classes. Concerningly, she details how many schools in South Africa do not employ teachers trained in the arts, but rather rotate teachers who have trained in other subjects. The arts are not seen as a priority by many schools, even the few who offer it as a subject.

Policy Recommendations

The lack of investment in educational arts in schools remains a challenge since it undermines the benefits of the arts to nurture and grow creativity, innovation and cultural expression. Limited funding for arts programmes results in insufficient resources such as art materials and a lack of adequately equipped spaces and trained art facilitators or teachers, all of which affect/impede the catalytic impact of the arts towards innovation. Additionally, the shortage of trained arts educators exacerbates the issue, as many teachers lack the specialised skills needed to deliver comprehensive and engaging arts curricula (Bamford, 2006). Such difficulties form part of larger, complex issues involving reoccurring development challenges like fiscal and/or debt constraints and national spending priorities.

However, the literature offers a reminder of the holistic outcome of incorporating the Creative Arts subject in the schooling system, emphasising that as a policy intervention, 'the Creative Arts subject should be taught at the same quality level as the other academic subjects so that learners are given a well-rounded quality education that would improve their future career choices' (Magagula et al., 2022, p. 381).

There is a growing recognition of the arts' role in driving innovation and societal progress. In terms of policy recommendations, the aim of this paper is not to diminish the priority rightfully given to literacy, digital literacy, numeracy and science and technology in education, but to add educational arts as an urgent priority for investment, resources and attention in the education sectors of African countries: to add educational arts to science, technology, engineering and mathematics subjects (STEM[5]), and to embrace frameworks similar to science, technology, engineering, the arts and mathematics (STEAM) and STEAMAC (plus agriculture and coding). Education departments at national, provincial and district/municipal level in African countries should strive to create education landscapes with:

- more schools offering Creative Arts (as the subject is known in South Africa) or the equivalent arts and culture subject in other African countries as a subject to study until the end of students' secondary school trajectories;
- more teachers, who additionally receive better training and specialise in the subject and the various disciplines within the subject;
- more resources for art materials;
- the inclusion of educational arts in the narratives and proclamations (in academia and in the traditional media) of educational priorities on the continent.

Beyond traditional schooling institutions, it is recommended at a policy level to promote and involve community-based social innovation programmes, such

as the Lalela model, transferring part of the innovation agenda and agency downward to community groups. Educational arts should be playing a significant role in national-level innovation policy and structure, preparing creative individuals with skills to capitalise on such policies and structures.

Conclusion

In conclusion, governments should integrate the educational arts into educational systems across the continent as a prized policy intervention. They should be valued more highly in society given the benefits observed in helping transform Sihle through his participation in educational arts and the impact that ripples out as an effect of his healthy behaviour choices, leadership and entrepreneurial efforts. This prioritisation is warranted due to the innovative and significant contributions of educational arts to developing Sihle's sense of identity, as well as its increasingly transformative economic potential. By fostering collaboration, problem-solving skills and creative expression, educational arts align with 21st-century skills, preparing students like Sihle to adapt to an uncertain future and allowing them the freedom to experiment and innovate while nurturing their creativity and helping them adapt to the ever-evolving creative economy.

With more programmes, offerings, trained teachers, resources and materials dedicated to educational arts, there would be far more spaces for far more young people like Sihle to discover themselves and realise their creative, productive potential across provinces, across countries. Therefore, allocating additional resources in the schooling curriculum and equipping teachers to progress educational arts in schools can enhance their capacity as a space for students to find or solidify their identity, and enrich their educational experience and attain better outcomes for their lives.

The lack of investment in the arts at schools may fuel the perception as outlined by Sihle and his mother that art is not perceived in the context of their community as a viable and productive means of a sustainable livelihood. In order to shift the dial to a more informed view of the value of the arts as a catalytic tool for innovation and growth, amplifying its benefits must be prioritised in policymaking and knowledge outputs by academics.

Notes

1. In South Africa, the terms 'township' and 'location' typically denote urban areas that were historically racially segregated and often underdeveloped. These areas were reserved for populations who were not designated 'White' and were established from the late 19th century until the end of apartheid. Townships were commonly situated on the outskirts of towns and cities.
2. The Lalela curriculum promotes health, social and environmental responsibility, as well as an understanding of constitutional rights and responsibilities. CAPS was published in 2011 and implemented in the Foundation Phase in 2012 (Pretorius et al., 2022).

3. A school subject for the last three years of and to complete secondary school in South Africa.
4. Pseudonyms of the interviewees are used for this paper. One of the interviewees, Firdous Hendricks, gave permission for her real name to be used.
5. STEM stands for science, technology, engineering and mathematics, traditionally associated with innovation. STEAM is a model which adds an 'A' representing 'arts', while STEAMAC, as it is known in the Western Cape province in South Africa (Western Cape Education Department, 2020), adds a second 'A' representing 'agriculture' and a 'C' representing 'coding'. It is not just recommended to develop schools specialising in STEAMAC subjects and/or the arts but to promote the educational arts curriculum across all schools or as many as possible.

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Chapter 8

Financial Sector Development: The Fintech Solution

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Introduction

The development of a robust financial sector is critical for sustainable economic growth, poverty reduction and equitable wealth distribution (Beck & Levine, 2004; Omar & Inaba, 2020). Strong financial systems can boost productivity, direct resources to their most efficient uses and provide opportunities for marginalised groups to access capital. Yet in Sub-Saharan Africa, financial exclusion remains widespread, hampering these economic and social benefits. Historically, many Africans have relied on informal mechanisms – such as rotating savings and credit associations (roscas), cooperative credit unions and informal moneylenders – due to limited penetration of formal banking services, underdeveloped infrastructure and insufficient regulatory support (Bouman, 1995; Mahdi, 2018). As a result, vast segments of the population lack secure avenues to save, borrow or invest, perpetuating cycles of poverty and economic vulnerability (World Bank, 2022).

Over the past two decades, fintech has emerged as a potential game-changer by making financial services cheaper, faster and more accessible. The runaway success of Kenya's M-Pesa demonstrated how mobile money can drive financial inclusion for low-income users, spurring a wave of similar solutions across the continent (Burns, 2018; Ndung'u, 2021). More recently, mobile money providers like Wave have disrupted established players through lower fees and innovative user experiences, signifying fintech's promise to transform economic ecosystems in both Anglophone and Francophone Africa. However, despite the considerable excitement, fintech is no panacea. Issues of regulatory uncertainty, uneven digital

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infrastructure and financial literacy gaps continue to impose barriers to adoption and scale (Demir et al., 2020).

This chapter explores the dual potential and limitation of fintech in Africa, arguing that digital financial services can serve as a vital spark for broader innovation and economic transformation – but only if coupled with supportive policies, cross-sectoral partnerships and context-sensitive design. In doing so, the chapter aims to situate fintech within Africa's evolving innovation landscape, where technology-driven solutions must address structural challenges such as poverty, gender disparities and fragile institutions. The analysis begins with a review of the region's financial sector development and the emergence of digital financial services, followed by an outline of the methodological approach. The core findings stem from an in-depth look at Wave as a case study, illustrating how innovative technology, strategic pricing and user-friendly solutions can attract previously underserved groups. Next, a discussion section synthesises these findings with existing literature, highlighting lessons learnt and remaining hurdles for fintech in Africa. Finally, the chapter presents targeted recommendations – addressing policymakers, financial institutions, fintech companies and development agencies – and concludes by reflecting on how an inclusive, innovation-driven approach can help reshape Africa's financial future.

Literature Review

Evolution of the Financial Sector in Africa

The financial sector in Africa has undergone significant transformations over the past few decades, transitioning from predominantly informal arrangements to a gradually expanding ecosystem of formal banking and financial services. Historically, many African countries relied on roscas, moneylenders and cooperative credit unions as primary sources of finance (Bouman, 1995; Mahdi, 2018). These informal mechanisms provided critical savings and lending options for individuals and small businesses that lacked access to, or trust in, traditional banks. Despite their efficacy in reaching low-income populations, informal systems often operated outside of regulatory frameworks, creating vulnerabilities and limiting the scale of financial intermediation (Refera et al., 2016).

In the 1990s and early 2000s, microfinance institutions (MFIs) began to proliferate across Sub-Saharan Africa, largely inspired by models like the Grameen Bank in Bangladesh's group-lending approach (Yunus, 1998). MFIs aimed to provide small loans, savings accounts and insurance products to underserved communities, often focusing on women and rural populations (Morduch, 1999). While microfinance expanded financial access and introduced millions to the formal financial system, many MFIs struggled with high operating costs, sustainability challenges and limited reach (Abor et al., 2022). Critics also pointed out that microfinance alone could not substantially lift households out of poverty without parallel interventions to improve livelihoods, infrastructure and regulatory frameworks (Demir et al., 2020).

In essence, while MFIs represented a meaningful step toward formalisation, their operational constraints and narrow scope left significant portions of the population still underserved. Despite incremental progress, *barriers to financial inclusion* remain widespread. Many Africans still reside in remote regions that lack the physical presence of banks, while formal banking services can be prohibitively expensive or encumbered by lengthy documentation requirements (World Bank, 2022). Persistent issues – such as low financial literacy, inconsistent identification systems and limited regulatory capacity – further constrain the effectiveness of traditional financial institutions (Lyons & Kass-Hanna, 2021). Consequently, a significant segment of the population continue to rely on informal means of credit, savings and insurance, which may expose them to risk and perpetuate cyclical poverty (Omar & Inaba, 2020).

Against this backdrop, the gradual rise of *digital financial services* over the past two decades has injected new momentum into Africa's financial sector development. Driven by advancements in mobile telephony, digital payments and agent networks, providers such as M-Pesa in Kenya, MTN Mobile Money in Uganda and, more recently, Wave in Francophone Africa have reshaped how individuals handle transactions and access financial tools (Burns, 2018; Ndung'u, 2021). These developments have demonstrated the viability of low-cost, convenient services that address longstanding infrastructure and cost barriers, paving the way for a broader fintech ecosystem offering peer-to-peer lending, digital banking and insurance technology (insurtech) solutions (Makina, 2019).

Overall, Africa's financial sector evolution reflects a complex interplay of *informal traditions, microfinance interventions and incremental formalisation*. While improvements in banking penetration and policy frameworks have emerged, a considerable gap persists in terms of equitable access, affordability and consumer protection. Emerging digital technologies offer a promising avenue to bridge these divides, yet their long-term impact depends on robust regulatory environments, supportive infrastructure and deliberate strategies to integrate fintech into broader innovation and development agendas (Demir et al., 2020; Pazarbasioglu & Mora, 2020).

Emergence of Digital Financial Services

Africa's financial sector trajectory took a significant leap in the 2000s with the advent of digital financial services, often termed financial technology or fintech. Unlike traditional brick-and-mortar banks, fintech solutions capitalise on widespread mobile phone adoption, innovative payment platforms and agent networks to extend services to previously underbanked segments (Makina, 2019). One of the earliest and most prominent success stories was Kenya's M-Pesa, launched by Safaricom in 2007, which offered a mobile wallet for transfers, bill payments and savings that bypassed the need for physical bank infrastructure (Burns, 2018). This simple yet powerful innovation rapidly expanded across Kenya and later to other countries in the region, establishing a proof of concept for how digital solutions can boost financial inclusion (Ndung'u, 2021).

Following M-Pesa's success, several other *mobile money* platforms emerged, including MTN Mobile Money in Uganda, Orange Money in West Africa and

Tigo Cash in Tanzania, each adapting the core concept of mobile-enabled payments to local market conditions. More recently, Wave – which was launched in Senegal in 2018 – demonstrated how *disruptive pricing* (charging only a 1% transaction fee) and user-friendly interfaces can spur mass adoption, even in competitive environments dominated by established telecom operators (Kobo, 2022). These mobile money initiatives underscore fintech's potential to reduce transaction costs, enhance speed and convenience and overcome the geographic barriers that long constrained formal financial services in Sub-Saharan Africa (World Bank, 2024).

Beyond mobile money, fintech in Africa spans a spectrum of innovations, including *peer-to-peer lending* platforms, digital-only banks and *insurtech* services that target low-income populations (Makina, 2019). Startups such as Flutterwave and Paystack in Nigeria focus on online payments for businesses, while digital banks like TymeBank in South Africa and Kuda in Nigeria attract customers through simplified account creation and minimal fees (Flötotto et al., 2022). Open banking and *application programming interfaces (APIs)* – where data can be securely shared between banks and third-party providers – are also gradually gaining traction, enabling more integrated financial services (Kapsis, 2020). These diverse models illustrate the fintech sector's dynamism as it adapts to different regulatory, infrastructural and cultural contexts across the continent.

Despite this momentum, the fintech landscape is not without challenges. Regulatory uncertainties, high compliance costs and inconsistent enforcement can stall innovation, especially for startups operating on limited resources (Demir et al., 2020). Furthermore, issues like low financial literacy, limited smartphone penetration outside urban centres and the lingering dominance of cash-based transactions remain persistent barriers (Lyons & Kass-Hanna, 2021). Many fintech platforms must still address digital infrastructure gaps, particularly in rural areas, as well as the need for robust cybersecurity measures to gain trust among new users (Sambo et al., 2023). These hurdles underscore that while fintech can be a powerful catalyst for expanding financial access, its success is contingent on broader systemic factors, such as strengthened regulatory frameworks, expanded digital connectivity and targeted financial education programmes (Pazarbasioglu & Mora, 2020).

In sum, fintech solutions have provided a blueprint for reimagining financial inclusion in Africa. Through mobile money and beyond, they have begun to chip away at entrenched barriers in credit, payments and savings, extending formal financial services to millions who had previously been locked out. Yet realising fintech's full transformative potential requires an integrated approach: one that encompasses appropriate regulation, supportive infrastructure and ongoing innovation aimed at serving the most vulnerable populations.

Linking Fintech to Innovation Systems

Innovation systems theory emphasises that technological progress is not solely about discrete inventions but about the broader networks, institutions and social

contexts that enable new ideas to be widely adopted and diffused (Freeman, 1987; Lundvall, 1992). In this perspective, economic transformation results from the dynamic interplay among government policies, research institutions, private-sector actors and user communities. Fintech provides a striking example of how disruptive technologies – when supported by conducive regulations, knowledge-sharing networks and accessible infrastructure – can reshape entire sectors. For instance, countries like Kenya or Rwanda that have fostered collaborative environments (involving central banks, telecommunications firms and fintech startups) demonstrate how well-aligned policies and partnerships can amplify the development impact of digital financial services (Ndung'u & Oguso, 2021).

Within national systems of innovation, the introduction of fintech solutions, such as mobile money, peer-to-peer lending and blockchain-based remittances, can stimulate a virtuous cycle of technological learning and institutional adaptation (Edquist, 2005). As new services gain traction, they create demand for complementary skills in software engineering, cybersecurity and data analytics – thus contributing to capacity building and job creation in related sectors. At the same time, fintech's success often hinges on supportive regulatory frameworks – such as sandboxes or open-banking policies – that encourage experimentation and risk-taking. This interdependence reflects a key tenet of innovation systems: breakthroughs in one domain prompt shifts in neighbouring spheres, ultimately driving structural change at the national or regional level (Nelson & Winter, 1982).

Moreover, technology diffusion theories highlight the role of user adoption and network effects in scaling innovations (Rogers, 2003). Fintech platforms are particularly sensitive to these dynamics, as uptake by early adopters and small communities can generate self-reinforcing feedback loops. In many African countries, social trust and community-based finance practices already exist, and fintech innovations that build on these informal networks can achieve rapid, widespread acceptance (Makina, 2019). Ultimately, viewing fintech through an innovation systems lens clarifies how digital financial tools contribute to broader economic transformation, provided that each stakeholder – government, industry, academia and civil society – collaborates to foster an environment conducive to inclusive, sustainable development (Ndung'u, 2021; Pazarbasioglu & Mora, 2020).

Methodology

The study adopted a three-step triangulation approach when conducting our research.

Desk reviews: This chapter adopts a desk-based research approach informed by a case study methodology to analyse how fintech could strengthen Africa's financial sector and contribute to broader development objectives. First, a comprehensive desk review was conducted to establish both the

theoretical underpinnings and real-world context of fintech in Sub-Saharan Africa. Government documents, policy papers and official reports from entities such as the World Bank and African Development Bank were examined, offering insights into national and regional strategies for financial inclusion, the regulatory environment and ongoing challenges. In parallel, academic studies and peer-reviewed articles provided frameworks for understanding the evolution of digital finance, while market analyses and industry white papers helped identify current trends and investor perspectives across different African fintech markets.

Case study methodology: Building on this literature-based foundation, the chapter employs a *case study* to illustrate fintech's practical impact and draw out actionable lessons for stakeholders. The chosen case – Wave – offers a particularly relevant example, given its rapid expansion, innovative pricing strategies and strong user adoption in Francophone Africa. Although additional references to M-Pesa and other prominent fintech platforms appear throughout the text, the central aim is to demonstrate how a single, high-impact venture can illuminate deeper systemic factors that enable or impede fintech-driven solutions to financing challenges. By placing Wave within its broader ecosystem of regulators, investors, telecom operators and users, the analysis captures both the distinct achievements of one fintech platform and the external conditions that shape such success.

Data collection and analysis: Data collection for this study combined policy documents, statistics from financial authorities, research from specialised think tanks and academic investigations of digital financial inclusion. These materials were thematically analysed to identify recurring patterns – such as the importance of agent networks, interoperability or regulatory clarity – and to triangulate the evidence behind Wave's trajectory. Because the fintech sector in Africa is both heterogeneous and rapidly evolving, the chapter remains attentive to possible biases in publicly available data, which may occasionally emphasise success stories or early-stage pilots. Nonetheless, the synthesising of diverse sources, ranging from macro-level policy briefs to granular market analyses, ensures a balanced view of the opportunities and limitations associated with digital financial services.

By integrating a desk review with a targeted case study, this methodology enables a blend of breadth (continent-wide trends and challenges) and depth (specific operational insights from Wave). The result is a nuanced understanding of how fintech can operate as a catalyst for financial development while highlighting structural gaps and opportunities for regulators, financiers and development partners to strengthen the transformative potential of digital finance in Africa.

Findings

Case Study 1: Wave

Wave, a mobile money service headquartered in the United States and operating primarily in Francophone Africa, has quickly emerged as a disruptive force in the region's digital financial landscape. Launched formally in Senegal in 2018, Wave has since expanded to Burkina Faso, Côte d'Ivoire and The Gambia, gaining momentum despite facing incumbent competitors like Orange Money. Central to Wave's growth trajectory has been its ability to offer a product specifically adapted to local market realities: low fees, an intuitive user experience and a supportive agent network.

A hallmark of Wave's approach is its disruptive pricing. While other mobile money services often charge between 6% and 10% in transaction fees, Wave introduced a rate of 1%, drastically lowering the cost barrier for low-income and rural customers. This pricing structure not only appeals to budget-conscious users but also aligns directly with financing-for-development objectives by allowing individuals – especially those operating at the economic margins – to retain more of their remittances, savings and daily earnings. Through cost reduction, Wave helps empower individuals who would otherwise struggle to participate in formal financial systems.

Beyond pricing, Wave's agent network strategy amplifies its market reach. By recruiting and training local agents to facilitate deposits, withdrawals and on-the-ground customer service, Wave closes the distance between digital tools and communities that have historically had limited access to formal banking infrastructure. Agents often reside in the same neighbourhoods as customers, enhancing trust and familiarity, two key ingredients for sustained adoption in rural and underserved regions. This local presence not only brings financial services closer to home but can also foster grassroots employment and entrepreneurship, particularly among youth and women who are eager to establish agency businesses.

Equally pivotal is Wave's user-friendly platform, which leverages both USSD and QR technology to accommodate varying levels of digital literacy and internet penetration. Users who lack smartphones or reliable connectivity can still transact using basic feature phones, while merchants can process payments through simple QR code scans rather than costly point-of-sale equipment. This flexibility is crucial for extending services to agricultural communities, market vendors and microenterprises – groups that are often sidelined by traditional banking processes. By reducing friction in payments and transfers, Wave enhances financial inclusion, ultimately supporting broader development goals such as rural integration, women's empowerment and local enterprise growth.

In sum, Wave's rapid ascent demonstrates that strategic pricing, an accessible agent model and user-centric design can achieve significant market penetration, even in competitive or underserved contexts. These features directly address financing-for-development needs by lowering transaction costs, bridging urban-rural gaps and fostering economic participation among marginalised

groups. Although challenges remain – such as navigating evolving regulations and maintaining service quality in remote areas – Wave's experience underscores the transformative potential of fintech when aligned with local realities and development priorities.

Case Study 2: M-Pesa

While Wave exemplifies how a new entrant can disrupt existing markets with strategic pricing and user-centred design, *M-Pesa* highlights a different yet equally influential narrative: pioneering a widespread mobile money ecosystem and influencing regulatory shifts not just within Kenya, but globally. Launched in 2007 by Safaricom, M-Pesa rapidly evolved from a pilot project for microloan repayments into an entire financial infrastructure that now serves tens of millions of users across multiple countries (Burns, 2018; Ndung'u, 2021). Its success model, which is centred on agent-based cash-in/cash-out transactions, helped overcome infrastructure limitations by allowing customers to deposit and withdraw money via local kiosks rather than queuing at distant banks.

M-Pesa's popularity is widely credited for *scaling up financial inclusion* among Kenya's unbanked and underbanked populations. Within just a few years of its launch, formal financial access in Kenya surged, prompting economists and development practitioners to reassess assumptions about mobile adoption and rural consumers' willingness to engage with digital payments. By driving billions of shillings in monthly transfers, M-Pesa significantly reduced the transaction costs and security risks inherent in cash-based economies, thus expanding opportunities for small businesses, rural farmers and women entrepreneurs, who previously faced mobility and documentation barriers (Ndung'u & Oguso, 2021).

Arguably, one of M-Pesa's most critical contributions lies in spawning regulatory changes and shaping industry norms. Its unprecedented scale forced regulators, which were initially cautious about non-bank entities handling financial transactions, to adapt rules to accommodate mobile money operators. This gave rise to more flexible licencing regimes, KYC (know-your-customer) innovations and agent-banking frameworks across East Africa. In subsequent years, countries like Tanzania, Ghana and Rwanda have followed Kenya's lead by crafting more agile, fintech-friendly regulations, a development that has smoothed the path for both domestic and international operators looking to serve previously marginalised segments.

Other fintechs have emerged to capitalise on or enhance these regulatory and infrastructural shifts. Some of them include:

- *Flutterwave* in Nigeria has become a leading payments gateway, enabling cross-border transactions and robust API integrations for merchants, thus extending digital finance across the broader African e-commerce landscape.
- *TymeBank* in South Africa, a digital-only bank, leverages partnerships with major retail chains to reach customers at convenient sign-up kiosks, reducing both cost and complexity for potential account-holders.

Collectively, these examples illustrate that *fintech innovation can escalate quickly* when user-friendly solutions coincide with enabling policy frameworks. M-Pesa's early achievements set a precedent for what was possible, paving the way for subsequent ventures – like Wave, Flutterwave and TymeBank – to refine the model and focus on strategic niches. Despite diverse operational contexts and regulatory environments, each initiative demonstrates how fintech can drive financial inclusion, foster entrepreneurship and encourage governments to enact supportive policies –cornerstones of a more equitable, innovation-driven financial sector throughout Africa.

Other Case Studies

Beyond Wave and M-Pesa, the broader African fintech landscape offers further evidence of digital finance's transformative potential. According to the World Bank's most recent Global Findex report, mobile money accounts now outnumber traditional bank accounts in several African countries, underscoring the speed and scale at which digital platforms are addressing previously unmet financial needs (World Bank, 2022). In particular, nations such as Ghana, Uganda and Tanzania have witnessed a surge in active mobile money subscriptions, with agent networks expanding into rural and semi-urban areas. This growth reflects the deepening of financial inclusion, as more people can now access basic transaction and savings services without needing to visit a physical bank branch.

In addition to payments and remittances, fintech solutions are branching into credit, insurance and wealth management. For instance, digital lending apps like Branch and FairMoney leverage alternative data, such as mobile phone usage and e-commerce activity, to underwrite loans for micro-entrepreneurs who lack collateral or formal credit histories. Meanwhile, insurtech startups like Bima and MicroEnsure package affordable micro-insurance policies for health and life coverage, tapping into historically underserved populations. Success stories are also evident in Nigeria, South Africa and Egypt, where proactive regulatory environments have attracted venture capital funding that fuels product innovation and cross-border expansion (Sy et al., 2019). These regional examples underscore a shared trend: when supported by enabling policies and infrastructure, fintech can drive both scale and inclusivity in Africa's financial ecosystem, reinforcing the foundational lessons gleaned from Wave and M-Pesa's experiences.

Discussion

Deeper Thematic Analysis

While mobile money and peer-to-peer payments have been instrumental in expanding financial inclusion, fintech's potential to address systemic financing challenges in Africa extends far beyond facilitating everyday transactions. One emerging area is climate finance, where digital platforms can mobilise capital for

green projects or enable smallholder farmers to access weather-indexed insurance products. By leveraging blockchain-based solutions or transparent crowdfunding mechanisms, fintech firms could channel resources to renewable energy and climate-resilient infrastructure, thereby tackling financing gaps that traditional banking tends to overlook. Similarly, trade finance presents another frontier: small and medium-sized enterprises (SMEs) engaged in cross-border commerce often encounter high transaction costs, currency volatility and difficulty securing letters of credit. Innovative fintech models, such as digital escrow services, supply chain financing platforms or stablecoin-based remittances, can lower barriers, reduce settlement times and enhance trust among trading partners.

Another major systemic challenge lies in SME lending, a segment routinely underserved by formal banks due to perceived risks and limited collateral. Fintech solutions that integrate alternative data, from mobile phone usage to e-commerce transactions, have begun to fill this gap, enabling lenders to assess creditworthiness more accurately and offer quick, personalised loan products (Makina, 2019). A key success factor here is the availability of collaborative regulatory sandboxes, where startups can safely pilot novel products under regulatory oversight without facing prohibitive licencing fees or compliance hurdles. Such sandboxes encourage experimentation and real-world learning, often spurring policy refinements in areas like KYC and anti-money laundering requirements.

Interoperability constitutes another essential driver of fintech's broader impact. When payment platforms, banks and telecom operators adopt common standards for data sharing, users benefit from seamless transfers across different networks. This facilitates not only customer convenience but also fosters competition and innovation, as new entrants can plug into existing ecosystems rather than rebuilding them from scratch. Digital infrastructure, notably reliable internet connectivity and affordable mobile devices, underpins this entire landscape; where infrastructure remains weak, fintech scale-up is hampered, especially in rural regions where the need for affordable financial services is arguably the greatest.

Nonetheless, these pathways to deeper financial transformation face significant constraints. Compliance costs can be burdensome for fledgling fintechs, especially when they must navigate multiple regulatory regimes across different countries. Cybersecurity threats, from data breaches to fraudulent apps, further necessitate advanced risk management systems, which can be financially and technically out of reach for smaller startups. Meanwhile, digital literacy remains uneven, with large swaths of the population unfamiliar with basic smartphone navigation or online financial products. Addressing these issues requires a concerted effort among governments, private enterprises and development partners to invest in education, promote robust consumer protection frameworks and facilitate secure digital ecosystems. Ultimately, fintech's capacity to unlock alternative financing streams, whether for climate projects, trade or SMEs, depends on a confluence of regulatory support, infrastructure investments and user engagement that collectively bridge the gap between innovation and inclusive development.

Innovation Systems Perspective

From a national systems of innovation standpoint, fintech embodies more than just new payment products; it represents a nexus of technological progress, policy evolution and market adaptation that can catalyse broader economic transformation (Lundvall, 1992). Within this framework, government agencies – particularly central banks and telecommunications regulators – serve as key orchestrators. By creating regulatory sandboxes, offering incentive schemes or endorsing open-API initiatives, governments encourage fintech start-ups to experiment, prototype and refine their products. These supportive signals reduce uncertainties inherent in launching financial innovations, thus nurturing a dynamic ecosystem of entrepreneurs and investors.

Academic institutions also play an essential role by contributing research and development (R&D) capacity. University-led incubators, for instance, may provide engineering students and young researchers with the resources to design or test fintech solutions in partnership with industry. This cross-pollination of ideas helps align theoretical knowledge with real-world challenges, fostering human capital development. The resulting pool of skilled developers, data analysts and product managers not only boosts the fintech sector but also enriches the broader labour market, potentially triggering job growth across complementary sectors, such as telecommunications and e-commerce.

At the same time, fintech's rapid expansion creates feedback loops that strengthen the national innovation system. As users adopt new financial tools, they generate valuable transaction data and consumer insights, fuel for further innovation in artificial intelligence, credit-scoring algorithms and related technologies (Rogers, 2003). This surge in data-driven insights can inform public policy, prompting local authorities to update regulations or collaborate with private firms on digital identity projects, consumer protection guidelines or even cybersecurity protocols. In turn, these improved policies lower barriers to market entry for additional fintech startups, reinforcing a virtuous cycle of experimentation and refinement.

Another key outcome is skill-building and job creation. With each wave of fintech growth, demand rises for software engineers, UX designers and agent networks, generating both formal and informal employment opportunities. These changes encourage strategic partnerships among government bodies, corporate R&D centres and educational institutions to ensure the availability of digitally savvy talent. Over time, the evolving fintech ecosystem can spill over into other sectors, such as agriculture (through e-wallets and agri-insurance), manufacturing (through supply-chain financing) and retail (through integrated payment platforms), amplifying the impact of innovation beyond finance alone.

In sum, fintech's interaction with national innovation systems underlines how technological breakthroughs are not merely market-driven events. Rather, they emerge from, and contribute to, a complex network of actors: governments, universities, private firms and end-users, whose collaborations and policy choices collectively shape the economic development trajectory. By studying these reciprocal relationships, policymakers and practitioners can better harness

fintech to accelerate inclusive growth and systemic advancement in Africa's rapidly changing financial sector (Freeman, 1987).

Financing-for-Development Implications

Beyond its immediate impact on payment efficiency and credit availability, fintech's expansion in Africa has deeper implications for financing development and advancing the United Nations Sustainable Development Goals. By lowering transaction costs and enabling micro-savings, digital financial services can bolster poverty reduction efforts, allowing low-income households to retain more disposable income and respond to financial shocks (World Bank, 2022). Mobile wallets, for instance, enable smoother receipt of remittances – often a critical lifeline for families in rural areas – and give informal entrepreneurs a stepping stone into more formal economic activities. Such inclusion of marginalised groups can be particularly transformative for women, whose control over household finances often increases when digital tools mitigate the need for physical travel, extensive documentation or face-to-face interactions in traditional banking halls. Improved access to working capital also fosters local enterprise growth, as micro- and small-scale entrepreneurs leverage mobile payments and digital loans to scale up operations, invest in equipment or diversify product lines.

However, these gains must be evaluated in light of potential pitfalls. One risk involves over-indebtedness, particularly when digital credit platforms offer easy but potentially expensive lines of credit without robust assessments of borrower capacity (Demir et al., 2020). Another concern is the inequality in digital access, which may unintentionally widen the gap between connected, tech-savvy urban populations and those in rural or remote areas with limited internet, sporadic mobile coverage or low digital literacy. Such disparities can reinforce societal imbalances, as those who are already disadvantaged face higher barriers to entry. In addition, cybersecurity threats, from fraudulent apps to data breaches, pose further challenges for consumers and providers alike. Addressing these obstacles requires a concerted approach: regulators enforcing responsible lending practices, development partners supporting digital infrastructure rollouts in underserved regions and fintech firms investing in robust security measures and user education. Collectively, these steps can ensure that fintech's promise for financing development is both inclusive and sustainably impactful, laying the groundwork for broader socio-economic transformation.

Recommendations

Fintech holds the potential to be a catalyst for inclusive economic development across Africa, provided that digital infrastructure, supportive regulation and stakeholder collaboration are effectively aligned. By harnessing mobile technology, data analytics and innovative payment systems, fintech can address longstanding barriers to financial access, reduce the cost of transactions and

enable underserved populations to build capital and manage risk. Yet the realisation of these gains requires more than technology alone: governments must foster transparent and flexible policy frameworks, investors and traditional financial institutions must channel resources into scalable solutions, and community-based organisations must work to raise financial literacy and trust in digital platforms. When these essential conditions converge, fintech's capacity to spur job creation, enhance rural financial integration and promote sustainable entrepreneurship can significantly advance Africa's broader development goals. Through coordinated efforts across the public, private and civil society sectors, fintech can transition from a niche innovation to a driver of systemic change, ultimately contributing to poverty reduction and shared prosperity throughout the continent.

Recommendation for Regulators

Regulators occupy a pivotal position in shaping how fintech solutions emerge, operate and evolve across Africa. By developing coherent licencing frameworks, refining anti-money laundering and know-your-customer (AML/KYC) rules and encouraging innovative models for risk assessment, regulatory bodies can strike a delicate balance between encouraging new market entrants and preserving systemic stability. For instance, tiered licencing structures can simplify entry requirements for smaller start-ups while assigning more rigorous capital or compliance obligations to larger, more complex fintech entities. This flexible approach lowers barriers for innovation, especially in rural areas where entrepreneurs might otherwise be deterred by high upfront costs or cumbersome bureaucracy.

Equally essential is the refinement of AML/KYC protocols, ensuring that integrity safeguards remain strong without disproportionately excluding low-income populations. Collaborative initiatives with technology providers, such as biometric verification or artificial intelligence-driven risk assessments, can make identity checks more efficient and less paper-heavy. In tandem with these measures, regulatory sandboxes serve as valuable 'safe zones' in which new products can be tested under supervised conditions. This controlled experimentation helps both innovators and regulators gather data, identify unforeseen issues early and refine policies based on tangible evidence rather than theoretical assumptions. Such an iterative approach to rule-making fosters a more vibrant ecosystem, as startups learn in real time how best to deploy services while ensuring consumer protections.

In this regard, Nigeria's 2018 payment service bank framework offers a compelling example of balanced regulation in action. By designing a licence specifically tailored to telecom companies and other non-bank operators, the Central Bank of Nigeria created clear conditions for expanding financial services into underserved regions. Early results show both an increase in agent banking networks and a rise in innovative, low-cost products, demonstrating how astute

licencing rules and measured oversight can open markets without compromising on consumer trust or financial stability.

Recommendation for Fintech Companies

Fintech companies stand at the forefront of innovation in Africa's financial sector, but to achieve sustainable impact, they must prioritise user-centred design. By developing products that account for the diverse linguistic, cultural and technological realities of their target markets, fintech firms can avoid a 'one-size-fits-all' approach that often alienates potential users. Simple, intuitive interfaces that function seamlessly on low-end devices or via USSD can significantly broaden adoption, particularly in rural or low-income communities. Additionally, inclusive product development that accommodates women, the youth and other marginalised demographics increases the likelihood that fintech solutions will drive meaningful financial inclusion rather than reinforce existing inequalities.

To scale and deepen their market presence, fintech companies should explore partnerships with MFIs or traditional banks. Such collaborations allow fintechs to leverage established client bases, agent networks and regulatory know-how while bringing cutting-edge technological capabilities to legacy institutions. In return, MFIs and banks benefit from enhanced operational efficiency and an expanded suite of digital services, enabling both parties to reach previously untapped segments more effectively. As these partnerships evolve, firms should invest in robust cybersecurity measures, not only to protect consumer data but also to build trust in digital platforms. Clear privacy policies, strong encryption and ongoing risk assessments bolster user confidence, which is vital in regions where concerns about fraud and data breaches remain high. By embracing user-centred design, inclusive development, strategic alliances and steadfast cybersecurity practices, fintech companies can ensure that their innovations genuinely address development challenges and generate lasting social and economic value.

Recommendation for Traditional Financial Institutions

Despite the excitement surrounding new fintech entrants, traditional financial institutions, including commercial banks, MFIs and insurance providers, remain integral to Africa's financial system. To stay competitive and relevant in an evolving digital landscape, these incumbents can adopt digital transformation strategies aimed at modernising legacy infrastructure and providing customers with seamless online and mobile services. By optimising back-end processes, leveraging data analytics and simplifying user experiences, banks and insurers can reduce operational overheads and reach underserved segments more efficiently.

A key component of this shift involves open API integrations. Banks can securely expose data or specific service functionalities, allowing fintech startups

to develop new solutions on top of legacy systems. This approach fosters a collaborative ecosystem in which traditional institutions and agile fintechs exchange value. A case in point is South Africa's Nedbank, which established its own API marketplace to facilitate partnerships and fuel co-innovation with digital payment providers and fintech developers. In one notable instance, Nedbank collaborated with Ozow to deliver an integrated direct electronic funds transfer payment solution. Through such initiatives, Nedbank has not only broadened its reach to tech-savvy consumers but is also enabling diverse fintech players to plug into robust banking infrastructure, creating a win-win dynamic for both the bank and innovative third parties.

Beyond providing open APIs, co-innovation with fintech startups can help traditional financial institutions accelerate their digital transformation. Established banks possess valuable resources: client trust, capital and compliance expertise, while startups bring fresh ideas, niche technologies and rapid development cycles. Joint ventures and pilot programmes in areas such as credit scoring, automated insurance underwriting or real-time payments can result in market-ready products that are more inclusive and responsive to customer needs. By actively seeking out these collaborative opportunities, traditional financial institutions can transcend siloed operating models and become architects of Africa's growing digital finance ecosystem rather than passive observers.

Recommendation for Development Agencies and Non-governmental Organisations (NGOs)

Development agencies, NGOs and other mission-driven institutions play an essential supporting role in the expansion of fintech across Africa. By leveraging their expertise in community outreach and socio-economic development, these organisations can amplify fintech's impact among low-income or historically underserved communities. *Financial education* sits at the heart of this effort: NGOs can design and deliver culturally appropriate training modules on digital payments, savings strategies and basic cybersecurity awareness. By equipping people with the skills to effectively navigate digital platforms, NGOs help broaden adoption and minimise risks such as fraud or over-indebtedness.

Moreover, development agencies can assist in *capacity building* by collaborating with fintech providers to identify local partners, train agent networks or adapt product features to meet specific community needs. For instance, they might facilitate specialised microlending schemes for women entrepreneurs or enable farmers to access weather-indexed insurance via simple mobile interfaces. Such interventions not only deepen financial inclusion but also provide agencies with valuable data on how fintech solutions perform in different contexts. A notable example of this collaborative approach is the partnership between AfricaNenda Foundation and RSwitch in Rwanda, where technical expertise and institutional support from AfricaNenda are strengthening Rwanda's payment infrastructure. Through these coordinated efforts, local fintech solutions gain greater reach, reliability and trust among underserved demographics.

Finally, NGOs often have the flexibility and grassroots connections to pilot-test innovations in underserved areas. NGOs such as USAID and CARE have piloted savings group digitalisation solutions in several African countries, such as Uganda and Rwanda. They can coordinate with regulators, technology firms and local leadership to implement small-scale trials, gather feedback and refine products prior to wider deployment. This collaborative process reduces the risk of mismatched solutions and ensures that new services – whether mobile wallets, digital lending platforms or remittance tools – are grounded in a clear understanding of community realities. By championing financial education, strengthening capabilities on the ground and running pilot initiatives, development agencies and NGOs can accelerate fintech's potential to alleviate poverty and foster more equitable growth across Africa.

Conclusion

This chapter has highlighted the transformative potential of fintech in Africa's financial sector, illustrating both the successes and challenges of digital solutions like Wave and M-Pesa. Across case studies, we see how strategic pricing, flexible agent networks and user-focused product design can lower barriers to financial access for households and small enterprises that were previously excluded by traditional banking systems. Such innovations have meaningful implications for financing development, advancing poverty reduction goals and enhancing the economic participation of marginalised groups, especially women, the youth and rural communities. At the same time, the discussion underscored that fintech's long-term impact hinges on robust infrastructure, balanced regulatory frameworks and concerted collaborations among regulators, development agencies and private stakeholders.

From an innovation systems perspective, fintech has initiated valuable feedback loops that spur skill-building, job creation and policy refinements. Governments are revising licencing requirements and AML/KYC protocols to accommodate new market entrants, while established financial institutions are modernising their legacy systems and forging co-innovation ventures with agile startups. Development agencies and NGOs, in turn, are playing a pivotal role by delivering financial education, conducting pilot programmes in underserved areas and facilitating partnerships that expand the reach of promising fintech products.

Looking ahead, future research can deepen our understanding of fintech's effectiveness in solving systemic financing gaps. Cross-country comparative studies would offer granular insights into how cultural contexts, diverse regulatory regimes and varying infrastructure capacities shape adoption patterns. Additionally, more robust data collection on user demographics, credit outcomes and repayment behaviours would help illuminate both the opportunities and pitfalls in digital lending, insurance and investment products. Finally, there remains a need to explore how fintech can integrate with other development priorities, such as climate resilience, healthcare access and public service delivery.

By examining these intersections more closely, researchers, policymakers and practitioners can continue to refine fintech's role in fostering sustainable, inclusive economic growth throughout Africa.

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Chapter 9

Transformative Impacts of Ethical and Responsible AI: The Case of AI Sandboxes for Economic Policymaking

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Introduction: Artificial Intelligence (AI)-Driven Innovation within the African Context

The adoption and development of AI in Africa have accelerated in recent years, driven by rising technological literacy, increased investment and a growing recognition of AI's potential to address pressing socio-economic challenges (Mbangula, 2022). Technological advancement and, lately, AI implementation in Africa have historically lagged behind other regions, but significant progress has been made recently. Several African nations have developed AI strategies, prioritising AI research, skills development and real-world applications to enhance public services, boost agricultural productivity, improve healthcare outcomes and expand financial inclusion (Asiegbu & Okolo, 2024). Countries such as Kenya, South Africa, Nigeria and Ethiopia have become regional hubs for AI innovation, hosting numerous AI-focused startups, research centres and university programmes (Arakpogun et al., 2021). AI stakeholders from the public, private and civil society face a twin development challenge of steering AI innovations for growth while ensuring equity and ethical standards.

Regulatory mechanisms such as data protection laws and AI strategies that promote ethical and responsible AI principles are crucial for governing AI systems' development, deployment and use (de Almeida et al., 2021). These regulatory mechanisms ensure that AI technologies align with societal values, human rights and sustainable development goals. Embedding ethical considerations into the core of AI design and implementation processes helps mitigate potential

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risks, prevent unintended negative consequences and ensure equitable distribution of AI benefits (Konidena et al., 2024).

Despite practical research in academia and policy, the development of Africa's path towards an ethical and responsible AI transformative agenda is still underexplored. This chapter examines the role of AI regulatory sandboxing in creating a responsible and ethical environment for AI adoption, focusing on economic policymaking. Regulatory sandboxes provide controlled environments where AI solutions can be tested, evaluated and refined before broader implementation. These sandboxes allow experimentation with new AI-driven business models within a defined boundary, enabling regulators to assess AI technologies' impacts, risks and compliance considerations in a contained setting (Davis, 2023).

This approach offers vital advantages in high-stake domains, like economic policymaking, including risk mitigation, regulatory adaptation, stakeholder engagement and capacity building (Floyd, 2024). By creating controlled testing environments that adhere to ethical principles, policymakers can gain valuable insights into how AI systems may interact with and influence various economic factors. This proactive risk assessment and ethical evaluation approach helps identify and mitigate potential unintended consequences, biases or negative impacts before widespread deployment. Additionally, sandboxes facilitate collaboration between diverse stakeholders, fostering transparency, public trust and the co-creation of AI solutions aligned with societal values, human rights and development priorities (Torregrosa-Hetland et al., 2019).

Literature Review: Technological Innovation Systems (TISs) and AI Sandboxes for Innovation

TISs emphasise the systemic and collaborative nature of technological development, highlighting the roles of actors (e.g., firms, universities, policy agencies), their networks and supportive institutions (Carlsson & Stankiewicz, 1991). Rather than viewing innovation as isolated breakthroughs, TIS underscores how shared knowledge, resource flows and formal and informal regulations shape the trajectory of new technologies.

AI offers a clear illustration of TIS principles. AI's rapid advancement relies on continuous learning and collaborative networks involving researchers, industry and public institutions. Effective AI ecosystems depend on policies that both safeguard data and encourage experimentation. Overly restrictive rules hinder innovation, while lax governance risks ethical and social harm. Policymakers therefore play a crucial role in aligning regulatory frameworks, funding and infrastructure so that AI can develop responsibly within local contexts (Freeman, 1994).

For African countries, leveraging TIS to foster AI innovation means creating 'sandboxes' or controlled environments where AI systems can be tested, refined and scaled. These sandboxes allow stakeholders to collaborate on real-world

applications – such as healthcare or finance – while policymakers update regulations in tandem with technological progress. By prioritising adaptive governance, robust institutional support and cross-sector partnerships, African leaders can cultivate AI ecosystems that harness global advancements while directly addressing local needs. This systemic view of AI innovation, which is rooted in TIS, can serve as a roadmap for effectively steering investments, policy decisions and talent development, and ultimately unlock AI's transformative potential for the continent.

Ethical and Risk Considerations of AI in Sandbox Design and Implementation

It is crucial to recognise that AI models and solutions carry potential risks that a well-structured sandbox design could help mitigate. The potential risks of AI are widely documented in the literature and policy sources, including the African Union's (AU's) Continental AI Strategy. Cheatham et al. (2019) argue that the risks associated with AI, such as privacy breaches, discrimination, accidents and political manipulation, underscore the need for caution. Further, unforeseen consequences of AI could have severe impacts, including compromised national security, loss of life and significant organisational challenges such as reputational damage, financial losses and political backlash. Hendrycks et al. (2023) discuss how rogue AI agents could be misused to expedite the discovery of dangerous chemical and biological weapons, threatening humanity and particularly vulnerable communities.

At the policy level, the AU Continental AI Strategy highlights AI's potential risks within broader socio-economic contexts. AI's potential to displace jobs, erode indigenous knowledge and further marginalise women are among the ethical issues that must be addressed by AI stakeholders. The AU AI strategy thus categorises AI risks into several segments:

- environmental risks;
- system-level risks;
- structural risks;
- risks to African values.

AI presents multifaceted risks with varied impacts across individuals, organisations and society. Addressing these risks requires a comprehensive yet controlled environment where stakeholders can test and assess AI models. Additionally, AI-driven economic policies could either reduce poverty or exacerbate inequality, especially where underlying data and models are inaccurate. AI sandbox experimentation for economic policymaking provides a framework for multi-stakeholder collaboration, allowing for the development, testing and responsible use of AI solutions in economic policy contexts.

AI Sandboxes (Regulatory and Operational) as a Driver of Economic Policymaking

A regulatory sandbox is a limited form of regulatory waiver or flexibility for firms, enabling them to test new business models with reduced requirements (OECD, 2023). The African Development Bank (AfDB) similarly sees regulatory sandboxes as a virtual concept, a testing ground set up and administered by a regulatory authority, whereby participants can apply to test their innovative products and services in a controlled environment for a defined purpose and a predefined period of time (AfDB, 2022). Sandboxes allow all actors to develop and explore the regulatory implications of an emerging or grey technology field, with the view to helping innovators launch more quickly or get regulatory waivers with their innovations. They provide a win-win situation where regulators can learn about the technology and its nuances before developing a legislation or policy strategy to guide its adoption (Truby et al., 2022). Nascent innovation systems and informal economies, such as exist in most African countries, require an unconventional and accelerated AI innovation process to drive economic transformation. Like most frontier technology, AI is fast-paced, with innovators and users outpacing regulators and policymakers. AI regulatory sandboxes provide a balanced and controlled environment for AI innovation in Africa, where institutional and technical bottlenecks exist. Because regulatory sandboxes are primarily anticipatory and risk-based, they create flexibility and a degree of freedom for innovators to develop and go to market quicker while providing policymakers and users with the opportunity to interact and gain insights for responsive regulations around the technology.

For AI development, sandboxes play a crucial role in helping regulators identify governance, technical and financial knowledge gaps. AI and other emerging technologies require advanced knowledge and time to build within slow, bureaucratic government institutions. Additionally, AI is multi-sectoral, and sandboxes can help regulators quickly build state capacity through experimentation while allowing innovation to thrive.

Regulatory sandboxes, as seen in the case of fintech, revolve around three key pillars: the institutional and governance structures required for regulation, the technical aspects such as creation, design and implementation and the economic and financial considerations. These pillars are further detailed in the framework in Table 9.1.

The AfDB (2022) observed the consumer benefits of regulatory sandboxing for Africa. Sandboxes help introduce new products and services, encourage competition and decrease prices. Additionally, regulatory sandboxes signal to investors and researchers about market needs, emerging trends and market challenges. From the outside, investors can gauge the direction of national ecosystem development and the potential market dynamism to support it. AI, similar to a general-purpose technology (Kulkov et al., 2023), has varied applications across sectors and interests from different groups. Therefore, AI

Table 9.1. Framework for Designing Regulatory Sandbox for Economic Transformation.

Dimension	Description	Expected Outcomes
The Institutional and Governance		
Objectives and motivations	The governance of the sandbox concerns the objectives and processes involved in its creation and design, rules guiding who can participate and the exit and re-entry of innovators. The institutional dimension covers the regulatory body that supervises the sandbox and which other actors can join in. In addition, the set of laws, acts and policies that will operate within the sandbox environment will be determined. Where no Specific law exists, the guiding principles for evaluating sandbox participation would have been determined.	Clear understanding among stakeholders about the sandbox setup and roles of each actor. This could be for policy formulation, thematic or product-focused and cross-border. The benefits should also be stated here.
Rules and criteria		Who can apply, what are the rules for rejection, what is the time of Sandbox testing and what are the regulatory waivers?
Regulatory clarity – ethical and responsible		The scope and laws guiding principles outline any existing laws and approaches for socially and culturally responsive sandboxing.
Guidelines for multi-stakeholder engagement		Identify all states and non-states with roles in the operationalisation of the sandbox.
Monitoring and evaluation		A framework to guide and monitor progress made against set objectives to help the managers improve the sandbox or stop it where it is not viable.

(Continued)

Table 9.1. *(Continued)*

Dimension	Description	Expected Outcomes
Technical: Creation, design and Implementation		
A consultative and interactive process in creation and design	Approaches to running a regulatory sandbox vary significantly between countries, with the two most common governance models being the dedicated unit and the hub-and-spoke model. The dedicated unit involves creating and staffing new departments specifically for sandbox implementation. Given the diverse expertise required – from supervision to technology and governance – it is advisable to have subject matter experts available, either within the organisation or externally, to provide the necessary support.	Have a straightforward process for consultation in the creation and design.
Expertise pools for sandbox		Identify a list of experts to join technical committees for application review.
Resource requirements from public and private institutions – collaboration		Identify a list of physical, human and financial resources needed from the public and private sectors.
Data protection and security		Identify measures for data protection, ethical and responsible sandbox process.
Sandbox testing and exercises		Procedures for practical testing experimentation with the sandbox framework.
Economic and financial considerations		
Cost of implementation and operation	Regulatory sandboxes stimulate job creation, promote business growth and drive innovation by lowering entry barriers for innovators. Additionally, successful sandboxes attract investment, enhance financial inclusion and contribute to economic diversification by supporting diverse industries and technologies. Moreover, they lead to increased tax revenue and knowledge development,	The implementation of the sandbox to the state and participant.

	benefiting businesses and consumers. Overall, regulatory sandboxes serve as economic development catalysts, driving the innovation agenda forward while ensuring regulatory compliance and consumer protection.	
Job creation		Potential role of the process to create opportunities for job creation.
Tax revenues		Taxes to be generated from innovations.
Poverty reduction		Overall reduction in poverty from economic simulation.
Economic diversification		Supporting a range of industries and technologies.
Consumer benefits		Access to more diverse, innovative and competitive products and services.
Investment attraction		Successful sandboxes attract both domestic and foreign investment, positioning the country as an attractive destination.
Innovation simulation		Sandboxes lower entry barriers for innovators, encouraging the development and commercialisation of groundbreaking products and services.

Source: Authors.

sandboxing frameworks will help shape AI's national agenda and direction in economic transformation and policymaking while aiding the ecosystem beyond governments in identifying gaps in governance, technical expertise and the economic implications of adopting AI.

Envisioning AI Regulatory Sandboxes within the African Context

Africa's innovators and economic policymakers face the complex dilemma of embracing AI while being conscious of the potential risks and the exclusion of already marginalised communities (Gwagwa et al., 2020). Africa's experience with regulatory sandboxes has been focused on fintech, with less application to new sectors such as AI. What makes this problematic is that there has been no significant use of AI in driving economic policy, both in policy approaches and improving policymakers. However, the uptake of fintech regulatory sandboxes in Africa is fuelled by the transformative impact on the continent. The fintech revolution and the leapfrog in financial access are often examples of how technological innovations can transform the continent (Langley & Rodima-Taylor, 2022).

AI's development is different because national governments and the innovation ecosystem do not have the basic regulatory, technical and economic frameworks to build AI systems. Governments are now developing data governance laws with varied institutional frameworks while experiencing uncertainty about the risks as well as limited state capacity to support and stimulate the private sector in AI development. Ade-Ibijola and Okonkwo (2023) highlight challenges such as skills acquisition, lack of a structured data ecosystem, ethics, government policies, insufficient infrastructure and network connectivity, uncertainty and user attitudes. Reaping AI dividends requires new approaches that lean towards leapfrogging, such as fintech, despite the challenges. However, while AI has many ethical and technical challenges globally, Africa faces additional unique hurdles, such as limited digital infrastructure, inconsistent regulatory frameworks and a significant digital divide. These issues are compounded by lower levels of technical expertise, underdeveloped data governance structures and insufficient funding for AI research and development. Addressing these challenges requires building an AI ecosystem tailored to Africa's specific socio-economic and infrastructural context.

At the regional level, recent policies and strategies, such as the Digital Transformation Strategy for Africa (2020–2030), the AU Data Policy Framework, the Africa Continental Free Trade Area (AfCFTA) and the AUDA-NEPAD AI Continental Strategy that are aimed at creating a single digital market could guide national ecosystem development. They could also promote cross-border AI regulatory frameworks that create a demand for AI innovation and research, and economic transformation policymaking.

Research Methodology

This study employed a four-step triangulation approach:

(1) *Desk reviews*: Examined global sandbox models and African implementations through academic journals, policy documents and reports.
(2) *Interviews with experts and regulators*: Conducted semi-structured interviews with AI ethics/regulation experts and sandbox authorities in Africa to capture insights on best practices and challenges.
(3) *Case study methodology*: Focused on Mauritius, South Africa and Rwanda's fintech sandboxes, using Yin's methodology to assess implementation processes, regulatory frameworks and outcomes.
(4) *Data collection and analysis*: Combined qualitative content analysis (supported by NVivo) of government documents, policy papers and interview transcripts. A cross-case synthesis compared findings and contextual factors influencing sandbox effectiveness.

Operationalising Ethical and Responsible AI: Lessons from Regulatory Sandbox Implementations

This section will discuss how African governments, with perspectives from the global ecosystem, can foster ethical and responsible adoption of AI innovations for growth and policymaking using the AI regulatory sandbox frameworks. We will evaluate the technical, institutional and economic dimensions of AI sandboxing to accelerate its adoption in Africa, especially in terms of economic policy and transformation.

Overview of Regulatory Sandboxes: the Global and African Perspective

Africa Regulatory Sandboxes

Various countries have implemented different forms of regulatory sandboxes to guarantee broader stakeholder collaboration for deploying innovations where there is a lack of regulatory clarity. We found that over 170 regulatory sandboxes were implemented worldwide, each with unique objectives and scope. Annex 1 contains a list of global regulatory sandboxes, which we sampled to inform this research. Africa has its fair share of regulatory sandbox implementations, mainly in the fintech sub-sector. There are over 14 known regulatory sandbox implementations in Ghana, South Africa, Mauritius, Sierra Leone, Nigeria, Rwanda, Kenya and Egypt (World Bank, 2020).

Mauritius, as one of the pioneers, established its sandbox in 2018, focusing on fintech, AI and blockchain, with key initiatives like P2P lending regulations and AI innovation hubs. Similarly, South Africa's sandbox, launched in 2020 by the Intergovernmental Fintech Working Group, emphasises fintech and insurtech, addressing cross-border payments and crypto assets.

With its sandbox governed by the Capital Markets Authority since 2019, Kenya focuses on fintech and crowdfunding to boost financial inclusion. Rwanda's sandbox, overseen by the Rwanda Utilities Regulatory Authority, is aimed at sectors like telecom and energy. Ghana, Sierra Leone, Nigeria and Egypt have also launched sandboxes, with a strong emphasis on fintech and mobile payments, demonstrating a continental trend towards leveraging fintech innovations to enhance financial inclusion and economic development.

Global Regulatory and Digital Sandboxes: Lessons for AI Governance

Regulatory sandboxes can be tailored to various sectors – most commonly fintech – and have been adopted worldwide since the United Kingdom's Financial Conduct Authority (FCA) launched the first sandbox in 2016. Fig. 9.1 highlights the distribution of regulatory sandboxes by sector or theme as of January 2023.

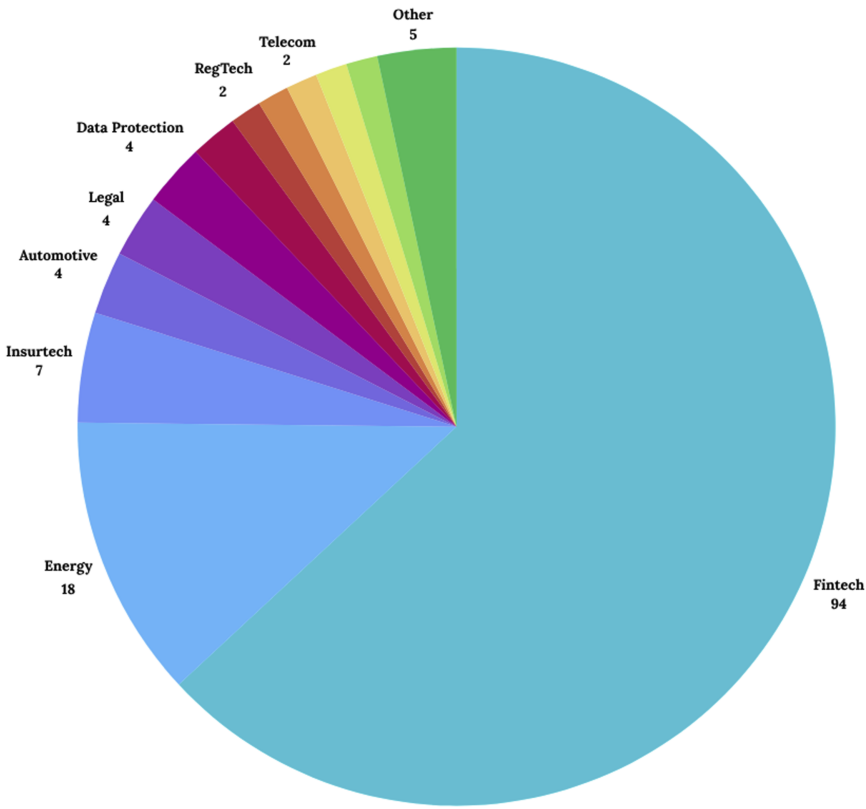

Fig. 9.1. Thematic Distribution of Global Regulatory Sandboxes as of January 2023. *Source*: Authors, with adaptation from Zaraba (2023).

Global experiences highlight three main components relevant for Africa's AI regulatory sandboxes. First, governance and institutional structures matter. Effective sandboxes require transparent processes and clear legal frameworks, exemplified by the UK FCA and the Monetary Authority of Singapore (MAS). Coordination across agencies is critical, as siloed efforts can reduce sandbox effectiveness. Second, technical design determines a sandbox's ability to test emerging technology in a safe, controlled environment. Many sandboxes, such as the UAE's ADGM and Australia's ASIC, invest in virtual infrastructures that lower costs and risks by providing standardised testing environments and expert guidance. Finally, the economic and financial framework underpins long-term sustainability. Some countries use cost-sharing models: firms shoulder application and testing expenses, with state support as necessary. This setup encourages genuine market participation and can drive sectoral diversification, as demonstrated by Kenya's Central Bank sandbox.

Alongside regulatory sandboxes, digital sandboxes offer a complementary approach focused on early-stage ideation and collaboration. As shown in Table 9.2, digital sandboxes often use synthetic data to facilitate experimentation without the regulatory overhead of real-world deployments. They are especially valuable for AI applications that need rapid prototyping and proof-of-concept testing.

By contrast, regulatory sandboxes – also highlighted in Table 9.2 – involve live market scenarios, higher compliance costs and real consumer data. Both models can be combined in Africa to streamline AI policy experimentation:

Table 9.2. Comparison of Digital and Regulatory Sandbox Approaches.

Feature	**Digital Sandbox**	**Regulatory Sandbox**
Stage of development	Early-stage ideation and development	Ready for live market testing
Testing environment	Virtual environment with synthetic data	A live market environment with real consumers
Regulatory guidance	Limited regulatory input	Extensive regulatory support and guidance
Cost	Lower due to virtual nature	Higher due to real-world deployment
Risk level	Lower, controlled virtual testing	Higher, real-world risks and complexities
Data access	Synthetic and anonymised data sets	Real consumer data and feedback
Collaboration	High, promotes early-stage collaboration	Lower, focused on compliance and market entry
Flexibility	High, few regulatory constraints	Lower, must adhere to existing regulations

Source: Authors.

digital sandboxes for early testing and knowledge-sharing, then regulatory sandboxes for controlled rollouts with greater oversight. Overall, these global lessons underscore the need for adaptive governance, coordinated technical resources and sustainable financial models. By drawing on international best practices, African policymakers can design AI-specific sandboxes that balance innovation with ethical and responsible standards, ultimately catalysing AI's transformative potential in the region.

Comparative Analysis of Regulatory Sandboxes in South Africa, Mauritius and Rwanda

The regulatory sandbox is an essential tool for financial innovation, offering a controlled environment for fintech companies to test new products and services under regulatory supervision. In South Africa, the sandbox is overseen by the South African Reserve Bank and focuses on financial inclusion and system efficiency, with a flexible testing process guided by regulatory oversight. Mauritius, positioning itself as a regional fintech hub, emphasises collaboration and flexibility and attracts both domestic and international players. Rwanda's sandbox, which is integrated into the Kigali International Financial Centre, focuses on financial services access and provides a cohort-based testing process with minimal financial barriers for participants.

The comparative analysis of regulatory sandboxes in South Africa, Mauritius and Rwanda reveals distinct approaches tailored to their financial ecosystems. South Africa's sandbox prioritises financial inclusion and innovation within a highly regulated environment, offering a flexible but oversight-heavy approach. Mauritius positions itself as a fintech hub, focusing on attracting international players through a flexible and collaborative regulatory framework. Rwanda's sandbox is more access-orientated, with a strong emphasis on financial services expansion, minimal financial barriers and a cohort-based testing process.

The Impact of AI on Traditional Decision-Making in Africa

AI sandboxing offers African governments controlled environments in which to test and refine policies without affecting live systems, thereby encouraging bold experimentation with minimal risk. In Mauritius, for instance, the sandbox approach enabled fintech companies like FundKiss to develop peer-to-peer lending solutions for small to medium enterprises' liquidity needs. Access to real and synthetic datasets further empowers data-driven policymaking in sectors such as healthcare and education, allowing solutions to align more closely with community needs (Forbes Africa, 2023). Additionally, collaborative governance is strengthened through cross-sector partnerships. In Mauritius, for instance, the Economic Development Board, the Bank of Mauritius and a dedicated technical committee work together to streamline sandbox processes, enabling coordinated responses to complex socio-economic challenges.

Applications of AI sandboxing are already influencing sectors such as public health, agriculture, finance and urban planning in Africa. Predictive healthcare models, precision agriculture, fraud detection and smart-city initiatives are just some examples where sandboxing enables governments to refine policies and infrastructure for greater efficiency. By embracing AI sandboxes, African governments are fostering data-informed governance that supports sustainable development and a forward-thinking approach to the region's evolving needs.

A sandbox approach to AI could significantly transform traditional decision-making processes across Africa by introducing data-driven methodologies that enhance efficiency and accuracy. In sectors such as agriculture, AI applications like SunCulture's AgOptimized integrate local soil and weather data with historical trends to provide farmers with precise recommendations on irrigation and pest control, optimising yields and reducing costs. Similarly, in healthcare, AI-powered diagnostic tools are being deployed in countries like Rwanda and Ghana to improve medical imaging analysis, assisting in the early detection of diseases such as breast cancer and tuberculosis. These innovations are reshaping decision-making by providing stakeholders with actionable insights derived from complex data analysis that was previously unattainable through conventional methods (Forbes Africa, 2023).

The major applications of AI in Africa extend beyond agriculture and healthcare to include education, finance and governance. In education, AI-driven platforms are personalising learning experiences, helping improve educational outcomes. In the financial sector, AI is enhancing credit scoring and fraud detection, facilitating greater financial inclusion. Governments are also leveraging AI for policy development and service delivery, as evidenced by the AU's adoption of the Continental Artificial Intelligence Strategy aimed at harnessing AI for sustainable development. These applications are not only modernising traditional decision-making frameworks but also fostering innovation and economic growth across the continent. However, a critical issue in the current debate on emerging technologies is the risk of AI misuse or errors. While such mistakes might cause disruptions in areas like agriculture or education, they could have severe consequences in economic policymaking. Decisions and models generated by AI in this field could have profound effects on national economic stability, societal welfare and citizens' livelihoods (African Centre for Economic Transformation (ACET), 2024).

The Rise of AI Regulatory Sandboxes for Ethical and Responsible Economic Transformation

The Global Implementation of AI Regulatory Sandboxes

Several countries have implemented AI regulatory sandboxes to foster innovation while ensuring compliance with emerging regulations. For instance, the Sandbox on Privacy by Design and Default in AI Projects by the Colombian Data Protection Authority and the French CNIL projects on AI in public services provide frameworks for testing AI technologies in a controlled

environment. Similarly, the Singapore Generative AI (Gen AI) Evaluation Sandbox and the Spain AI Reg Sandbox aim to facilitate AI development that is aligned with regulatory requirements. The UK's AI regulatory sandbox is particularly notable as it focuses on delivering new products and services that benefit the public while addressing data protection concerns.

The primary objectives behind implementing these AI regulatory sandboxes revolve around promoting responsible and ethical AI development, ensuring compliance with emerging regulations and fostering collaboration between regulators and industry stakeholders.

Emerging Approaches to AI Regulatory Sandbox Implementation

Implementing AI sandboxes for economic transformation involves complexities that exceed those of conventional regulatory sandboxes. AI sandboxes are centred on digital data and advanced models, yet many public and private institutions, particularly in Africa, lack the necessary technical and regulatory expertise. This gap poses challenges in developing and managing an AI sandbox, as it requires sophisticated knowledge of both emerging technologies and the policy frameworks needed to govern them. While an embedded model – where existing sandboxes incorporate AI technologies, as seen with South Africa's Intergovernmental Fintech Working Group – can help, scaling to meet AI's rapid evolution demands substantial capacity-building and cross-border collaboration.

Compared to traditional sandboxes, which often emphasise financial innovations such as peer-to-peer lending or digital payments, AI sandboxes focus on testing and validating AI-driven technologies while addressing ethical considerations, data privacy and societal impacts. For instance, the United Kingdom's FCA AI sandbox and Singapore's AI sandbox call for multiple-regulatory bodies and technical specialists to handle the far-reaching implications of AI across diverse sectors like healthcare, finance and data governance. From an economic standpoint, AI sandboxes target long-term priorities, including sustainable growth and investment attraction via grants or tax incentives, whereas traditional sandboxes typically emphasise near-term improvements to payment systems and financial inclusion. While AI sandboxes more explicitly prioritise responsible, ethically aligned technology development, they face a unique set of hurdles – particularly the scarcity of advanced technical expertise and the challenge of regulating constantly evolving algorithms.

Ethical and Responsible AI Sandboxes for Economic Transformation in Africa

As a frontier technology, AI can drive economic transformation within Africa. The role of technology and innovation in driving the first, second and third industrial revolutions for national economies is a guide. However, the transformation accrues to nations that built their institutional and regulatory mechanisms, put in the technical systems to support the design and implementation

and built the economic framework to derive the dividends. Today, Africa must develop AI systems with broader sectoral and industrial transformational agendas, reflecting its economic situation and building culturally relevant and inclusive AI solutions. The regulatory sandboxes implemented within Africa and globally have no direct agenda with regards to broader and critical technological advancements. This is probably because sectors such as fintech are incremental innovations in the traditional financial sector. From what we see, AI has a broader and more significant impact on improving productivity, economic and social policy modelling while helping the private sector to drive growth at the company, national and regional levels.

The cross-border nature of AI technologies, which heavily depend on data, presents a significant regulatory challenge for African governments. Many AI technologies so far are developed outside Africa, and African governments often lack the power to regulate them. The regulatory sandboxes to be developed and implemented should not solely focus on indigenous AI but also engage with foreign AI technologies. However, this requires African governments to collaborate regionally and internationally to create frameworks that account for global AI systems while maintaining local ethical standards.

Furthermore, given the dominance of foreign AI technologies, which may not prioritise the ethical and inclusion considerations essential for Africa, the challenge is not just technical but also geopolitical. African governments must leverage these sandboxes to test and adapt foreign AI technologies in ways that align with local needs. This includes pushing for greater control over data and establishing cross-border agreements that empower African nations to influence global AI regulations. Without such efforts, it is difficult for African nations to regulate AI effectively within their borders.

Experts who were interviewed shared hesitations about the regulatory AI sandboxes in advancing AI development for economic transformation. Respondents highlighted both the potential challenges and benefits of AI sandboxes. While there is a risk that poorly managed sandboxes could slow down AI adoption, they also enable the identification of essential regulations and control explorative innovation. This could help determine Africa's readiness for AI adoption and identifies necessary barriers, investments and strategies. Respondents highlighted several obstacles that need to be addressed, including a haphazard continental approach to AI, misalignment with cultural needs and the need for heavy computational resources and networks. The misalignment with cultural needs means that many AI systems are developed with assumptions and data that do not reflect Africa's diverse cultural, linguistic and social contexts. For instance, AI models trained on non-African data sets may fail to recognise local languages, dialects or behavioural patterns, leading to inaccurate results or bias. Respondents also emphasised the importance of adopting communication and negotiation strategies for public–private partnerships on a continental scale.

Existing regulatory sandboxes are overly focused on regulatory compliance, with less focus on the tools and resources stakeholders need to experiment and test AI models. Technical issues, such as data usability and access, are primary challenges in utilising significant data sources. Even though governments control

the massive datasets needed for AI development, the private sector in Africa could potentially contain larger datasets in areas such as telecommunication and banking. Further, the push towards an African single digital market means cross-border AI sandboxes will become complex by design and should also look beyond regulatory compliance.

Economic and development policymaking could also leverage AI sandboxes to build state capacity in policy development. AI and other emerging technologies are likely to lead to the most significant economic and social transformations in decades, and African leaders must be ready to partner with the private sector. They need to start now and prioritise experimentation.

Box Note: Sectoral application and contextualisation: The case of AI in Economic Policymaking.

The African Center for Economic Transformation (ACET) is conducting a three-year project to explore the potential of AI in economic policymaking, focusing on fiscal and monetary policies. The project seeks to develop AI tools to inform and enhance economic policymaking in Africa, create an African-centric knowledge base on AI applications in economic policy, enable practical experimentation and simulation with AI tools in policy contexts and establish a community of practice comprising experts and policymakers dedicated to advancing AI use in economics.

The project supports AI development in economic policymaking by identifying specific-use cases and economic policy challenges in pilot countries, facilitating peer-to-peer learning and sandbox exercises for innovative AI models and assisting governments in ensuring responsible and ethical AI applications. It explores AI solutions for key policy areas such as tax revenue forecasting, estimating financial impacts of tax policy measures and economic activity forecasting using novel data sources like satellite imagery.

The project is being piloted in three African countries, each with a unique focus. In Togo, it is collaborating with the Ministry of Economy and Finance to improve tax revenue forecasting and estimate the financial impacts of tax policy measures using AI. In Nigeria, it works with the Federal Ministry of Communications, Innovation & Digital Economy to identify AI applications for policy drivers unique to the country's socio-economic dynamics. In South Africa, it partners with the South African Reserve Bank to use satellite imagery and AI to inform economic activity forecasts.

This project is crucial for AI development in African policymaking for several reasons. As a pioneering effort, it represents one of the first systematic attempts to develop AI tools for specific economic policy needs in Africa. Its African-centric approach ensures that AI solutions are tailored to the continent's needs and contexts. The project builds local AI development and application capacity by fostering broader engagement among academia,

regional institutions and policy institutes. By generating insights into the current and future possibilities of AI in economic policies, it prepares African nations for the evolving landscape of AI-assisted policymaking.

Furthermore, the project emphasises responsible and ethical AI applications, which are crucial for building trust and ensuring sustainable AI adoption in policymaking. Through its community of practice and peer-to-peer learning approach, the project facilitates knowledge transfer across the continent, accelerating AI development in policymaking. This comprehensive approach positions the initiative as a significant catalyst for advancing AI-driven economic policymaking across Africa.

Policy Recommendations for Ethical AI Transformation: An Anticipatory and Risk-Based Approach

AI governance in Africa must evolve and anticipate technological and global policy changes rather than be reactionary about them. For African countries to harness the benefits of the AI revolution for all citizens while mitigating the risks, they must build effective AI governance frameworks. This involves establishing the necessary legislation and enforcement mechanisms and creating a broader enabling environment that includes technical design standards, building institutional capacity and fostering mechanisms for inclusive public engagement. These frameworks must anticipate and enable rapid adaptation to the fast-paced changes in AI technology, driving national transformation and inclusive growth across the continent.

Future-Proof Ethical AI Governance and Regulatory Frameworks

The governance approach of AI regulatory sandboxes for national transformation hinges on the process and the directionality. The process of AI innovation, which is the interaction between various stakeholders, if well managed, will build the proper environment framework for all stakeholders to shape its development to reflect social norms and national goals. Within Africa, where the institutional and governance process for AI is still developing, various institutional and government strategies are required, as outlined below.

Anticipatory Governance and Responsive Institutional Setup

Anticipatory governance is essential for Africa's AI regulatory sandboxes, requiring robust institutional mechanisms that integrate foresight, interdisciplinary knowledge and public engagement (Barben et al., 2008; Guston, 2014). This involves building the capacity of policymakers and regulators to navigate evolving AI trends as well as involving a wide range of stakeholders – including

civil society and the private sector – from the outset. By exploring future scenarios collaboratively, governments can set realistic regulatory pathways that accommodate rapid technological change while preserving public interests.

Regulatory oversight for AI sandboxes can draw on existing data protection commissions, such as those in Colombia, Spain or Singapore, to ensure alignment with broader data governance policies. Alternatively, countries can establish specialised AI councils, similar to the United Kingdom's AI Council, where private-sector and civil society actors share decision-making responsibilities. A dedicated central AI regulatory authority may also be beneficial. It would unify oversight, strengthen frameworks and ensure adherence to national AI policies, working closely with multiple ministries to align sector-specific rules and standards.

In addition to institutional support, multidisciplinary advisory committees can guide AI sandbox ethics, legal considerations and policy impact assessments. Composed of experts in technology, law, ethics and public policy, these committees would regularly monitor sandbox experiments to address emerging issues promptly. Equally important are capacity-building programmes that provide ongoing training on AI technologies, regulatory practice and risk management for policymakers, developers and the broader public. Finally, inclusive public engagement remains a cornerstone of trust and transparency and should be facilitated through consultations, forums and collaboration with civil society groups to integrate citizen perspectives into AI policy discussions.

Adopting an Inside-Out Multinational–Stakeholders Collaboration

Governments alone cannot fully resource or evaluate AI regulatory sandboxes, making an inclusive and outward-facing approach crucial. Partnerships with private sector and civil society actors help shape co-creation, risk-based regulation and AI solutions aligned with national economic agendas.

> Therefore, governments must look from the outside for a more inclusive AI regulatory sandbox implementation.

AI sandboxes should also engage minority and informal-sector groups to ensure responsible innovation that considers vulnerable communities. In Africa, regional collaboration with entities like AUDA-NEPA, Smart Africa, the Economic Community of West African States (ECOWAS) and the East African Community (EAC) can facilitate cross-border policy harmonisation, reduce compliance costs for expanding companies and promote a unified AI market. Clear guidelines for multistakeholder participation will accelerate AI adoption, address ethical concerns and strengthen overall governance of sandbox initiatives.

Align Objectives and Motivations to Development Goals

Aligning AI regulatory sandbox processes with national development objectives is crucial to maximising AI's transformative potential in Africa. While governments often focus on ensuring regulatory compliance and mitigating risks, this narrow approach can overlook opportunities for broader economic and social advancement. By embedding sandbox initiatives within existing AI strategies and national development frameworks, policymakers can more effectively prioritise resource allocation and foster widespread adoption of AI solutions across various sectors. Governments should also collaborate with development partners to identify key priority areas – such as healthcare, agriculture and education – where AI can deliver measurable impact. Clear targets, set in tandem with broader AI strategies, can help guide sandbox experimentation and ensure that ethical considerations and societal needs remain central to innovation. Such alignment prompts a holistic view of AI governance, supporting not just compliance and competition but also the long-term growth, inclusivity and resilience of national economies.

Regulatory Clarity: Differentiating Liability and Responsibility in AI Regulatory Sandboxes

Differentiating liability from responsibility is vital in AI regulatory sandboxes. Liability covers the legal obligations of developers and operators – such as rectifying harmful outputs or safeguarding user data – while responsibility encompasses broader voluntary measures to ensure ethical and sustainable AI deployment. Clear legislation must define when and how these entities are obligated to remediate potential harms, adopt robust data security systems and act in users' best interests.

However, an overreliance on strict mandates can stifle innovation. In some cases, governments may encourage voluntary ethical guidelines and best practices, fostering transparency and accountability beyond legal requirements. Regional and international collaboration among policymakers is essential to prevent fragmented regulations. By working together, governments can strike a balance between incentivising innovation in AI sandboxes and safeguarding public interests.

AI Sandboxes and the Innovation Ecosystem: Creation, Design and Implementation

The current regulatory sandbox architecture often lacks scalability, as entry criteria and resource constraints can prevent promising AI innovators from participating. Limited technical expertise among government bodies further slows the process by restricting evaluations of novel ideas. In Africa, a more open, stepwise approach could better encourage ethical and responsible AI innovation. Drawing inspiration from collaborative tech infrastructures (e.g.,

GitHub), regulators could introduce flexible platforms where innovators first experiment with minimal oversight and then transition to licencing once their solutions mature. Adopting these new implementation models would foster a broader innovation ecosystem that supports the ethical development of AI across the continent.

Adopting 'Platformisation' in AI Regulatory Sandboxes

Governments in Africa should embrace a 'platformisation' approach to AI regulatory sandboxes by co-creating a collaborative digital platform with the private sector and managing it through practitioner and user guides. This platform would act as the central hub, hosting data repositories, AI subcommittees and open-access tools that allow innovators to develop and test AI solutions in a secure, user-friendly environment before licencing. A robust repository of public and private datasets – compiled with strict data protection measures – would ensure inclusive and representative AI testing. By adopting phased, anticipatory regulation, policymakers can integrate ethical and responsible principles into the sandbox process while incentivising private-sector stakeholders to contribute anonymised datasets for broader experimentation. This can be implemented in two phases:

Phase One: AI Sandbox with Minimal Regulatory Requirements

In the first phase, governments concentrate on building a collaborative open innovation platform that prioritises experimentation over regulation. This AI digital sandbox focuses on driving economic transformation and enriching policymaking, offering secure access to diverse datasets – such as synthetic, anonymised or pseudonymised information spanning entities, transactions and financial records.

By providing a shared development environment (see Fig. 9.2), innovators can prototype AI solutions while maintaining data privacy and security, encouraging broad stakeholder engagement. This approach also includes a showcase space where solutions can be tested in real time, allowing policymakers and regulators to observe their impact directly. Unlike traditional sandbox cohorts, which limit participant numbers, a platform-based method fosters larger-scale experimentation. The result is a more inclusive process that generates valuable insights for regulators and provides a foundation for subsequent higher-level oversight.

Phase Two: Fully Regulated AI Sandbox for High-Risk Innovations

After phase one, public and private stakeholders have clearer insights into emerging AI verticals and any potential risks. In phase two, those innovations requiring deeper regulatory scrutiny proceed to a fully fledged regulatory sandbox. By now, each project has received broad feedback from policymakers, civil society and academia, smoothing its transition into stricter regulatory oversight.

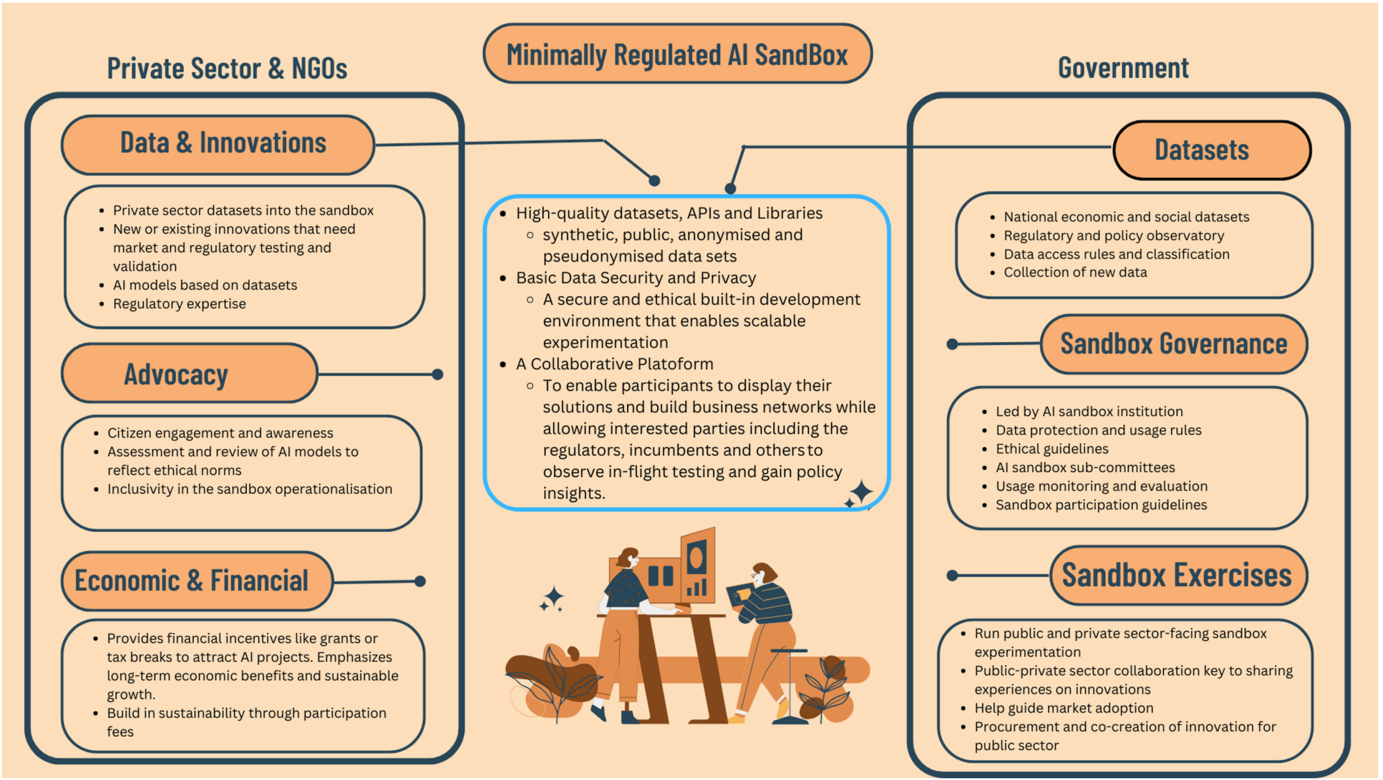

Fig. 9.2. Conceptual Representation of Implementing a Minimally Regulated AI Regulatory Sandbox Platform. *Source:* Authors.

This two-phase strategy reduces overall compliance costs because many low-risk projects may not require additional regulation after phase one. It also ensures that high-risk AI applications receive the rigorous assessment they demand. Throughout both phases, policymakers, private sector entities, civil society and end users collaborate closely, helping shape AI solutions that align with local cultural values, address development goals and attract sustainable investments.

Technical Toolkits and Guidelines for AI Regulatory Sandboxes: State Capacity

Mainstreaming AI regulatory sandboxing into AI development for social, development and economic policy for national development has cost implications and considerations for the resources needed. The ultimate goal of AI regulatory sandboxes is to drive growth for increased government revenues, employment, poverty reduction, food security and better healthcare, among others. Achieving this requires building the requisite state capacity in terms of know-how – in data officers and cybersecurity personnel, among others – to support companies that readily participate in AI regulatory sandboxes.

Box Note: Regulatory Sandboxes in South Africa, Kenya, Mauritius and Rwanda: Development of State Capacity and Institutional Setup.

Countries like South Africa, Kenya, Mauritius and Rwanda have demonstrated notable progress in setting up regulatory sandboxes aimed at fostering innovation, particularly in fintech and other emerging sectors. The success of these sandboxes relied heavily on building state capacity and creating an enabling institutional framework. Below is an overview of how each country developed the necessary state capacity and the institutional setups they adopted for implementing their sandboxes.

Each country built its state capacity by focusing on collaboration, both domestically and internationally, and by enhancing the skills of its regulators through training, partnerships and reforms. Their institutional setups varied slightly but consistently involved multi-stakeholder approaches, with financial authorities, central banks and other regulatory bodies playing a central role. The following key strategies were used:

- *Interagency collaboration:* Key financial regulators and central banks collaborated to ensure coordinated oversight.
- *Training and knowledge sharing:* Regulators were trained to handle emerging technologies like blockchain, digital finance and AI.
- *International partnerships:* Global collaborations helped regulators adopt best practices in managing new technologies.
- *Public–private partnerships:* Engaging the private sector ensured that regulatory frameworks were both practical and forward-looking.

Augment Government Budgetary Funding with Private Sector Funding for Sandboxes

Ensuring the long-term sustainability of AI regulatory sandboxes hinges on robust funding mechanisms that combine public and private resources. Governments should allocate specific budget lines within existing digital transformation or innovation programmes to finance sandbox operations and tie these allocations to broader economic policy objectives such as revenue generation, budgeting efficiency and social intervention targeting. By embedding AI sandbox activities in national planning processes, policymakers can secure ongoing financial support while showcasing tangible benefits for public institutions.

In addition to government funding, attracting private investment is crucial for expanding the infrastructure and reach of AI sandboxes. Leaders at both national and regional levels can encourage private sector contributions by highlighting the ethical and financial incentives of responsible AI adoption. Nominal fees for sandbox participants – covering access to data, regulatory guidance and platform resources – can also generate revenue. Such a balanced approach fosters a financially sustainable environment where sandboxes not only drive innovation but also remain viable, helping governments and private stakeholders continually refine and adopt ethical AI solutions.

Outcome-Based Rewards for Economic Models for Continuous Monitoring and Evaluation

Performance-based funding models ensure efficient and effective resource use by structuring funding disbursements based on the achievement of specific milestones and performance metrics. These models promote accountability and continuous improvement. Innovators can contribute to developing open economic and social impact models for policymakers and other development partners. Implementing outcome-based financing models, where funding is tied to predefined outcomes such as job creation, successful AI deployments and measurable social impacts, aligns funding with the sandbox's goals. This approach directs resources towards initiatives that deliver tangible benefits and support economic transformation.

Continuous monitoring and evaluation are crucial for ensuring the effectiveness and sustainability of AI regulatory sandboxes. Regular financial audits and performance evaluations maintain transparency and accountability in fund usage. Establishing mechanisms for continuous feedback from participants and stakeholders helps refine and improve funding models and operational strategies. Scalable financial models, adjustable based on the sandbox's growth, participant needs and technological advancements, ensure the sandbox remains responsive and effective. These practices ensure the sandbox evolves with stakeholder needs and continues to deliver long-term value. The World Bank Report on Global Experiences from Regulatory Sandboxes (2020) outlines a comprehensive

framework for evaluating sandbox impacts at various levels. While initially applied to fintech sandboxes, these principles apply equally to AI regulatory sandboxes.

Linking to Ethical and Responsible Economic Policymaking

Integrating these financial and economic models into broader economic policymaking can ensure that AI regulatory sandboxes contribute to ethical and responsible development in Africa. Governments can ensure that AI technologies are developed and deployed to benefit society by aligning funding and operational strategies with national priorities and development goals. Emphasising transparency, accountability and inclusivity in the governance of AI sandboxes ensures that they support equitable economic growth and social development. By fostering innovation and economic transformation through AI, governments can create a foundation for sustainable and inclusive development in Africa.

Strengthening Regional and International Collaboration for AI Regulatory Sandboxes within the Framework of African Regional and International Policies

Leveraging Existing Policies to Promote Regional Collaboration

To drive national and regional transformation through AI sandboxes, African nations must enhance collaboration within existing regional policy frameworks. AI regulatory sandboxes can be critical in developing standardised regulations and governance practices that span national borders. This collaborative approach will help harmonise AI policies, creating a cohesive regulatory environment that is conducive to innovation and economic growth.

Regional organisations such as the AU and regional economic communities (RECs) such as the EAC, ECOWAS and the Southern African Development Community (SADC) are pivotal. Various policy frameworks, such as the recently adopted Africa Continental Artificial Intelligence Strategy, the African Digital Compact and the AU Data Policy Framework, can be the base for making AI regulatory sandboxes interoperable and regional. These organisations can ensure that member states adopt harmonised standards and practices by leading initiatives to develop regional AI policies and frameworks. The AU's Digital Transformation Strategy for Africa (2020–2030) is an excellent foundation for regional AI governance, promoting digital integration and technological advancement across the continent.

Ensuring Legislative Compatibility

African nations must ensure legislative compatibility across borders to avoid siloed regulatory regimes, aligning with regional and international policies. This is particularly important for trade, health and labour mobility sectors, where

harmonised regulations can facilitate seamless transactions and information flows. Policymakers should strive for regulatory coherence in e-transaction laws, promoting regional and global compatibility.

Developing regional e-commerce frameworks that align with international standards can minimise barriers to cross-border trade. Adopting guidelines from the United Nations Commission on International Trade Law (UNCITRAL) can help African nations establish compatible e-transaction regulations. Harmonised regulations enhance consumer trust and protect digital transactions, fostering a thriving digital economy across Africa.

Conclusion

The tech revolution, driven by advancements in AI, has the potential to transform lives, economies and societies across Africa. However, to fully unlock this potential, policymakers in Africa must navigate complex challenges, such as improving the safety and security of digital systems, maintaining sovereignty and harnessing the benefits of AI-driven digitisation. Achieving these goals requires decisive political leadership and a strategic approach to AI governance. This is more important for economic policymaking, which needs to anticipate and swiftly respond to changing macroeconomic conditions.

The key to enabling the fast and safe adoption of AI technologies lies in an anticipatory governance model. This model includes implementing future-proof legislation and enforcement mechanisms, fostering effective partnerships between the public and private sectors and enhancing international cooperation. By proactively addressing these areas through AI regulatory sandboxes, African nations can create environments that are conducive to innovation and growth. These sandboxes will play a crucial role in national transformation, ensuring that AI technologies are developed and deployed ethically and responsibly, ultimately supporting sustainable development and economic progress across the continent.

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Chapter 10

Countering Violent Extremism in Africa: The Challenges of Navigating Uncertainty

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Introduction

Africa's comprehensive peace and security architecture, coupled with intricate development and governance frameworks, is meant to secure the African Union's (AU's) ambitious 'Agenda 2063' vision (AU, 2022). Yet attempts at peacebuilding suffer perennial failure. This chapter examines the causes of this failure. A related question is what can be done to create positive peace for the continent. To demonstrate the complexities of achieving and sustaining peace and security, the chapter uses two recent peace missions as cases: the Southern African Development Community (SADC) Mission in Mozambique (SAMIM) and the SADC Mission in the Democratic Republic of the Congo (SAMIDRC). The chapter suggests that, with the aid of strategic foresight and anticipatory governance, peace and security decision-makers in Central and Southern Africa can improve on their peacebuilding efforts.

A contextual statement is necessary to counter the pessimistic narrative of 'Africa, the hopeless continent' (The Economist, 2000). Many parts of Africa enjoy stability and development. Over the past decade, at least 10 countries embarked on a positive developmental and democratisation trajectory: Indian Ocean island neighbours Mauritius and Seychelles, North Africans Tunisia and Morocco, West African neighbours Cabo Verde and Senegal, plus Ghana and the Southern neighbours Botswana, South Africa and Namibia (Mo Ibrahim Foundation, 2023). Much work remains to be done. In terms of human development, Africa is the worst performing region (Human Development Index (HDI), 2022). Apart from Afghanistan, Pakistan and Yemen, the 'low human development' category consists exclusively of African countries.

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Governance failures and the absence of peace and security are prominent features of the African landscape (Mo Ibrahim Foundation, 2023). The Sahel is described as the epicentre of violent extremism (Institute for Economics and Peace, 2024). In West Africa, democratic reversals have resulted in a series of military take-overs (Baltoi, 2023). In Central Africa, civil war rages unchecked, with humanitarian catastrophes engulfing the citizens of the two Congos and the two Sudans (CrisisWatch, 2024).

Supported by donors and experts from African think tanks, the AU established a range of instruments to advance peace and security, including the African Peace and Security Architecture (APSA), the African Governance Architecture (AGA) and Regional Economic Communities (RECs) (Engel & Porto, 2014). The APSA can be understood to be a set of norms and practices, guided by informal and formal rules, acting as an expression of politics and, broadly speaking, a set of institutions (Doring et al., 2021). In 2017, to give effect to the APSA imperative, African leaders enthusiastically embraced a continental 'guns must fall silent by 2020' campaign. However, by 2020, the guns had not fallen silent, and the AU shifted the deadline to 2030 (Louw-Vaudran, 2022).

As violence deepens and spreads across Africa's various conflict zones, questions arise about how to understand the continent's failures with conflict management and whether opportunities exist to recover lost ground.

Conceptual Framework and Methodology

To examine the challenges and opportunities with regards to obtaining peace and security, the chapter uses the concepts of anticipatory governance and African foreign policy decision-making behaviour. It concludes with a way forward by identifying several innovation systems concepts that might enable African peace and security decision-makers to re-envision the task of 'silencing the guns'.

Anticipatory Governance

The notion of anticipatory governance is used in various influential strands of social science and sustainability science scholarship. Anticipatory governance refers to a system of institutions, rules and norms that provides a way to use foresight, networks and feedback to reduce risk and increase capacity to respond to events at earlier rather than later stages of development (Fuerth, 2011).

Anticipatory governance is explicitly addressed in national security policy analyses. It is envisioned here as governance that can manage crises ex ante ('before the event') to prevent their destabilising effects. This perspective focuses on the adaptive capacity of national planning systems. The future is conceived of as containing reducible risks that can be acted upon and mitigated through improved planning processes in the present. This approach is described as 'plausible futures, enhanced preparedness, and navigating uncertainty' (Muiderman et al., 2020, p. 20).

This chapter adopts the view that anticipatory governance is a nonpredictive approach to enhance present-day preparedness, including through building capacities in foresight and multi-stakeholder engagement.

However, anticipatory governance has inherent shortcomings. Its application in the African context is limited. Peace and security decision-makers remain wedded to old-school paradigms, hard security and military solutions, and are hesitant to engage non-state actors and strategic thinkers in the quest for peace and security (Macaringue & Magano, 2008). The thinking behind deploying peace missions in Mozambique and the Democratic Republic of Congo (DRC), coupled with poor planning and resource constraints, creates sub-optimal outcomes and even outright failure. It is unclear what SADC's leaders prefer the outcome (preferred future) to be, and research is needed to explore the logic and impact of these interventions and to identify alternatives.

African Foreign Policy Decision-Making Behaviour

Historically, postcolonial African states have faced severe constraints that have limited the freedom of African decision-makers (Khadiagala & Lyons, 2001, p. 3). These included, firstly, the need to consolidate power and meet socio-economic demands at home, and secondly, being confronted with the considerable influence of external actors, particularly former colonial powers, over most aspects of African life. This influence is partly why anti-colonialism and opposition to external intrusion continue to form significant aspects of Africa's foreign policy behaviour.

Limited resources confine African foreign policy largely to regional and continental contexts, and when elites articulate national interests beyond the continent, they do so to win prestige, establish a presence in the proliferating international institutions and forge strategic alliances with other global underdogs to extract resources from dominant power blocks. African states also construct their own continental and regional institutions. Building alliances is a well-tested strategy for weak states in search of security; hence, African states band together into blocs that will enhance their leverage in world affairs.

Critically, responses to constraints continue to be shaped by personality. African foreign policy decision-making has always been the province of leading personalities (see Clapham, 1996; for an incisive overview). As Khadiagala and Lyons comment: '...the charismatic leader became the source, site, and embodiment of foreign policy' (2001, p. 5). Weak and manipulable bureaucratic structures compound the lack of effective representative institutions (Olowu & Sako, 2002), with the consequence that foreign policy emerges as a tool for leaders to both disarm their domestic opponents and compensate for unpopular domestic policies. African presidents take inter-African summitry quite seriously, as this quotation from Zartman (2001, p. 5) illustrates:

> Specific, even minute, decisions may be made by the president whose prestige in Africa and experience in dealing with other

> leaders gives him a special competence in inter-African relations. His anger and his ardor, his whims and his convictions, may become the mood of his country's policy, and his friendships and acquaintances mark its limits...

The online quarrel in early 2025 between presidents Cyril Ramaphosa of South Africa and Paul Kagame of Rwanda over the role of SADC in resolving the conflict in eastern DRC is an illustration of this point (Chanson, 2025). In sum, contemporary African elites are preoccupied with political stability, legitimacy and economic security, issues whose importance seems to increase rather than diminish.

Methodology

Research in conflict zones is challenging. Permission to gather sensitive information is often withheld, and personal safety is of prime importance. These conditions pertain in the conflict zones of Northern Mozambique and eastern DRC. Innovative and indirect routes to data gathering therefore become par for the course. In producing this chapter, data were gathered by way of a mixed-method approach, consisting of literature reviews, official declarations and communiqués and participant observation. A small number of 'off-the-record' conversations were conducted with senior decision-makers, and a local research network was engaged. In the course of 2024, the author attended meetings of civil society members in Pemba, Northern Mozambique, and Entebbe, Uganda (both close to conflict zones). In these meetings, participants offered 'bottom-up' critiques of formal military interventions as responses to crises. For obvious reasons, meeting notes are kept confidential. As SAMIM withdrew from Mozambique, SADC undertook a 'lessons learnt' assessment involving mission leaders, SADC personnel, diplomats and academics. The outcomes were written up by a team of local researchers, including the author, and made available by SADC for internal consumption.

Hopefully, this exploratory analysis will allow for deepening the tracing (reconstruction) of Southern African decision-making processes relating to peace and security (for earlier attempts, see Aeby, 2019; Van Nieuwkerk, 2014; Vrey, 2007). It asks whether SADC and African leaders can learn lessons and adjust behaviour.

The chapter therefore offers a way forward. It suggests that several innovation systems concepts, applied to SADC, will assist peace and security decision-makers in undertaking a re-envisioning process to silence the guns.

SADC Decision-Making Structures

We need to briefly examine the policymaking machinery of SADC. Previous reviews found SADC to be wanting in several respects, particularly with crisis management (Aeby, 2019; Cawthra & van Nieuwkerk, 2004).

Regional cooperation in the 1980s, even if informal and limited, succeeded in realising several regional development projects, mainly in the infrastructure and food security sectors (Oosthuizen, 2006; McGowan et al., 2006). The Southern African Development Coordination Conference was transformed into SADC in 1992, reflecting the changing regional and external environment.

In 2001, the SADC Summit signed a protocol on Politics, Defence and Security Co-operation, which provided for an Organ on Politics, Defence and Security Co-operation under the SADC Summit. The Organ has its own set of regional structures and mechanisms for policy formulation and implementation.

The Summit is the supreme policymaking institution of SADC. It is led by a Troika system consisting of the chairperson, incoming chairperson and outgoing chairperson. Decisions are taken by consensus and are intended to be binding.

Finally, the Organ is supported by the Directorate for Politics, Defence and Security Affairs, based at the SADC Secretariat in Gaborone, Botswana. It functions under the overall supervision of the SADC executive secretary and is headed by a director for Politics, Defence and Security. It focuses primarily on strategic planning and policy analysis and development; the monitoring and evaluation of the implementation of Organ decisions and the provision of administrative backup to the Organ. It also supervises the activities of its Regional Peacekeeping Training Centre, based in Harare, Zimbabwe, and its Regional Counter-Terrorism Centre, based in Dar es Salaam, Tanzania.

Informed by the Strategic Indicative Plan of the Organ (SIPO I and II) and now by the Regional Indicative Strategic Development Plan (RISDP 2020–2030) and the APSA, SADC has adopted several policies and set up institutional pillars of the regional peace, security and governance architecture. So far, SADC has operationalised the Common Defence Pact, the SADC Standby Force, the SADC Mediation, Conflict Prevention and Preventative Diplomacy Structure, the Regional Early Warning System, the SADC Election Observation Mission and SADC Electoral Advisory Council, the SADC Anti-Corruption Strategy, the SEAC Strategy for the Prevention of Electoral Related Conflict, the Regional Strategy on Women in Peace and Security and the Regional Counterterrorism Centre.

This chapter's analysis of SADC political cooperation suggests a developmental path from informal, ad hoc governance to formal, rules-based governance. This is in line with Oosthuizen (2006, p. 325), who notes that SADC provides an 'evolving, institutionalised, rules-based forum within which the members meet regularly to discuss and argue about political and security issues'. It appears that this level of institutional evolution is necessary before common foreign policy approaches or positions can be formulated and implemented.

It seems the SADC leadership is rhetorically committed to full integration in both the socio-economic and security arenas (and to the eventual merging of the two into one, human security, agenda). The practice reveals the maintenance of a stable (but not always efficient) institution, used by members to behave in a disaggregated manner, driven by the overriding demands of national interest and sovereignty (for similar findings, see Brosig, 2013).

Case Studies

The SADC Mission in Mozambique

SADC deployed its standby force to Cabo Delgado in Northern Mozambique in July 2021, to deal with what was perceived to be a threat of violent extremism and terrorism (SADC, 2021). The violence, which took root in October 2017 in Cabo Delgado province, has resulted in the death of more than 6,500 people and displaced over a million people (Chingotuane & Sidumo, 2023). SAMIM was initially intended for a six-month duration, but it has since been extended three times. When the second extension of SAMIM was approved by SADC in 2022, its mandate shifted from an African Standby Force Scenario 6 military-only operation (a 'peace-enforcement mission to neutralise the terrorist threat and restore state-authority in the affected districts in Cabo Delgado') towards a more comprehensive approach, emphasising peace building and governance. The mission was withdrawn by SADC in July 2024. In early April 2024, it was announced that the Rwandan Defence Force (RDF) presence in Mozambique would be expanded to replace SAMIM, as the Mozambican security force seemed unable to take over the responsibility for security provision in Cabo Delgado. The RDF deployment is being conducted in partnership with the European Union (EU), which is funding the deployment expenses. The decision by SADC to withdraw SAMIM and the Mozambican government to strengthen the Rwandan presence in the north of the country has raised questions, particularly in light of a resurgence of attacks by violent extremists in the Cabo Delgado province since September 2023 (Mandrup, 2024).

The SADC Mission in the DRC

Following decades of colonial and post-independence misrule, the DRC continues to suffer large-scale violent conflict involving rebels, neighbours and foreign interests. Despite peace-making efforts, including by South Africa, the violence continues. The country's abundance of natural resources (including the rare earth metals that are in great demand by the world's largest economies) makes it attractive to exploitation and criminal behaviour, enabled by a weak state and a ruling class with questionable democratic credentials. More than 120 militias and armed groups actively operate in the Ituri, North Kivu, South Kivu and Tanganyika provinces of the eastern DRC, many of whom are accused of perpetrating widespread violations and abuses. The M23 group in particular is accused of being a proxy for neighbouring Rwanda. To deal with this, in 2012, a United Nations (UN)/SADC Force Intervention Brigade (FIB) was deployed with South African, Tanzanian and Malawian troop contributors. However, the Congolese lost confidence in the UN presence in the DRC and the DRC government asked it to leave by the end of 2024. An East African Community peacekeeping force, deployed in 2022 to fight the rebels in the eastern DRC, similarly made little progress and withdrew in 2023. Soon after, at the request of the DRC, the SADC leadership agreed to deploy a peace enforcement mission to

the DRC (SAMIDRC) on 15 December 2023. From the word go, the deployment suffered from weak technical support, and casualties mounted as it faced stiff armed opposition (it is unclear whether SADC realised that the DRC employed several other forces to fight the M23, including a large contingent of European mercenaries). Following the death in January 2025 of 14 SAMIDRC soldiers during a violent confrontation with M23 rebels around Goma, where the mission was stationed, SADC decided on 13 March 2025 to terminate the mission and withdraw its personnel and equipment (Wolters, 2025). At the time of writing, prospects for peace remained slim.

Discussion

SAMIM

Despite some of the gains registered by SAMIM, its efforts towards peacebuilding and good governance have faced numerous challenges, including funding shortages. Progress made through military offensives is put to the test as violent extremists adapt their strategies. They now operate in smaller groups, directing attacks on civilians and military targets and integrating into local communities, which makes them more difficult to detect and counteract.

How did SADC Arrive at the Decision to Deploy Its Military Standby Force to Mozambique?

The key motivation to deploy SAMIM lies with the concern by the region's security decision-makers for violent extremism to threaten their own countries. Violent extremism is believed or feared to have spread throughout the region, with political, social and economic consequences. For this reason, the region's political leaders engaged the Mozambican government and offered assistance. For the Mozambican ruling class, violent extremism was throttling the political economy of exploitation in the north – from the lucrative gas exploration project to hardwood logging, drug smuggling and ruby mining – with implications for its national economy and to be more precise, the benefits that flow to it. It was hesitant to approach SADC or its immediate neighbour, South Africa, which has a stake in the gas fields of Mozambique, choosing instead to contract private security companies to undertake the work of neutralising the violent extremists. Failure by mercenaries to secure the region forced the Mozambican government to accept the SADC offer of assistance. However, separate from the SADC engagement, it negotiated a deployment of Rwandese soldiers to assist. Rwanda was ready for the task: in defence of the national interest, it plays an increasingly interventionist role in Central and Southern Africa. It hopes to attract attention as a security provider and, in the process, benefits from strategic (and commercially viable) partnerships (Behalal, 2025; Donelli, 2024). With SADC's departure in 2024, Rwanda stayed behind as the premier security provider, ensuring the continuation of the political economy of exploitation.

The SADC decision-making machinery is proving to be slow and bureaucratic in creating and deploying SAMIM. In a comprehensive analysis of SAMIM, Walwa and Malebang (2023: 175–6) traced the decision-making procedures and processes, which gives insight into the complex nature of the process:

> Prior to deployment, a series of technical and statutory meetings were held, culminating in the 23 June 2021 SADC Extraordinary Summit of Heads of State and Government which authorized the deployment of the SADC-SF, constituted as SAMIM, to Mozambique on 15 July 2021. SAMIM has been deployed in terms of Scenario 6 of the African Standby Force which allows deployment in grave situations that require urgent intervention.

Several factors account for SAMIM's limited success. The SADC leadership remains reluctant to acknowledge or counter the role of Rwanda as it intensifies its resource exploitation practices in the subcontinent (Behalal, 2025; UN, 2024). SAMIM's impact was blunted by the reluctance by most SADC member states to contribute resources to undertake a complex peace enforcement operation. SADC itself was on the back foot, not having a logistics warehouse ready for use or having raised enough funds for the mission to deploy fully and for a longer period. In addition, SADC decision-makers harboured a belief that a short-term military response to a complex and violent conflict was adequate to restore peace and security. SAMIM's mandate eventually included supporting humanitarian aid provision and re-establishing law and order. However, it had limited impact in these areas: the pilot peacebuilding programme SAMIM introduced in 2022 ended with its withdrawal (Opperman & Pigou, 2024). Mozambique hasn't called for its continuation, reflecting the extent to which it seems locked into a securitised response that, at best, contains the conflict in current circumstances (ISS, 2024).

Mandrup (2024) reports that in July 2023, an internal SADC assessment concluded that SAMIM had successfully reduced the insurgents' capacity and assisted the Mozambican military. However, as he points out, SAMIM has not achieved its objective of training the Mozambican security forces since the host nation could not identify its training needs. It receives training from other actors, including the EU, the United States and a private security company. Mandrup also notes that in terms of creating a sustainable foundation for the livelihoods of the returning internally displaced persons (IDPs), the mission wanted to achieve more, but resources were limited. International donors and UN agencies were the main humanitarian and development assistance actors.

In mid-2024, a civil society meeting in Pemba, Mozambique, reflected on SAMIM's achievements and challenges. Participants argued that SAMIM's activities allowed for violence to be reduced and the insurgents contained, but its withdrawal reversed these gains. The attempt by SAMIM and the Mozambican government to address the human security agenda, and in particular Cabo Delgado's economic development prospects, was seen as too little, too late. They noted the adverse impact of the political economy of peacekeeping or peace

enforcement on the province's poor households. Participants observed that the provision of humanitarian aid largely depended on international donors and UN agencies, and they identified the government's poorly trained, equipped and led security sector personnel (defence, police, justice) as a major source of human insecurity.

In late 2024, SADC hosted a 'lessons learnt' conference in Maputo to assess SAMIM. It invited a range of regional stakeholders to participate. A key lesson emanating from the assessment was the need for the region to adopt a holistic and integrated understanding and implementation of the concept of peace building, a theme the chapter will address in more detail in the conclusion.

The SADC Mission in the DRC

The security situation in eastern DRC has deteriorated significantly in recent months (Martin, 2025; United Nations Security Council, 2024). Fighting between the Congolese Armed Forces (FARDC) and the so-called M23 has intensified in North Kivu, the epicentre of the conflict. Armed militias, including the FDLR and 'wazalendo' (patriots), have joined forces with the FARDC in the conflict. The UN Organization Stabilization Mission in the DRC (MONUSCO) has provided support to the government's military operations in North Kivu as part of Operation Springbok, which was launched in November 2023 to halt the M23's advance towards Goma, the provincial capital.

Simultaneously, MONUSCO is implementing its own disengagement plan, as agreed with the Congolese government.

In recent years, several regional forces have been deployed in eastern DRC alongside MONUSCO, which has operated in the area for more than two decades. The East African Community Regional Force (EACRF) was stationed in eastern DRC for a year as part of the Nairobi process, a regional initiative led by the East African Community. However, the Congolese government seemed dissatisfied with the force's inability to neutralise the M23, and EACRF ceased operations when its mandate expired on 8 December 2023. Even before EACRF's withdrawal, the Congolese government sought support from SADC, which on 8 May 2023 decided to deploy SAMIDRC in eastern DRC. The SAMIDRC deployment in North Kivu, which began only in December 2023, consisted of 5,000 troops from Malawi, South Africa and Tanzania. The mission had an offensive mandate in support of the Congolese government's military operations. Burundi and Uganda also have forces in eastern DRC under bilateral arrangements with the Congolese government. SADC terminated the mission in March 2025, following a disastrous encounter with the rebels.

In summary, there is serious concern with the growing number of actors involved in eastern DRC and the potential for the conflict to escalate into a regional crisis. Regional forces' compliance with international humanitarian law and human rights law, including the protection of civilians, remains a live concern.

A recent meeting of civil society activists and researchers in mid-2024 in Entebbe, Uganda, close to the theatre of conflict in the eastern DRC, examined the efficacy of formal governmental responses to crises. Participants were highly critical of the attempts by the government of the DRC and members of the East African Community to address the violent conflict by deploying a peace enforcement mission (EACRF). By the same token, they questioned the wisdom of SADC to deploy a similar mission and pointed out that its fate would be similar to that of the EACRF. Participants were concerned about the opaque and secretive nature of decision-making that led to the SADC military intervention and pointed out that a political and diplomatic intervention was preferable to address the complexities of the crisis in Central Africa.

Case Studies: Conclusion

Both SAMIM and SAMIDRC suffer from similar shortcomings. As reported by Mandrup (2024), an internal SADC assessment report concluded that SAMIM had suffered due to a discrepancy between capabilities outlined in the initial SADC pre-mission report of April 2021 as a requirement for a successful operation and the capabilities and force numbers deployed to the mission. As many commentators have pointed out (see, for example, Amani Africa, 2024; Wolters, 2024), the SAMIDRC suffers from a severe lack of capabilities and pledged force numbers by member states to be deployed. The two forces lack the air assets needed, especially the air cover required to conduct offensive military operations. Logistical support, camp protection and extraction capabilities are limited or even absent. The DRC mission suffers from a shortage of ammunition and food supplies and a lack of camp protection. These shortfalls have resulted in operational effectiveness being hampered and casualties among the SADC forces.

SAMIM has suffered from insufficient coordination between itself and the RDF and the host nation's security forces. Joint operational planning and even operations have been problematic. Information sharing was limited due to operational security concerns and experiences of information being leaked to the insurgents, which made joint operations difficult. Unclear political interference also played a role, where the local authorities blocked planned operations at a late hour without proper explanation. This issue also points to the host nation's role, which must be supportive and take the lead for a mission to be successful. But this has not been the case in Mozambique. SAMIM created a space where political solutions could have been found, but these did not materialise.

The South African security decision-makers have received some strong criticism. Heitman (2024) believes that the South African National Defence Force's DRC deployment was an unfair imposition. He argues that while there were strategic and economic arguments for it, the decision to deploy 2,900 South African National Defence Force troops to the DRC as part of a SADC mission went against several principles set out in the 2008 Revised White Paper on South

African Participation in International Peace Missions. Deployment of a weak a force with inadequate air support was not acceptable (see also Martin, 2025).

A military option is clearly not adequate to address the deep-seated historical, ethnic and resource-based fault lines throughout central Africa, as they play out in the DRC (Van Nieuwkerk, 2024). Relations between the presidents in the region, in particular the DRC and Rwanda, and more recently, between Rwanda and South Africa, have been strained because of this history (Chanson, 2025).

To augment stabilisation measures, African leaders must pursue diplomatic options. This includes an urgent ceasefire. It must be accompanied by disengagement of forces. There must also be confidence-building measures between the parties to the conflict.

If a ceasefire can be negotiated, a robust AU-led peace support operation, replacing the UN and SADC missions – with dedicated financial and logistics support from international partners – will be needed. At the time of writing, the UN agreed to assist the mission with enhanced coordination, sharing of information and technical assistance. However, the question remains: is this militarised focus the appropriate response to Africa's deep-seated, multidimensional crises?

Methodology: Reflection

The aim of this exploratory analysis was to deepen the tracing (reconstruction) of Southern African decision-making processes relating to peace and security. To what extent was this a success? As discussed above, experts in the field encourage a focus on the actors, practices (routines and institutional interaction) and narratives relating to the APSA. This, they argue, would allow the research community to reflect more accurately how decisions are made (or avoided), by whom and for what reasons. At the same time, they warn of methodological complexities: lack of access to classified material, political sensitivities, officials who are not allowed to reveal decision-making dynamics, the role of bureaucracies, the influence of outsiders and the credibility of the researcher and their project. The research focus on SADC security decision-making dynamics has encountered similar obstacles in recreating a full or complete picture of how leaders go about selecting a particular strategic course of action.

A pertinent example is the experience of the author in gaining knowledge of the technical process meant to assist SADC leaders in formulating a response to a request from a member state for military assistance. The 'evidence' produced by the technical report suggested one course of action, but political considerations (as sketched out by Khadiagala, above) led to another, potentially fatal, decision. None of this can be documented formally, given the need for confidentiality. This requires the researcher to tell the story in a different way. It can be done but requires a long-term perspective. Members of the Southern African Defence and Security Management Network have developed a track record in this regard (Van Nieuwkerk et al., 2023, pp. 12–13).

Conclusion

The analysis of the SAMIM and SAMIDRC cases is an illustration of a particular strategic culture at play among African leaders and the institutions they work with (the APSA configuration). Strategic culture can be viewed as a set of shared beliefs, assumptions and modes of behaviour, derived from common experiences and accepted narratives that shape collective identity and relationships to other groups, and which determine appropriate ends and means for achieving security objectives (Lantis, 2006, pp. 15–16). In the preceding discussion of African foreign policy behaviour, Khadiagala pointed out that African foreign policy reflected the continual attempts by elites to manage threats to domestic security and insulate their decision-making from untoward external manipulation. African elites are preoccupied with political stability, legitimacy and economic security. Our case studies confirm this orientation and the subsequent behaviour.

Decision-making mostly remains state-centric and military-orientated in responding to peace and security crises in the Southern and Central African regions. State sovereignty, political survival and economic benefit remain the decision criteria of choice. Militarised approaches to deep-seated and multidimensional crises will not advance the cause of peace and security and will not enable the guns to fall silent soon. Quite the contrary – militarised interventions are at best short-term stabilisation efforts, built on the assumption that they will open the door to political and diplomatic solutions. It is a doubtful assumption, given that violent extremism feeds off state violence. SADC ought to rethink its approach.

The Way Forward: Innovation Systems Proposals

The following innovation systems concepts, applied to the SADC peace and security architecture, will assist peace and security decision-makers in undertaking a re-envisioning process:

(1) *The 'system':* The APSA configuration, particularly within SADC, is the system under analysis. The 'innovation' desired is the effective generation and implementation of sustainable peace and security solutions, moving beyond reactive, militarised approaches towards proactive, integrated peacebuilding.

(2) *Actors:* The following key actors are relevant to the system rethink:

- *Currently dominant:* State elites (political leaders, military figures, diplomats).
- *Underutilised/excluded:* Civil society, academic/research communities, African communities of practice, women mediators, youth and potentially the private sector.

- *Institutions:* the SADC Secretariat, member state governments, the Regional Counter-Terrorism Centre, the (dormant) Regional Poverty Observatory and the SADC Parliament.

(3) *Institutions* (formal and informal rules/norms):

- *Dominant informal institutions:* SADC'S 'strategic culture' emphasises state sovereignty, political survival, regime security and economic benefit. This culture dictates state-centric, military-orientated behaviour and decision-making protocols. Silo mentality is another detrimental informal institution.
- *Formal institutions:* SADC features outdated decision-making protocols and security structures, a lack of robust mechanisms for civil society input and weak feedback/oversight mechanisms (e.g., the limited influence of parliament).

(4) *Interactions and linkages:* SADC suffers from severe networking weaknesses, a core concern in innovation systems theory.

- *Failure:* Silos predominate; generals, diplomats, politicians and non-state actors do not converse. There is a lack of integrated thinking and doing between SADC and member states, and between state and non-state actors. Cooperation with African communities of practice is weak, potentially overshadowed by donor agendas.
- *Proposed solution:* To fix these linkage failures, establish a networked system for integrating foresight and the policy process. Encourage inter-organisational cooperation and bring diverse actors (state, non-state, public, private) into dialogue to tackle 'wicked problems'. Strengthen the academic-practitioner interface as another key linkage enhancement.

(5) *Knowledge flows and learning:* Innovation systems thrive on knowledge creation, diffusion and absorption. SADC suffers from the following deficiencies:

- *Failure:* Weak foresight capacity (insufficient knowledge creation/analysis about future threats/opportunities). Poor institutional knowledge management and weak feedback systems mean learning from experience is limited and often outsourced. Lack of an open-minded institutional culture inhibits experimentation and learning.
- *Proposed solution:* Implement a foresight system (knowledge creation/analysis) and a feedback system (learning from performance). Promote an institutional culture shift towards experimentation and adaptation (enhancing absorptive capacity and learning-by-doing) and leverage the research community (knowledge source). Reactivate the SADC Regional Poverty Observatory and overhaul the early warning system to strengthen knowledge infrastructure.

(6) *Policy implications* (systemic instruments). Policies need to be designed to address innovation system failures:

- *Network building:* Creating platforms for interaction between diverse actors.
- *Institutional reform:* Changing decision-making protocols, strengthening oversight (e.g., regional parliament) and fostering a culture of openness.
- *Capability building:* Enhancing foresight capacity, supporting mediation networks and training for peace support operations.
- *Knowledge infrastructure development:* Improving early warning systems, supporting research centres and communities of practice.

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Chapter 11

Harvesting Tomorrow: Revitalising African Foodscapes

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Introduction

Modern statistics paint a grim picture of food security in Africa. Estimates from a report published by the Food and Agriculture Organization (FAO) set the prevalence of undernourishment (PoU) levels at 19.1% of Africa's population, or approximately 250 million people (FAO; International Fund for Agricultural Development (IFAD); United Nations Children's Fund (UNICEF); World Food Programme (WFP); World Health Organization (WHO), 2020). The continental figures for moderate and severe food insecurity stood at 32.6% and 19% of the population in 2019. This is contrasted with the sources that point to a food-secure continent during pre-colonial times. During this era, food scarcity in Africa was transitory and typically followed calamities such as conflict, floods or drought (Bjornlund et al., 2022). Food security was enhanced through self-created social, agricultural and trading mechanisms, adaptability, biodiversity and mobility.

Several challenges necessitate the need for innovative solutions for food security in Africa. Primary among these challenges is the continent's burgeoning population. Of all global regions, Sub-Saharan Africa (SSA) will account for the largest share in population growth during this century. SSA hosts more than 75% of the countries with annual population growth rates twice as fast as the world average (Gu et al., 2021). Relatedly, there is an increasing youth bulge. At 18 years old as of 2019, Africa's median age gives it

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the status of the world's youngest population, a trend that is expected to persist throughout the century (Desjardins, 2019). To stress the significance of this statistic, it is worth noting that the closest continental median age is 31, almost 13 years older.

The climate crisis, precipitated by the previous few centuries of the Anthropocene age, is estimated to cause disproportionate adverse effects on poor regions such as SSA (Sandalli, 2021). Such impact is despite the meagre contribution that SSA makes in terms of global greenhouse gas (GHG) emissions. Contemporary agriculture and food logistics are significant contributors of GHGs, and hence, are partially responsible for global warming. Crippa et al. (2021) make mention of the GHG emissions that occur along the food value chain, from planting to harvesting, transporting, processing, distributing, cooking and even disposing of food.

Another significant challenge involves the plight of farmers across SSA, where farmers, mostly smallholders, lack supportive agricultural policies and access to investment and credit. These farmers are often at the mercy of exploitative brokers and experience declining yields due to improper farming techniques (Alliance for a Green Revolution in Africa (AGRA), 2019; Bjornlund et al., 2020).

These challenges expose several needs for:

- adequately feeding the growing population;
- meaningful employment for the youth bulge;
- climate adaptation and resilience strategies;
- more sustainable forms of agriculture and food systems management;
- improved welfare and well-being of agricultural producers.

Using results from participatory foresight workshops conducted with agri-food practitioners, this paper centres on food as commons as the main innovation recommended to address the aforementioned needs. The innovation theories used in the process are grassroots innovation (GI) and the chocolate model of innovation, both of which show how the food as commons model can be innovatively implemented.

Reframing food as a commons values the non-economic attributes that food offers, such as it being a vital fuel for human bodies, as a human right, as a product of nature and as an element of our culture (Vivero-Pol et al., 2019). Recognising the essential roles of food in all aspects of life, every individual is inherently a stakeholder in food systems. However, current discourse often confines these conversations to a select group of experts, when in fact, food systems should be democratised, ensuring that all Africans are integral stakeholders in the food system within which they are embedded. They should have a say on how food is produced, distributed, processed, consumed and disposed of.

A Glimpse into the Past: Food Security and Community

Nana and Talel's Tales of Africa's Food Histories

Nana (a fictional name), a crop farmer in precolonial Benin, thrived on mixed cropping and subsistence farming, ensuring her family and community were food-secure. She relied on communal ties for support and surplus food storage for lean times. However, colonialism shattered this balance. As Nana was forced into growing non-food cash crops like cotton and paying oppressive taxes, her food security crumbled. Social bonds weakened, and traditional resilience strategies eroded.

Meanwhile, Talel (a fictional name), a livestock farmer from precolonial Kenya, once roamed freely between modern-day Tanzania and Kenya in search of pasture. Colonial borders restricted his movement, and when the next drought hit, his flock perished. This loss devastated Talel, stripping him of his food security and livelihood.

As noted in both stories, the colonial era introduced new socio-economic and political structures that exacerbated the plight of all African societies to date. However, we have accounts of ample food security in precolonial Africa, as indicated by the reports below.

> 'The blacks have many foodstuffs such as [guinea] hens, husked rice (all high-quality and cheap), plenty of milk, and excellent mantiega [fat]...This is because the whole kingdom of Nhani [Ghana] is full of villages of Fulos, who have foodstuffs in abundance. A cow costs only a pataca or its equivalent...Thus, everything necessary for human existence is found in this land in great plenty and sumptuousness' (Francisco De Lemos Coelho, 1999).

This was the narrative of Francisco De Lemos Coelho, a Luso-African merchant who traded along the Gambia River in the early to mid-1600s.

Another description takes us south to the mediaeval Kingdom of Mapungubwe, where it is noted that '*like other kingdoms in southern Africa, theirs produced ample food and a surplus*' (Kordas et al., 2023).

Nana and Talel's stories paint a contrasting picture of food security as compared to the historical accounts given. This contrast is aptly explained by Bjornlund et al. (2022), who note that SSA was largely food secure before colonisation. The same authors, in a different paper, argue that the aetiology of low

agricultural productivity in SSA can be traced back to external interference by colonialist forces, which prioritised the production of a few export crops (Bjornlund et al., 2020). Aworh (2023) notes that one of the factors that contributed to food security in traditional African societies was dietary diversity, incorporating a wealth of indigenous crops and wild food plants.

Emphasis should be placed on the fact that, aside from food production, a major factor contributing to food security involves the communal nature of traditional African life, modelled along *ubuntu*. This concept emphasises social cohesion, humanist trust, loyalty, social ties and social solidarity (Ndhlovu, 2024). Ubuntu provides an excellent lens through which to examine issues of food scarcity and insecurity in Africa, as these challenges are driven less by production insufficiencies and more by limitations in physical and economic access, as well as unequal and inefficient distribution (Liebetrau, 2019). Robbins and Dowty (2019) note that 'people command food through entitlements – that is, their socially defined rights to food resources' (p. 178). In traditional African societies, it was precisely these ubuntu-based social ties within communities that guaranteed such rights.

Beyond food security, traditional African societies also exhibited the communal role of food through feasts, ritual activities involving the consumption of food and drink. Dietler (2001) observes that in African societies, feasts have served vital structural roles in the broader political economy. They not only establish sentiments of kinship, friendship and community solidarity but also cement bonds between affine groups. Additionally, feasts served to enhance labour mobilisation, provide religious and ancestral links and maintain social control.

Food also functioned as a cultural artefact containing elements of art. Different ethnic groups had distinct feasting practices, and the indigenous knowledge used in food preparation and presentation constituted unique art forms. As Aworh (2023) notes, these methodologies and skills were acquired empirically over centuries, based on observation and experience.

Theoretical Framework: Innovation for Change

It can be inferred from this brief history that indigenous African communities have long-established knowledge that can be adopted in the modern age to innovate within food systems. One highly relevant innovation theory in this regard is **GI**. This theory discusses 'networks of activists and organizations generating novel bottom-up solutions for sustainable development and consumption, solutions that respond to the local situation and the interests and values of the communities involved' (Sheikh & Kumar, 2021). There are six dimensions of GIs: affordable cost, indigenous knowledge, informal innovations, local fits, sustainability and adaptability.

A related model that was used to understand how these GIs come about is the **chocolate model of innovation**. The model comprises four layers, akin to the layers used in making chocolate. The hard core consists of the core agronomic and business activities; the soft core is the supporting activities; while the wrapper

represents the external factors influencing innovation. The chief layer of interest is the chocolate layer, where innovation occurs; in this specific case, the innovation of food as a commons.

Methodology

The methodology for this chapter is rooted in the Grassroots Stakeholders Futures (GSF) project. Over two months, this project convened young African stakeholders from Nigeria, Kenya, Rwanda and South Africa in a series of workshops to collectively explore and imagine the future of African food systems from now until 2050. Participants brought diverse professional backgrounds, including agriculture, culinary arts, foresight, human rights advocacy, community development, medicine, performance art and economics, enriching the conversations with a wide range of perspectives and expertise.

The workshops incorporated immersive and participatory foresight methods, allowing participants to co-create future scenarios and develop actionable strategies for sustainable food systems in Africa 2050. The methodology incorporated foresight tools such as the futures triangle, causal layered analysis (CLA), VERGE, Scenario, Drivers of Change and Three Horizons.

Before the workshops, participants completed an onboarding questionnaire, and their responses informed the development of a scenario titled Luxury African Food Commons (See Fig. 11.1). This scenario served as an entry point into foresight work, immersing participants in a plausible future, provoking questions and discussions for reframing food.

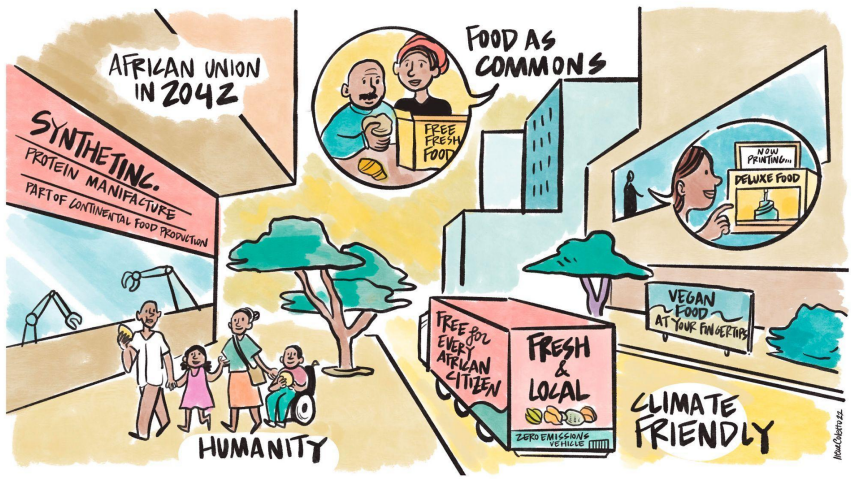

Fig. 11.1. The Luxury African Food Commons Scenario.
Source: Credit Irene Coletto as the image creator.

In this scenario, the African Union (AU) in 2042 recognised food as a commons, which is contrary to how it's currently regarded as a commodity. This resulted from the recognition that food is essential for human existence and that the 'no money, no food' system is inhumane. Therefore, pan-African cooperation and collaboration worked to establish a continental vegan food production and distribution network. This network coordinates farming, synthetic protein manufacture and fresh produce for free to every African citizen. There's a mix of luxury cuisines, produced by humans and robot systems in collaboration. There is little point in travelling for food since there will be no more restaurants if food production is automated. There is 3D printing of vegan food, with massive implications for food poverty.

Data Analysis

Thematic analysis of the participants' data revealed the following concepts with relevance to food as a commons:

- Food as a common resource rather than a commodity.
- Nourishing body and soul: food as art and community.
- Root absorption: expertise and ancestral knowledge.
- Empowering food producers: farmer well-being.
- Cultivating a health future: sustainable agriculture.

Discussion

Food as a Common Resource Rather than a Commodity

Reframing food as a commons seeks to restore African food security and abundance, a revitalisation of the continent's foodscapes. The main question, however, is 'what is the commons?' In traditional political language, a commons is a property that is not subject to private ownership, regardless of the type of management employed over that commons. By contrast, a commodity refers to property that is produced to be exchanged or traded in markets. The commons infers collective stewardship, whereas commodities reflect individualism and private ownership.

Elinor Ostrom, a leading scholar on commons governance, refers to the commons using the more specific term, common-pool resource (CPR). Many successful CPRs, she observes, 'are rich mixtures of "private-like" and "public-like" institutions defying classification in a sterile dichotomy' (Ostrom, 1990, p. 14). Competitive markets, which are public goods, rely on public institutions for their operation. The 'sterile dichotomy' is the main reason why treating food purely as a commodity, as is the case now, falls short. Food as a commodity is subject to capitalistic market forces, which determine food production not by need but rather by the market for food. How many people can afford to buy this food? This is why food production is hardly at its maximum, with underproduction manifest in the

allocation of fertile land to export-orientated crops like cotton and tobacco or marginally nutritious crops like tea and coffee.

Recognising food as a commons should thus become a legislative priority across Africa. Such legislation would affirm food as a public good and guarantee every citizen's right to adequate, nutritious food daily. Yet, even as hunger affects millions across Africa, hunger is a personal issue; it is the individual human being who is, at any moment, hungry. On a larger front, hunger grows into a household issue, and further, a community issue (which is why certain communities face hunger more frequently than others). Therefore, food should be as physically close as possible to every human. There are numerous implementable models, one being the mandated creation of communal and local food banks/produce boards to ensure widespread food availability across localities. Existing decentralisation models within each country will be utilised, such as provincial systems in South Africa, devolved systems in Kenya and federal systems in Ethiopia.

The primary purpose of the proposed legislation is to recognise the right of each African to have ample and nutritious food for each day. Accordingly, each African government ought to establish mechanisms that ensure all those under its jurisdiction have food to eat, especially those who are unable to do so themselves, e.g. low-income families, homeless individuals, aged people, disabled people and anyone facing economic stress.

Nourishing Body and Soul: Food as Art and Community

Viewing food as a commons also means appreciating its cultural heritage and its role as art. Traditional African food systems have long been rooted in community, from collective agricultural labour to communal food preparation and consumption (Bennett, 2002; Molieleng et al., 2021). Akabane (1970) identifies diverse organising principles for collective labour, including those based on kinship, neighbourhood and age groups. The relevance of communal methods persists to this day, where smallholder farmers, who produce most of the continent's food, rely on group labour that is primarily provided by immediate family (Giller et al., 2021).

Commensality (eating together) remains widespread across African households, serving as a practice that strengthens social bonds (Osseo-Asare, 2005; Poe, 2002; Sabar & Posner, 2013). Food preparation and consumption thus become communal rituals, enriching both physical sustenance and cultural identity. Meals become occasions for gathering, sharing stories and strengthening social bonds; an effort at nourishing not only bodies but also souls.

Traditional processing techniques such as fermentation, sun-drying and smoking have sustained African communities for centuries. These methods increase shelf-life and often enhance nutritional content. Examples are fermented porridge made from millet or sorghum. Such culinary practices are not merely functional but are also artistic and expressive of cultural identity. A vivid example is the West African dish, jollof rice. The main and only necessary

ingredient is rice; the other ingredients depend on the recipe for whichever particular ethnicity or region. The preparation and consumption of jollof rice is thus a culinary adventure into the heart of West Africa (Amrahs, 2024). From Senegal to Nigeria, eateries, street vendors and households offer their unique take on this dish.

These culinary arts should be preserved in cultural repositories, alongside traditional music, language and dress. They are artefacts of living heritage. Food also appears in visual art, such as rock paintings and hieroglyphs, where even the materials – animal fat, plant extracts – derived from food sources, were used as binders (Butler, 2017). Quinet (1981) likens food preparation and presentation to the sculptural and visual arts.

Root Absorption: Expertise and Ancestral Knowledge

Traditional food practices, passed orally through generations, are increasingly validated by modern science. Indigenous African farming systems – agroforestry, terracing, intercropping, mulching and crop rotation – closely align with ecological principles and are beneficial to the environment and animal and human health (Soni et al., 2022).

Given their demonstrated benefits, these practices should be systematically preserved through knowledge repositories (Lwoga et al., 2010). Farmers across Africa who harness indigenous knowledge use it to improve their farming activities and food security. Accordingly, they should be recognised as the primary custodians (and users) of such knowledge, and efforts should be made to build knowledge systems around their expertise. A case in point is Yacouba Sawadogo of Burkina Faso, whose revival of zai pits helped reverse desertification. Zai pits are small, manually dug planting holes in semi-arid regions to capture water and concentrate organic matter, thereby improving soil fertility and crop yields. Yacouba trains communities locally and regionally, offering a model of community-based agroecological education (Agbor et al., 2019).

The case of indigenous knowledge extends to knowledge of various indigenous and traditional food crops (ITFCs) that have largely been relegated in the contemporary context. This includes grains, tubers, green leafy vegetables and others. ITFCs have been shown to have numerous desirable traits such as higher nutrient content, potential for year-round availability, pharmacological benefits and environmental benefits (Akinola et al., 2020). To ensure their continued use, community-based education programmes are essential, enabling farmers to share and refine their expertise.

Empowering Food Producers: Farmer Well-Being

The CPR concept heralds a shift away from capitalistic models that often exploit people and labour. In the case of farming, this means the exploitation of farmers, typically small-scale farmers. Robbins and Dowty (2019) observe that the modern capitalistic way of farming is 'capital intensive, favors large, state-subsidized

agribusiness, and minimizes use of labor' (p. 176). The small farmer is at a disadvantage in such a system, as they witness declining profits and prestige associated with this occupation.

Dawson et al. (2016) note that the African Green Revolution was accompanied by neoliberal political agendas that disenfranchised millions of smallholder farmers across the continent. Woodhill et al. (2022) note the poor well-being and livelihoods of smallholder farmers and rural folk in SSA. This is even though those living in extreme poverty in SSA typically have access to small parcels of land, and only lack farm inputs and market access. Other studies have examined the plight of livestock farmers, with one noting the poor mental health of livestock farmers in Africa (Nuvey et al., 2020).

A commons-based legislative framework must enshrine farmer well-being as a core principle. This includes measures such as:

- Promoting farmer cooperatives: Incentivise the formation of farmer cooperatives and collective bargaining groups.
- Establishing fair pricing mechanisms: Curtail the exploitative power of many middlemen and brokers.
- Providing financial support and resources: Facilitate inputs, storage, infrastructure, finance and market access.
- Encouraging agricultural education and training: Provide continuous technical and advisory support.

Cultivating a Healthy Future: Sustainable Agriculture

Reframing food as a commons implores us to seek more sustainable food production methods. Sustainability – as defined by the then United Nations (UN) body, the World Commission on Environment and Development – termed it as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs' (UN, n.d.). This definition is crucial as it urges us to farm in a way that does not hinder future generations from doing so themselves.

The commodification of food, however, hinders future generations from farming through environmentally friendly practices. Intensive monoculture, pesticide use and synthetic fertilisers harm ecosystems and human health. Food from industrial systems is also nutritionally inferior to that from ecologically sustainable farms (Edlich et al., 2007). Widespread use of pesticides and herbicides poses serious risks. Insecticides harm pollinators and leave residues in food (Ashgar et al., 2016; Sanchez-Bayo & Goka, 2016; Sharnma et al., 2019), while glyphosate-based herbicides have been linked to cancer (Sullivan, 2018). Many of these chemicals, banned elsewhere, are still widely used in Africa (Anaduaka et al., 2023).

Herbicide use is closely linked to monoculture, a practice that reduces farm biodiversity, depletes soil nutrients, increases pest and disease risk and lowers resilience to environmental and economic shocks (Anaduaka et al., 2023). The increased use of inorganic fertilisers has degraded soils, primarily through

acidification, leading to reduced fertility and greater environmental pollution (Kumar et al., 2019; Zingore et al., 2015). Additionally, modern agriculture significantly contributes to global warming (Lynch et al., 2020), making conventional farming a key driver of the triplanetary crisis: climate change, biodiversity loss and pollution.

Africa already has a rich history of sustainable farming methodologies, which were the mainstay before the era of colonisation and foreign imperial domination. These practices include, but are not limited to, agroforestry, intercropping, crop rotation, polyculture, companion planting, terracing, natural mulching, use of indigenous seeds and organic fertilisation. These methods reduce dependence on expensive chemical inputs, thus lowering production costs and increasing profitability. Over time, many sustainable practices are also less labour-intensive, enhancing their appeal to smallholders.

Recommendations

Realising food as a commons requires a multi-tiered approach, as outlined in the following targeted recommendations.

The African Union

At the continental level, the AU must take the lead by ratifying food as commons legislation, firmly establishing food as a public good rather than a commodity. This foundational step would pave the way for other crucial initiatives. To preserve Africa's rich agricultural heritage, the AU should also spearhead the establishment of a digital repository, carefully documenting indigenous farming techniques and the vast array of traditional crop varieties found across the continent. This would ensure that valuable knowledge is not lost but is integrated into modern practices. Furthermore, to ensure accountability and track progress towards food security, the AU should deploy a continent-wide monitoring system, characterised by transparent metrics and open public reporting. This will foster trust and enable adaptive policy-making. Recognising the importance of sustainable practices and fair trade, the AU must also take the initiative to develop Africa-specific standards for sustainable farming certification and fair-trade practices. This will not only protect the environment but also empower farmers. Finally, the AU can play a vital role in mitigating food crises by coordinating the establishment of regional food reserves, providing a safety net during emergencies and stabilising prices to protect vulnerable populations.

National and Regional Governments

At the national and regional levels, governments must translate the continental vision into actionable change within their specific contexts. This begins with adapting existing governance structures to effectively implement community-based food management models, ensuring that local voices and needs are

prioritised. To address immediate food insecurity, governments should establish local food banks, strategically prioritising areas with the highest rates of need. It is also crucial to enact legislation that directly tackles market failures by regulating market prices and shielding farmers from exploitative practices. Investing in the future of food systems requires a commitment to research, with governments funding institutions focused on the potential of ITFCs. Education is equally important; therefore, agricultural curricula should be updated to integrate indigenous knowledge with sustainable modern techniques, creating a new generation of informed agricultural practitioners. Given the dangers posed by harmful chemicals, governments must act decisively to protect both people and the environment by banning toxic agrochemicals that have already been prohibited in other regions, implementing a phased approach to ensure a smooth transition.

Civil Society Organisations (CSOs)

Civil society organisations are indispensable partners in this transformation. They can empower communities through training workshops led by local farming experts, sharing valuable traditional methods. To safeguard indigenous knowledge, CSOs should prioritise documenting the wisdom of elder practitioners before it disappears. Recognising the social and cultural dimensions of food, CSOs can create structured programmes centred on communal food preparation, fostering stronger social bonds. To ensure that policies are implemented effectively and equitably, CSOs should develop citizen oversight mechanisms, holding authorities accountable. Finally, CSOs should play a critical advocacy role, campaigning for expanded rights and improved market access for smallholder farmers.

Private Sector and Social Impact Innovators

The private sector and social impact innovators have a crucial role in driving innovation and creating sustainable solutions. This includes creating mobile platforms that connect farmers with knowledge resources and fair market opportunities, fostering efficiency and transparency. To preserve biodiversity and support climate-resilient agriculture, there should be funding for conservation initiatives focused on traditional seed varieties adapted to local conditions. Investments in processing facilities that offer fair prices to farmers while preserving the nutritional value of food are also essential. To create more equitable and efficient supply chains, there should be a development of shortened supply chains that directly connect smallholders to consumers, reducing the power of intermediaries. Innovation must also extend to agricultural inputs, with the development of affordable organic inputs and sustainable irrigation solutions tailored to the needs of small farmers.

Agri-Food Practitioners

Finally, agri-food practitioners themselves are agents of change. They can establish farmer-to-farmer training networks to share successful indigenous practices, fostering collaboration and knowledge exchange. Implementing sustainable farming practices such as intercropping, agroforestry and crop rotation is essential for enhancing productivity naturally. To safeguard crop diversity, practitioners can organise community-based seed preservation initiatives. Traditional preservation methods, which maintain nutritional value and extend shelf life, should be utilised. Farmer cooperatives can be formed to increase bargaining power and reduce individual costs, creating a more resilient and equitable agriculture sector.

Conclusion

In conclusion, revitalising African foodscapes requires us to reframe food as a commons through legislation. This step is crucial for building resilient, equitable and sustainable food systems across Africa. While the proposition of food as a commons may seem radical, it allows us to explore reasonable potentialities that could have a transformative impact on the continent. Through innovative thinking and reshaping the narrative around foodscapes, we can enhance food security, celebrate African culinary heritage and improve the well-being of farmers. Ultimately, this is a speculative exploration that serves as an invitation to imagine innovation through revisiting policy and legislation, creating a future where food is a source of cultural and social cohesion for all African citizens.

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Chapter 12

Reimagining African Futures Through Higher Education Policy: Evidence from South Africa

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Introduction

In a recent opinion piece for *The Guardian*, two former African heads of state describe the importance of education for Africa to realise its potential and become a 'colossal powerhouse' on the global stage (Akufo-Addo & Kikwete, 2024). This fits into a powerful narrative that positions education as the key enabler of Africa's 'demographic dividend' – a vision framed around global competition and economic productivity, where education serves as a means to transform Africa's young population into skilled workers and entrepreneurs. Policy documents such as the African Union's (AU) Agenda 2063 and South Africa's Revised Strategic Plan 2020–2025 for higher education and training reflect this narrative, focusing on scaling up training, evaluation and certification of young Africans entering the labour market. While acknowledging that the desire to transform Africa into an economic powerhouse is driven by genuine goodwill, this chapter interrogates the origin and legitimacy of this specific vision for Africa's future. It also considers how imagination of the future is interwoven into the continent's education systems and where opportunities for new imaginaries may arise.

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The powerful productivist vision of Africa articulated in *The Guardian* article, is anchored in neoclassical economic theory about human capital and growth. Zein-Elabdin (2004) draws attention to the strength of the economic development narrative that frames much of the imagination of Africa's future. Development is taken as an unambiguous, scientific and inevitable process leading to 'the industrial prototype'. Any other form of social organisation is understood as lacking (Zein-Elabdin, 2004). The lack of exploration of alternative visions has been critiqued as 'paradigmatic lock-in', where the future is imagined as linear progression through a set of predefined and predictable stages leading to a modernist vision of industrial society (Karuri-Sebina, 2020). Policymaking then becomes a means of managing the path towards this vision rather than a space for exploration, imagination and innovation. It may be instructive to ask where the idea of this future comes from and whether there would be benefits in imagining alternatives. Research on African futures highlights the impact of colonisation not only on narratives of the past but on how the future is imagined (Bourgeois et al., 2022). Wider scholarship examining how human beings anticipate draws attention to the tendency to reproduce the past (even if it has failed) rather than face the uncertainty of an unknown future (Miller et al., 2018).

Much attention has been paid to the difficulty of reforming institutions of learning that emerged during and after the Industrial Revolution. These institutions are defined by standardisation, regimentation and control and have been criticised as no longer being fit for purpose in the 21st century (Bishop, 2012; Conway, 2020; Inayatullah, 2020). The slow pace of reform is contrasted with a rapidly changing educational landscape filled with new opportunities and challenges. Co-creation in learning, open-source education, big data and machine learning are some of the changes confronting conventional education. Currently, the African higher education sector is at risk of being locked into an industrial vision of a society that is enabled by industrial-era education institutions. Policy that is orientated around this outlook does not respond to the need to reimagine African futures and is at risk of being bypassed by the fluidity, flux and dynamism of the real world.

This chapter seeks to examine and enhance understanding of how anticipation shapes policy formulation in higher education, particularly in the South African context. The authors aim to demonstrate how different approaches to 'using the future' can influence education policies by making explicit the implicit narratives and assumptions that drive current policymaking. Rather than prescribing specific policy recommendations or solutions, we position this work as a contribution to existing voices calling for new ways to imagine higher education policy, with an emphasis on understanding uncertainty and complexity. The authors investigate how a 'futures literacy' approach might help look beyond dominant narratives of education and development in Africa and what this means for innovation and policy solutions. Through analysis of two futures literacy laboratories conducted with senior policymakers and university leadership in South Africa, we examine how certain dominant narratives about African education are underpinned by specific notions of economic development and progress. Rather than attempting to develop alternative 'indigenous' models of

learning, we focus on examining how our collective imagination around education is shaped—and potentially limited—by certain dominant narratives.

While acknowledging universal debates around higher education reform, we specifically examine these issues through an African lens, suggesting concrete actions including more research on how the future influences imagination and policymaking processes, increased training in futures literacy to deal with uncertainty, and moving away from 'solutioneering' approaches. This work situates itself within broader scholarship around decolonising African futures and the recent UNESCO Futures of Education[1] initiative to reimagine knowledge and learning.

Literature Review

Current imaginaries of higher education and their role in Africa's future may be better understood in the context of global trends. Conway (2020) gives a comprehensive overview of different epochs of the Western university, highlighting the tension between the 'traditional' university of the past and the contemporary 'managerial' university.[2] The sacrosanct autonomy and academic freedom traditionally afforded to universities has been subverted by demands to justify spending taxpayer funds and the growing emphasis on research impact to help address some of society's most pressing challenges (Kokshagina et al., 2021). This represents a fundamental shift in the purpose of higher education institutions, moving from a role defined by the 'search for truth' to a new role defined by contribution to national economic priorities and needs (Conway, 2020).

As this tension between differing visions for the university plays out, there is a risk of losing sight of the need for adaptation in response to changing societal dynamics (Bishop, 2012; Conway, 2020). Bishop (2012) is especially acerbic in his analysis, arguing that it would take a meteor-like event (invoking the mass extinction of dinosaurs) to shift education systems away from all-too-familiar practices that were formed in the industrial era:

> Students still sit in rows listening to professors lecture at them. They still purchase textbooks, take tests, get grades, and earn credits and degrees in the same way that previous generations did more than 100 years ago. School children still attend school from 7:45 am to 2:45 pm each day (or thereabouts), nine months of the year, separated into grades by age, and into subjects by the ringing of a bell.

[1] https://www.unesco.org/en/futures-education?hub=81942

[2] The rise of managerialism was ushered into Western universities by a new cadre of administrative and managerial staff that began to emerge in the 1970s. The term 'managerial university' highlights a shift in the management and agenda-setting roles at universities away from academics (Conway, 2020).

In response to the internet, open-source educational resources, such as Wikipedia, and advances in machine learning and big data, education systems need to explore alternative modes of being rather than continuously trying to 'optimise the present' (Bishop, 2012; Inayatullah, 2020). A recent UNESCO (2020) report argues for urgency with regards to reimagining futures for education and posits three key questions: 'What should we continue doing? What should we abandon? What needs to be creatively invented afresh?'

In the context of African higher education futures, documents such as Agenda 2063 (AU, 2015) and South Africa's 2020–2025 higher education strategy suggest that policymakers are focused on improving existing systems of education and training. This includes working towards universal access, harmonising accreditation systems, investing in educational institutions and equipment, and ensuring there are enough good quality teachers. While these are all worthy and useful endeavours, especially in places where access to education is not guaranteed, they do not address the need to adapt to change and uncertainty. Furthermore, they do not speak to the importance of decolonising discourses around higher education and development in Africa (Bourgeois et al., 2022; Zein-Elabdin, 2004).

Bourgeois et al. (2022) draw attention to the impact of colonisation not only on narratives of the past but on how the future is imagined. The German philosopher Hegel famously asserted that Africa exists outside of history. This assertion ignores the rich and diverse histories across the continent and the central role that Africa and Africans played in the emergence of the modern world (French, 2021). Yet it is the narratives that cast Africa as pre-modern, underdeveloped and lacking that play a dominant role in imagining what the continent should become (Zein-Elabdin, 2004). The perspective that Africa's development should culminate in 'European-like industrial society' (Terry et al., 2024) and that this process will be enabled by investment in education systems, advantageous demographics and technological advancement has become something of an 'official future'. This narrative impacts all policymaking efforts, including those in the higher education sector. Policy documents such as South Africa's 2020–2025 higher education strategy are filled with ratios, indices and indicators that allow for cross-country comparison, articulating the position of South Africa in relation to other countries along a spectrum (low, middle and high income), which implicitly reinforces the idea of linear progress along a set of predictable stages (Karuri-Sebina, 2020). Similarly, the language of Agenda 2063 is framed around the idea of an 'African century'. This desirable image of the future is described in terms of global competition and an Africa that must aim to surpass the current centres of political and economic power – to beat them at their own game so to speak.

Overpowering narratives have the effect of 'colonising the future', dominating our imagination of what the future could and should look like (Bourgeois et al., 2022; Miller, 2018a). This ignores overwhelming evidence about the future that it is inherently complex, always in flux, unpredictable and full of unintended consequences (Fuerth, 2009; Miller et al., 2018; Poli, 2010). This is where it becomes crucial to diversify the ways in which the future is imagined (Bourgeois et al., 2022; Miller, 2018a). Addressing the legacy of colonialism and dealing with

the unpredictability of the future require a more open and exploratory approach to policymaking. Emerging approaches to the future that are centred on building human capabilities to deal with and embrace complexity may offer some useful strategies to address these challenges.

Futures literacy is broadly concerned with understanding anticipation. Anticipatory systems exist everywhere, from a tree that loses its leaves before the coming cold to the religious leader who believes they know when the world will end and to an individual who picks up their umbrella after seeing a cloudy sky (Miller et al., 2018). Human beings have the ability to consciously imagine the future. Images of the future are a powerful source of hope and fear and have a profound impact on how we perceive the world. This is why understanding anticipation and advancing human beings' ability to make use of their anticipatory systems is so important (Miller, 2018a,b).

The term 'futures literate' describes a person who has gained the skills to choose how to use their anticipatory abilities to bring images of the future into the present (Miller, 2018a). By sharpening these skills, futures literacy offers the chance to move beyond official futures and embrace novelty and change to open up human imagination in ways that more closely match the realities of an ever-changing world.

Fuerth (2009) focuses less on individual capabilities than on creating governance systems that are anticipatory rather than reactive. This requires decision-makers to have an awareness and understanding of past, present and future as well as the ability to see the complex interactions that occur between all parts of an interlinked system. Fuerth argues that current civilian government systems that are broken down into neatly divided bureaucratic portfolios with rigid planning mechanisms are bound to fail in the face of a future that is constantly changing in unpredictable ways. Alternatively, governance systems could be developed in a networked, fluid manner that integrates the use of foresight to enhance decision-making. While this is challenging, Fuerth argues that the alternative, to continue making decisions in a siloed, reactive manner, is not an option.

The tension between uncertainty and control in higher education policymaking is further explored in UNESCO's Futures of Education initiative (2021), which emphasises that while planning and preparation are necessary, an overreliance on prediction and control can limit innovation and adaptability in education systems. The concept of anticipatory governance, as outlined by Fuerth (2009), becomes especially relevant when examining how higher education institutions can better navigate uncertainty. Traditional approaches to policymaking often assume a linear progression of development, with clear cause-and-effect relationships. However, as Miller et al. (2018) argue, this assumption fails to account for the complex, interconnected nature of social systems and the inherent unpredictability of the future. In the context of African higher education, this linear thinking is often manifested in policy documents that emphasise quantitative targets and benchmarks against Western institutions, potentially limiting the exploration of alternative paths.

The call for decolonial approaches to higher education futures, as discussed by Bourgeois et al. (2022), requires more than just acknowledging historical injustices. It necessitates developing new capabilities to imagine and work with uncertainty in ways that challenge dominant narratives about progress and development. This aligns with Miller's (2018a) argument that futures literacy can help individuals and institutions move beyond 'official futures' to embrace more diverse possibilities.

The emphasis on futures literacy and anticipatory capabilities offers a potential way forward. As Miller et al. (2018) suggest, developing these capabilities can help institutions and policymakers work more effectively with uncertainty and complexity. This approach acknowledges that while the future cannot be predicted or controlled, the way we imagine and anticipate it profoundly influences our present actions and decisions. For African higher education institutions, this could mean developing policy approaches that are more adaptive and responsive to changing circumstances while remaining grounded in local contexts and needs.

Methodology

Study Design

This study employed a participatory action research approach through the futures literacy laboratory (FLL) method. The research design was grounded in futures literacy principles, which examine how anticipation shapes present actions and perceptions. FLLs are structured workshops that engage participants in exploring how their imagined futures influence perception and decision-making. The laboratories were designed to make explicit the narratives, thinking patterns and hidden assumptions that participants use when thinking about the future.

Study Site

Both FLLs were conducted at the Future Africa Campus within the University of Pretoria, South Africa. The first laboratory was held over one and a half days in August 2022 while the second laboratory took place over one full day in February 2023. The Future Africa Campus was selected as the study site due to its role as a platform for transdisciplinary research and its connection to both academic and governmental stakeholders.

Participant Recruitment and Profile

Purposive sampling was used to select 31 participants across two laboratories, with an emphasis on recruiting individuals in senior leadership and decision-making roles. The first laboratory (2022) comprised 15 in-person participants representing senior university leadership from various academic departments within the University of Pretoria, including engineering, public health, law,

Table 12.1. Participant Summary.

Personal Information	**Total Participants (N = 31)**	
	Lab 1: Academia	**Lab 2: Government**
Gender		
Female	6 (40%)	7 (44%)
Male	9 (60%)	9 (56%)
Profession		
Government	2 (13%)	16 (100%)
Academia	13 (87%)	0 (0%)
Total	15	16

Source: Authors.

management and institutional planning. The second laboratory (2023) included 12 in-person and four online participants from various agencies within the Department of Science and Innovation in the South African Government. Participants were selected based on their positions as decision-makers in their respective organisations and their connection to the Future Africa platform (Table 12.1, source: author).

Data Collection

Data were collected through multiple methods during each laboratory session. The laboratories were structured in three distinct phases, each with unique prompts for participants to imagine different types of futures: probable futures, desirable futures and unexpected futures (neither desirable nor probable). Data collection included:

- Written outputs from groupwork sessions;
- Facilitator observation notes and
- Post-it notes from participants that were digitally transcribed by the first author.

Data Analysis

An inductive qualitative content analysis method was employed to identify principal themes from the data, intentionally avoiding predefined theoretical frameworks. This method was selected to permit the data to speak for itself and ensure that themes emerged organically from participant responses. The first author conducted open coding of the transcribed data using the QualCoder open-source software package. The coding process involved comparing and

consolidating codes to develop a unified codebook for both laboratories. This consolidated codebook was subsequently used to encode all data from the two labs, and relevant themes were extracted from the coded data.

Theoretical Interpretation

The final stage of analysis involved interpreting the data using the Futures Literacy Framework. This framework was used to:

- Deduce different types of anticipation observable in participant data;
- Detect changes in anticipatory systems and processes as participants progressed through different phases of the laboratory and
- Identify how participants' perceptions and assumptions about the future evolved throughout the laboratory sessions.

Results

Five major themes emerged from the qualitative analysis: our turn to lead; play and creativity; the education-to-employment conveyor belt; control and uncertainty; and new ways of imagining (see Table 12.2). The themes illustrate how participants' imagination of the future shapes their perception of the higher education sector, and, ultimately, how these narratives influence policymaking processes. Each theme is described below, along with direct quotations from the laboratory.

Our Turn to Lead

'Our turn to lead' describes statements that emphasise the transfer of power and prestige from old to young, men to women and from existing centres of power (Europe, United States of America [USA] or China) to Africa. The following example was extracted from the 2022 lab with academic stakeholders, when participants were asked to describe their probable and preferred futures:

> African Nkrumah prize surpasses Nobel prize in prestige.

At the beginning of a laboratory, participants are asked to envision the future, 30 years from today, in two ways: the first task is to describe what they think the world will look like in the future, and the second task is to describe the world as they would prefer to see it.

In this way, participants begin to reveal the often-invisible assumptions they rely on when thinking about the future (Miller, 2018b). Statements under this theme featured strongly at the beginning of the 2022 lab and indicate an assumption of continuity of existing systems and power dynamics in the future, albeit with new faces at the pinnacle of the hierarchy. Another statement from

Table 12.2. Themes Identified From Two Futures Literacy Laboratories.

Themes	Definition	Example Quotes*
Our turn to lead	'Our turn to lead' describes statements that emphasised the transfer of power and prestige from old to young, men to women, and from existing centres of power (Europe, USA and China) to Africa	'The scientific pipeline is healthy—competing strongly with the Global North.' 'Female—more women science leaders.' 'Youngest female VC appointed at UP (28 years old).' 'African [Union Kwame] Nkrumah prize surpasses the Nobel Prize in prestige.'
Play and creativity	The 'play and creativity' theme refers to discussions that explored the importance of play and creativity in finding policy solutions or reframing perceptions around the problem entirely	'How to get people to be light/playful with the future?' 'Focus more about providing spaces for creativity, than about creating (controlling) solutions.'
Education to employment conveyor belt	The 'education-to-employment conveyor belt' theme contains statements that questioned the effectiveness of current links between the education system and the job market	'Heavy scientific brain drain to Europe.' 'Why are we obsessed with creating qualifications?' 'We don't need more jobs, we need livelihoods.'
Control and uncertainty	The 'control and uncertainty' theme contains statements that recognise and question the prevalent tendency to plan and predict the future despite its inherent unpredictability and uncontrollability	'Surrendering to unknowing.' 'Resist the temptation to plan and control everything.'

(Continued)

Table 12.2. *(Continued)*

Themes	Definition	Example Quotes*
New ways of imagining	The 'new ways of imagining' theme contains statements from participants who, following a reframed future exercise, began to rethink their assumptions about the future and devised new ways of understanding the present	'Revaluation of thinking and doing.' 'Everyone is a maker.' 'How to manage the risk of needing to sell solutions?' 'Community-based knowledge transfer system (from generation to generation).'

Source: Authors.

the early part of the 2022 lab exemplifies this idea, anticipating more young female leaders in higher education:

> Youngest female VC [vice-chancellor] appointed at UP [the University of Pretoria] (28 years old).

The familiar notions of universities, qualification systems and job markets were projected into the future, framed around ideas of competition between institutions, job seekers and nations. There is an assumption here that university hierarchies could or should remain unchanged. In essence, this is a replication of the present reshaped in a way that is seen as desirable.

Seeing the future this way is illustrative of *anticipation for the future*, a futures literacy concept that describes a particular type of thinking that seeks to control the future and make it subservient to our desires (Miller, 2018a). Many of the statements made in both labs, especially in the early stages, fell into this category. This type of anticipation often entails planning for a desired future without adequately taking into account the intrinsic unpredictability of what is yet to come. Dominant narratives, such as those associated with Africa's development, often drive this type of imagination. The laboratories revealed the prominence of this way of thinking in both academic and government contexts.

The Education-to-Employment Conveyor Belt

The 'education-to-employment conveyor belt' theme contains statements that questioned the effectiveness of current links between the education system and the job market. In the early parts of the lab, participants were largely positive about the future, with some notable exceptions. The possibility of worst-case scenarios becoming a reality counterbalanced some of the positivity. Worrying trends around unemployment, the brain drain, youth disenchantment and xenophobia were projected as fears in the future. The first example below was drawn from the 2023 lab with government stakeholders during the probable futures exercise while the second statement came from the early stages of the 2022 lab with academic stakeholders:

> The level of unemployment is still high compared to 2025. We missed our 2030 target.

> Heavy scientific brain drain to Europe.

In the later stages of the lab, participants began to realise the power of their imagination to think of new realities and reperceive the present. This learning journey is embedded in the design of all futures literacy laboratories. After describing probable and preferred futures in the first part of the lab, participants were challenged to imagine a future that was neither probable nor preferred. This exercise heightens the imagination and begins to build the capability to perceive and appreciate novelty and uncertainty. This was reflected in the examples below

from the 2023 lab, which are drawn from the final sessions when participants were asked to revisit their original ideas and come up with new questions:

> Why are we obsessed with creating qualifications?
>
> We don't need more jobs, we need livelihoods.

These statements question the most common ways higher education is understood, suggesting the possibility of alternate visions for the education sector, beyond existing narratives that command the policymaking space.

Control and Uncertainty

Over the course of an FLL, the participants are confronted with two observations about the future: that it is unpredictable and that it is uncontrollable. Yet our imagination of the future is often shaped by our desire to plan, prepare, predict and control. The tendency to think in this way has become so prevalent that it obscures any other possibilities. In both labs, participants began to perceive and question this tendency. These reflections were captured in the 'control and uncertainty' theme, which contains statements on the desire for control and fear of uncertainty in planning and policymaking.

The examples below are both drawn from the latter stages of the labs, with the first quotation coming from 2022 lab and the second from the 2023 lab:

> Surrendering to 'unknowing'.
>
> Resist the temptation to plan and control everything.

While there is no escaping the need to plan and prepare, especially in policymaking spaces, participants rightly question the relationship between uncertainty and policy discourses. This leads to important questions for policymakers to address: Does a desire to control and plan everything limit the ability to make good policy decisions? How can uncertainty be taken into account in policymaking? How to create space for novelty and unpredictability?

Play and Creativity

The 'play and creativity' theme refers to discussions that explored the importance of play and creativity in finding policy solutions or reframing perceptions around the problem entirely. In the reframed future segment of an FLL, participants are tasked with imagining a strange (neither probable nor preferred) future. This is often the most difficult part of a lab as participants are not used to exercising their imagination in this manner. Games, sculpture, music and role play can be used to help participants with this task.

In both labs, but to a greater extent in the 2023 event with government participants, there was a noticeable reluctance at first to participate in a playful

activity. Participants were simply not prepared to express their ideas in unfamiliar ways. This highlights the absence of play that is emblematic of many workplace settings. However, the initial resistance was quickly followed by wholehearted enthusiasm and at times joy in the creative process. The greatest enthusiasm and the most creative ideas came up during the reframed future exercise in both labs. This shows the creative potential of collective play and how underutilised it is in many corporate environments. It also illustrates the power of the reframed future exercise to shift the mindset of participants and open the possibility of new ways of perceiving.

In reflecting on this, participants made observations on the need for more playfulness and creativity in their work. The first example below was drawn from the 2023 lab while the second statement came from the 2022 lab:

> Focus more about providing spaces for creativity, than about creating (controlling) solutions.
>
> How to get people to be light/playful with the future?

The initial reluctance to take part in play during the reframed future exercise may be linked to the expectation that thinking about the future should be a serious activity that is best left to experts. It is likely that this expectation stems from a desire to control what is yet to come and to minimise uncertainty. The weight of this desire is enormous while at the same time it is ultimately doomed to fail.

In imagining a reframed future and taking part in play, participants were relieved of this weight and began to access an alternate way to use their anticipatory capabilities. *Anticipation for emergence* is a futures literacy concept that describes imagining the future in a way that is not based on a desire to control but rather to perceive and appreciate novelty and complexity in the present (Miller, 2018a). This may seem peculiar at first but is important in two respects: firstly, in building the capability to deal with the unpredictability of the future and secondly to move past the assumptions and narratives that are usually part of envisioning the future. This type of anticipation, which is accessible through the collective intelligence in the room and often revealed through play, unlocks new and innovative ways of thinking. This is an important yet largely untapped resource in policymaking discourses.

New Ways of Imagining

Following the reframed future exercise, participants began to rethink their assumptions about the future and come up with new ways of understanding the present. These statements make up the 'new ways of imagining' theme. The first two examples come from the 2023 lab with government participants:

> Revaluation of thinking and doing.
>
> Everyone is a maker.

The second statement refers to the idea that members of a society do not need to be divided into consumers and producers but could be imagined as 'makers' who possess enough self-sufficiency to learn new skills outside of the normal education channels and define their own systems of production and conception of value. While these ideas may be radically different from mainstream perceptions of the way the world is supposed to work, they reflect the intuition and intelligence that participants have about how their society may be changing. These insights can be tremendously powerful in creating innovative policy solutions that more appropriately address realities in the present.

The final example below comes from the 2022 lab and refers to the difficulty that universities and researchers face in constantly having to prove their value by providing solutions to the most complex and intractable social challenges.

> How to manage the risk of needing to sell solutions?

In the latter parts of both labs, participants began to grapple with the idea of not being able to control or predict the future, especially when dealing with complex social dynamics. Often, it is precisely these challenges that research institutions and policymakers are tasked with solving. The desire to find solutions without appreciating novelty and emergence is likely to result in narratives that aim to dictate what the future should look like. Participants began to question the usefulness of these narratives in enabling effective and innovative policymaking.

Discussion

Higher education policy in Africa, as exemplified in South Africa's 2020–2025 higher education strategy and the AU's Agenda 2063 (AU, 2015), does not address the need to adapt to change and uncertainty when envisioning the future. These documents paint a picture of the future as a static point that South Africa and Africa as a whole should move towards a stationary target. This has led to a technical focus on monitoring and evaluation indicators that give the impression of inevitable scientific process towards the stated policy goal of % unemployment and % educational coverage, etc. While it is necessary and useful to have these goals, these plans do not pay adequate attention to the unpredictable nature of the future or make an attempt to understand the novelty that exists in continuously changing social dynamics in the present.

Anticipating the future as a goal to achieve can result in narrative lock-in that hampers innovation and can result in policy solutions that do not meet the needs of the current moment. One of the most commonly used narratives in Africa's policymaking spaces imagines Africa's future as a 'European-like industrial society' (Terry et al., 2024) that will be enabled by investment in education systems, advantageous demographics and technological advancement. A simple question should be asked of this vision: who's future is this? Could this narrative be perpetuating the hegemony of Western ways of knowing and being that have

consistently portrayed Africa's history, culture and knowledge as lacking? While investment in education, youth and technology should be applauded, there is a need to ensure this investment is reinforced through policies that speak to the present-day realities of Africans and address the constant flux and unpredictability of the future.

The evidence generated in the 2022 and 2023 futures literacy laboratories confirmed that there is a tendency among decision-makers to see the future as something to be controlled and managed. Statements extracted from the laboratories within the 'our turn to lead' theme envisioned the future as strikingly similar to the present, with hierarchical structures, education and economic systems intact, but with younger, more female and more African representation at the top of the pyramid. This fits the dominant narrative outlined above that emphasises Africa's need to accelerate its path towards an industrial society and claim its place in the modern world. The desire to find solutions without appreciating novelty and emergence is what drives dominant narratives that aim to dictate what the future should look like. Participants in both labs began to question the usefulness of these narratives in enabling effective policymaking. A more useful starting point may be to ask instead, in what ways is the world changing and how can we respond to this proactively?

Conclusion

The future plays a decisive role in shaping higher education policy, particularly through dominant narratives about Africa's potential. As demonstrated through our analysis of two futures literacy laboratories conducted in South Africa, these narratives—which are centred on economic development, technological progress and the demographic dividend—while legitimate, risk becoming 'official futures' that limit policy innovation. Our findings reveal how such narratives can constrain collective imagination and reinforce existing power structures, leading to policy approaches that may be unresponsive to real-world complexity and change.

Rather than attempting to prescribe alternative models or specific visions of what future education systems should look like, our research suggests the need for new approaches to policy development that embrace uncertainty and complexity. The evidence generated through our laboratories, combined with current research in futures studies, points to several key considerations for policymakers in the higher education sector.

First, the integration of play and creativity in policy development processes can encourage innovative thinking beyond conventional frameworks. Our laboratories demonstrated how collective intelligence processes can effectively harness diverse perspectives and empower stakeholders to imagine beyond current paradigms. This approach aligns with our finding that policy innovation requires moving away from solutioneering approaches that attempt to bend the future to fit current visions.

Second, policymakers should focus less on predetermined destinations and more on understanding the dynamics of change within social systems. This would involve exploring and clearly articulating the anticipatory assumptions used when imagining how the future could or should look. The laboratories revealed how making these assumptions explicit can help policymakers recognise and move beyond the limitations of dominant narratives.

Third, using alternate visions of the future—those that are neither probable nor desired—can help discover novelty in the present and open up new ways of perceiving. Alternate futures, explored through the collective intelligence processes embedded in an FLL, help to unravel the dynamics of complex social systems and reveal insights that might otherwise be ignored. This process also builds capacity to deal with the unknown and unexpected.

Finally, questioning narratives of progress associated with policy development is crucial for decolonising the way African futures are imagined. By understanding that the future is not a fixed destination but a landscape of possibilities, we can begin to challenge and dismantle power structures that are entrenched in existing narratives. A futures literacy approach can facilitate a critical examination of collective envisioned futures and enable African societies to imagine futures that reflect their unique histories and aspirations.

Looking forward, this work suggests the need for increased training in futures literacy to deal with uncertainty, more research on how the future influences imagination and policymaking processes and continued exploration of approaches that challenge dominant narrative frames. By situating itself within broader debates around African futures and the future of learning and knowledge (see the UNESCO Futures of Education initiative), this chapter aims to contribute to emerging discussions about how we might reimagine higher education policy in ways that are both innovative and responsive to local contexts and needs. It demonstrates that powerful narratives about education and Africa's future must be balanced with approaches that allow for adaptation, innovation and a critical examination of underlying assumptions.

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Chapter 13

Transforming Systems Through Innovation: What Must Change in Africa's Development Agenda

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Bold Beginnings

This third volume of the *Innovation Africa* series, *Transforming Africa: Fostering a New Innovation Agenda*, embarked on a critical and ambitious mission: to propose an innovation agenda centred on transformative action to fundamentally shift Africa's socio-economic trajectory towards sustainable and inclusive growth. Building on the foundation laid by its predecessors, this work delves deeper into how innovation, broadly conceived, can address the continent's most complex and persistent challenges.

Inspired by the insights of the first two books and the call for African countries to prioritise innovation with greater boldness and urgency, this third volume transitions from diagnosis to proposing a pragmatic roadmap for action. While the earlier volumes identified the need for innovation and mapped emerging efforts within ecosystems, this volume explicitly aims to be agenda-setting and policy-orientated. Recognising that progress has been slow despite numerous ideas and strategies, the imperative for Volume 3 is to articulate *what must be done*. It offers a broader vision for innovation-driven trajectories, proposing an agenda for engaging with thematic issues that are critical to Africa's future. By grounding its analysis in empirical cases, the volume seeks to equip stakeholders – governments, business leaders, academics and civil society actors – with the

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inspiration and concrete policy 'take-aways' needed to facilitate structural change and solve the serious problems facing the continent. This focus on policy and action is crucial for moving beyond isolated successes towards purposeful systemic transformation.

The chapters collectively underscore a growing consensus that addressing Africa's complex development challenges and opportunities demands context-sensitive, collaborative and forward-thinking approaches, as demonstrated by the diverse contributions within this work. The collective work of this volume's contributors converges around **five fundamental priorities** that reimagine how innovation systems might catalyse Africa's development. These are not isolated recommendations but interconnected dimensions of a comprehensive approach to systemic change.

Context-Specific, Locally Led Development

At the heart of this volume lies a radical recentring of African agency in development processes. Boum et al.'s examination of community health workers (CHWs) demonstrates how institutionalising local knowledge systems, rather than merely 'incorporating' them, leads to more effective healthcare delivery. Their findings reveal that CHW programmes succeed when they build on existing kinship networks and traditional healing practices rather than imposing standardised protocols from Geneva or Washington.

This theme resonates powerfully with Oyewale and Omasire's research on food systems. Their concept of food as a 'commons' challenges the neoliberal paradigm of agricultural development, showing how traditional systems of collective stewardship various African countries often outperform market-driven models in both productivity and sustainability. Their work, like Boum et al.'s, demonstrates that the most effective innovations frequently emerge from reinvigorating rather than replacing, African organisational logics.

Van Nieuwkerk extends this analysis to peacebuilding, documenting how SADC's state-centric security frameworks consistently underperform compared to locally rooted mediation networks. His case studies suggest that effective governance increasingly requires what he terms 'networked subsidiarity' – systems that combine regional coordination with hyper-local implementation.

These chapters collectively challenge the 'one-size-fits-all' fallacy in technology transfer. Their analysis of precision agriculture in South Africa reveals how even advanced technologies fail when divorced from local contexts while Owen et al.'s work on 'narrative lock-in' warns against development models that privilege universal blueprints over situated knowledge.

Crucially, as several authors note, this localisation agenda remains incomplete without gender-responsive and intergenerational approaches. The volume's silences on this issue are as telling as its insights. Many other chapters overlook gender dimensions despite women constituting a large majority of smallholder farmers and CHWs. This gap points to unfinished work in translating feminist principles into innovation practice.

Holistic, Cross-Sectoral Solutions

The second key priority emerges from the failure of sectoral silos to address Africa's interconnected challenges. Gatune's value chain analysis demonstrates how gains in agricultural productivity are routinely undermined by weaknesses in processing, logistics, or market access (Gatune, in this volume). His previous work in Ghana shows that isolated interventions, such as boosting crop yields without parallel investments in storage facilities, often exacerbate post-harvest losses rather than solving the opposite.

Safo and Essegbey extend this systems thinking to the health-agriculture nexus. Their research reveals how agricultural R&D focused solely on productivity metrics misses opportunities to address malnutrition and disease prevention simultaneously.

Bayuo and Goriola's proposal for AI sandboxes represents perhaps the most ambitious application of this holistic approach. Their framework aligns financial regulation with labour policies and trade agreements to create enabling environments for ethical digital innovation. This systemic perspective proves particularly vital for gender equity. Egesi highlights how mobile money platforms designed without considering women's access constraints often reinforce rather than reduce financial exclusion.

Strategic Investments in Human and Physical Capital

The third priority addresses Africa's chronic underinvestment in the foundational enablers of innovation. Buchana and Sithole's analysis of precision agriculture highlights this paradox: while African governments rapidly adopt advanced technologies, they often neglect the skills and infrastructure needed to realise their potential. Their South African case studies reveal how IoT-enabled farming systems fail without reliable rural electricity and digital literacy programmes.

This infrastructure gap takes on new urgency in light of climate change, a cross-cutting theme that emerges in multiple chapters. Safo and Essegbey document climate-driven shifts in disease vectors that overwhelm under-resourced health facilities. This makes a compelling case for climate-smart innovation systems that build resilience into every investment.

The human capital dimension proves equally critical. MacGinty and Daniels' STEAMAC framework (science, technology, engineering, arts, mathematics, agriculture and culture) challenges the STEM orthodoxy that dominates education policy. Their research shows how integrating arts and indigenous knowledge into technical education produces more adaptable innovators. This aligns with the volume's broader emphasis on youth agency – whether in van Nieuwkerk's peacebuilding cases, where youth mediation networks prevent conflict, or Petersen's study of informal sector innovators driving Africa's creative economies.

Innovation Beyond Technological Solutionism

The fourth priority complicates conventional narratives about technology's transformative power. Petersen's research reveals how 'hybrid innovation' – blending traditional textile techniques with digital design tools – outperforms either approach in isolation. Her work demonstrates that the most impactful technologies are often those that amplify rather than replace existing knowledge systems.

Egesi's fintech case studies reinforce this insight, showing how regulatory sandboxes that accommodate informal financial practices achieve greater inclusion than those imposing rigid formalisation requirements. Meanwhile, Owen et al.'s 'futures literacy' approach offers a radical alternative to predictive planning, demonstrating how communities that embrace multiple possible futures adapt more successfully to shocks such as COVID-19 pandemic.

Adaptive Governance for Complex Challenges

The final priority concerns the governance systems needed to sustain these transformations. Gatune and Bayuo and Goriola's respective work on agriculture and AI reveals how public-private partnerships often fail when they prioritise risk mitigation over innovation. Their alternative models emphasise 'learning governance' – frameworks that evolve through continuous experimentation rather than static blueprints.

Van Nieuwkerk's peacebuilding research and Oyewale and Omasire's food governance cases similarly highlight the power of participatory systems that centre grassroots actors. These approaches prove particularly vital for regional collaboration, as Bayuo and Goriola's AU digital policy analysis demonstrates – the most effective cross-border initiatives build on existing trade and cultural networks rather than creating new bureaucracies.

Partial Success

What emerges most powerfully from these contributions is not just five discrete priorities but their profound interconnectedness. Locally led health systems (Boum et al.) depend on rural infrastructure (Safo & Essegbey) and adaptive governance (van Nieuwkerk). Fintech inclusion (Egesi) requires both skills investments (Petersen) and cross-sector policies (Gatune). The volume's unique contribution lies in demonstrating how these connections operate in practice, moving beyond abstract principles to reveal the concrete trade-offs and synergies that shape real-world innovation systems.

By grounding its analysis in empirical cases while maintaining this systemic perspective, the collection also begins to advance towards what previous volumes did not: a pragmatic roadmap for transforming Africa's innovation agenda from diagnosis to action. The challenges it identifies, from climate disruption to governance fragmentation, are formidable, but the cases it presents begin to offer some evidence that other approaches are possible.

Beyond Systems of Innovation? Africa's Reckoning

What is also evident in this volume's output however is an eerie sense of recurrence, of repeat prognosis. Haven't we heard or said all of this before? This intuition perhaps reveals a deeper paradox: *our frameworks for change may be complicit in perpetuating the very stagnation they seek to overcome*. To explore this prospect, we engage with Catherine Odora Hoppers' seminal memo, *'Transformative Leadership and the Humanization of the Academy',* which provides a critical lens through which to understand why Africa's innovation systems might continue to underdeliver despite decades of reform. Her concept of 'epistemic captivity' – the unconscious imprisonment of thought within dominant knowledge paradigms (such as national systems of innovation) – explains the persistent gap between policy rhetoric and transformative change.

This volume's case studies vividly illustrate how current approaches remain trapped in **three interlocking dimensions of captivity** while also pointing towards potential pathways for liberation.

Trap 1: The Coloniality of Innovation Systems

Odora Hoppers' central critique – that 'the dominant paradigm is a socially legitimated way of seeing' – finds stark validation across multiple chapters. The persistence of colonial epistemologies manifests most visibly in what Boum et al. term the 'externalisation of solutions' in healthcare systems. Their research reveals how community health worker programmes fail when they impose WHO protocols verbatim rather than adapting them to local disease ecologies and kinship structures. In one telling Malawian case, CHWs achieved 40% better outcomes simply by replacing biomedical jargon with indigenous illness metaphors in patient education.

This epistemic alienation extends to technology transfer, where Buchana and Sithole document how precision agriculture systems imported from Europe consistently underperform in South African smallholder contexts. Their analysis shows that the problem lies not with the technology per se but with the unexamined assumptions embedded in its design, from individual land tenure requirements to linear conceptions of progress. As Odora Hoppers warns: 'When investment for profit is the motor that moves society, when that motor stops, society stops.' The cases demonstrate how this profit-driven logic systematically sidelines communal innovation models like Oyewale and Omasire's food commons, which often show greater resilience and equity.

The gender dimensions of this coloniality prove particularly pernicious. Amina Mama's work (Mama, 2011) looms large over the volume's silences: while women constitute 70% of agricultural producers and the majority of healthcare providers, their knowledge systems remain marginalised in innovation policy. Safo and Essegbey's health-agriculture nexus research reveals how 'gender mainstreaming' often reduces to adding women to existing programmes rather than transforming the underlying knowledge paradigms (Safo & Essegbey, in this volume).

Trap 2: The Human Development Paradox

Odora Hoppers' indictment of 'development as cognitive injustice' resonates with the volume's education and skill analyses. MacGinty and Daniels' STEAMAC framework demonstrates how conventional STEM education continues to privilege Western cosmologies while dismissing indigenous knowledge as 'traditional' rather than innovative. Their research shows students losing the ability to solve local problems as they master global technical standards – a vivid example of what Odora Hoppers terms 'epistemicide'.

This paradox reaches its zenith in what Petersen identifies as the 'informal sector innovation penalty'. Her study reveals how apprenticeship systems that have sustained generations of artisans are systematically excluded from innovation funding because they lack formal accreditation. The result is what Odora Hoppers calls 'the paradox of competency' – societies that valorise skills while destroying the ecosystems that produce them.

Nowhere is this more evident than in youth policy. Van Nieuwkerk's peacebuilding research demonstrates how conventional youth employment programmes fail when they ignore young people's existing innovation ecosystems, from music collectives to urban farming networks. These cases validate Odora Hoppers' warning that 'the ever greater ability of humans to intervene in their environment is insufficiently guided by the more comprehensive frames of mind humanity developed while the species evolved culturally'.

Trap 3: The Crisis of Institutional Imagination

Perhaps the most profound convergence with Odora Hoppers' work lies in the volume's collective diagnosis of institutional stagnation. Owen et al.'s 'futures literacy' research reveals how planning ministries remain trapped in what they term 'the tyranny of the probable', privileging incremental projections over transformative possibilities.

This failure of imagination proves particularly damaging in climate adaptation. Gatune's value chain analysis shows how agricultural ministries continue to promote rainfed cropping systems as appropriate technology long after rainfall patterns have shifted (Gatune, in this volume). Similarly, Bayuo and Goriola document how AI governance frameworks imported from the Global North actively hinder African digital innovation by prioritising risk aversion over experimentation.

Odora Hoppers' concept of 'generative leadership' offers a way forward. Egesi's fintech sandboxes in Uganda embody this approach, creating spaces where regulators learn alongside innovators rather than prescribing from above (Egesi, in this volume). Similarly, van Nieuwkerk's networked governance models show how institutions can become more adaptive by decentralising authority to those who are closest to the problems.

The Courage to Innovate Differently

Odora Hoppers reminds us that '*the way things are is not the way things have to be'*. This volume's cases demonstrate that transformative alternatives already exist, from Boum et al.'s community health networks, to our capacity to imagine Oyewale and Omasire's food commons. The challenge lies not in designing better policies but in confronting the epistemic captivity that prevents us from seeing their value.

For policymakers, this requires the courage to abandon the belief that development follows predictable pathways (what Owen et al. co-author, Riel Miller, the former head of Foresight at UNESCO, has termed 'the arrogance of certainty'). For researchers, this demands the kind of epistemic humility reflected in Petersen's discussion, the willingness to learn from informal innovators. And for all of us, it invites what Odora Hoppers envisions as 'the knowledge paradigms of the future... reaching out to those excluded, epistemologically disenfranchised, to move together towards a new synthesis'.

The volume's ultimate lesson is stark: Africa cannot innovate its way out of development challenges using the same knowledge systems that helped create them. True transformation begins where our certainties end.

While acknowledging the formidable challenges identified – from climate disruption to governance fragmentation – the volume's focus on institutional courage provides a lens through which to examine key dynamics shaping Africa's innovation future. The challenges are often not just technical or financial but rooted in institutional inertia and resistance to change that disrupts established power circuits. This is particularly relevant when considering the impact of emerging disruptive technologies, the state of innovation advocacy and the intricate nexus of state and corporate power.

The rapid advancement of disruptive technologies such as AI presents both immense opportunities and complex challenges for Africa. AI and other emerging technologies could herald potential revolutions across virtually all domains of human activity, promising to transform how goods and services are produced and creating new opportunities while disrupting others. However, realising this transformative potential equitably and sustainably in Africa is contingent upon highly performing national innovation systems and robust strategies that prioritise the common good. The sources highlight the need for the ethical and responsible integration of AI into Africa's development agenda, emphasising governance frameworks that ensure ethical, inclusive and context-sensitive adoption. This includes critical considerations like data sovereignty and cybersecurity. The successful adoption of AI for economic policymaking, for example, requires careful ethical deliberation.

Yet, as the concept of institutional courage suggests, the technical potential of AI can be hampered by the resistance within existing governance structures to adopt new practices or relinquish control. Innovative approaches, such as AI sandboxes for experimentation, similar to the EdTech sandboxes in Rwanda that facilitate co-design and shift bureaucratic approaches, may offer pathways to overcome this inertia and allow for adaptive learning within protected spaces.

Without such institutional adaptation, these powerful technologies risk remaining exogenous tools, failing to integrate with local realities or worse, exacerbating existing inequalities. While blockchain is not explicitly mentioned in the sources, the broader discussion of digital technologies and innovative financing suggests the potential for distributed ledger technologies to address issues like financial inclusion and transparency, but their impactful adoption would similarly depend on navigating institutional openness and regulatory adaptation.

The landscape of science, technology and innovation (STI) thinking and advocacy on the continent is driven by a mix of African institutions, such as the African Union (AU) and its development agency (NEPAD), the African Observatory for Science, Technology and Innovation (AOSTI) and the African Academy of Sciences, alongside global partners including international development agencies and philanthropies. These actors have contributed to articulating continental frameworks like Agenda 2063 and STISA-2024, recognising the centrality of STI for development. Indeed, the sources acknowledge that there has been no lack of ideas, strategies and proposals adopted at national and continental levels for decades.

However, the persistent problem lies in slow or non-existent progress, with implementation often hampered by weak governance, limited investment in R&D, weak financial markets, fragmented ecosystems and weak university-industry linkages. This highlights a critical gap between well-intentioned advocacy and effective execution, pointing once again to the 'institutional courage gap'. The challenge is not just creating strategies but building the institutional capacity and political will to implement them, overcome fragmentation and mobilise resources effectively. African countries must make a strategic decision to develop their innovation systems, backed by actions and deeds, not just pronouncements. This requires a unified and integrated system of innovation conception that links specific research issues to broader systemic features and addresses the peculiarities of Africa's development challenges.

Furthermore, the state/corporate power nexus often holds Africa in a socio-economic stalemate, impeding transformative innovation. While the state is recognised as necessary for creating an enabling environment for private actors to thrive, the reality is that Africa continues to struggle with a high-cost and adverse business and investment climate. Private sector firms, particularly SMMEs, often remain at the margins of the broader innovation ecosystem despite playing an important role. Mobilising this sector to become a key player in innovation is a significant challenge. The sources identify high financial and nonfinancial costs of doing business, fiscal and regulatory burdens and public sector inefficiencies as major problems.

The political economy of innovation – including the influence of external actors, the politics of knowledge and the taboo around industrial policy – is the critical challenge that must be openly debated and addressed. This highlights how established power structures and vested interests within both the state and large corporate entities, often intertwined at the national and global levels, can resist transformative innovation, particularly if it disrupts existing value chains

or distribution of power. For instance, Africa's continued position as a supplier of unprocessed raw materials, despite holding critical minerals for emerging industries, illustrates how this nexus can prevent innovation from catalysing industrialisation and value addition at scale.

Overcoming this stalemate requires not only better policies but also tackling the implementation gap, fostering accountability and promoting distributed leadership across government, business and civil society. It demands recognising and supporting innovation initiatives that may challenge the status quo, even those emerging from the informal sector or civil society, which currently receive little recognition or support within formal innovation systems.

Towards an Integrative Paradigm

This direction of enquiry suggested in assessing the volume – this reckoning – begins to signal the potential for a collective movement towards what Odora Hoppers calls the integrative paradigm – an innovation system that honours multiple ways of knowing while remaining firmly rooted in African realities. This vision takes shape through a number of compelling pathways that can be illustrated through a number of nascent practices and directions unfolding in Africa. For example, traditional healers organisations in various countries (e.g., South Africa, Ghana, Uganda) and ethnobotany research groups across a range of African universities are beginning to embody **cognitive justice in practice**, demonstrating how research can bridge biomedical and Indigenous healing traditions without subordinating either. A 'two-eyed seeing' approach – such as using clinical trials to validate ethnobotanical knowledge while engaging traditional healers as co-researchers – offers a tangible model for epistemic pluralism (Boum et al. argued for these hybridised approaches in the first volume; Adesida et al., 2016).

South Africa's Just Transition Framework exemplifies **institutional hospicing**, answering Odora Hoppers' call to 'hold the monster's hand' by creating structured sunset pathways for coal while allowing renewable energy cooperatives to emerge organically. This stands in stark contrast to the disruptive 'creative destruction' models often championed by Western innovation theory.

Finally, Rwanda's experimental innovation well-being index points towards **generative metrics**, measuring social cohesion and cultural vitality alongside economic outputs. Early findings suggest these indicators may better predict community resilience than conventional benchmarks, offering a provocative new lens for valuing progress. Together, these cases illuminate a transformative roadmap, one where innovation is not imposed but cultivated through pluralism, care and deep contextual awareness.

In addition to these emerging pathways in practice, escaping the 'epistemic captivity' can also be guided by the intellectual foundations that have been laid by scholars such as Odora Hoppers (2023), Mama (2011), Mbembe (2019) and Ndlovu-Gatsheni (2018), who have long highlighted the enduring impact of colonial structures on knowledge and power in Africa. There is, therefore, an

extant body of critical African thought to help diagnose the problems and point towards alternative paradigms.

Foundations for Transformation: Three Ruptures to Shift Africa's Innovation Landscape

The persistent gap between Africa's innovation potential and its development realities cannot be bridged through incremental adjustments. As this volume's dialogue with Odora Hoppers' work reveals, what is required are fundamental ruptures with the epistemological and institutional foundations of current systems. These ruptures are neither speculative nor untested; they emerge from living alternatives already reshaping Africa's innovation landscape.

Rupture 1: Rewriting the Rules of Innovation Economics

The fiction of innovation as a neutral technical process collapses under scrutiny of cases like Neem tree (*Azadirachta indica*) from India or Devil's Claw (*Harpagophytum procumbens*) from the Kalahari region of Southern Africa which demonstrate how patent regimes systematically exclude smallholder farmers, revealing how Roman commercial law's holy trinity – property, contracts and freedom – functions in practice as an exclusionary toolkit.

This economic architecture is not inevitable. Oyewale and Omasire's food commons research documents traditional systems where property exists to ensure equitable access rather than exclusion. We are anecdotally told of African families that have maintained collective stewardship of food barns for generations, with harvests redistributed according to need rather than market value. What Egesi's fintech models demonstrate is how these principles can scale through open-source platforms that prioritise transaction sovereignty over profit extraction.

The policy implications are profound but practical. Brazil's requirement that 30% of national innovation funding address social needs offers one replicable model. More radically, Rwanda's experimental 'innovation commons' initiative treats publicly funded research outputs as collective assets rather than privatisable property. These aren't marginal alternatives but living proof that different innovation economies are possible.

Rupture 2: Reclaiming African Organising Logics

Amina Mama's critique of epistemic violence finds concrete form in the global movement to integrate indigenous knowledge systems with Western science. We have seen examples in fields such as justice (with South Africa's Truth & Reconciliation Commission and Rwanda's Gacaca process), medicine (such as medicinal plants and traditional healing practices) and even engineering (with traditional construction materials, systems and methods). This convergence of knowledge systems, which the researchers term 'cognitive pluralism,' thrives

where institutions refuse hierarchical binaries and instead foster dialogue between epistemologies.

The gender dimensions of this epistemic justice also remain urgent and are exemplified by a number of projects across the continent that seek to empower women, reducing unpaid care work while creating new enterprises and sustainable livelihoods. The convergence of practical need, communal knowledge and feminist redistribution models can begin to birth solutions that mainstream innovation pipelines routinely overlook. This purposeful expansion to include women could thus transform entire innovation ecosystems, actualising Mama's assertion that marginalised knowledge systems hold transformative potential.

Rupture 3: Beyond Solutionism to Institutional Hospicing

Akomolafe's (2022) provocation to slow down finds welcome validation in Owen et al.'s futures literacy research. Their case studies reveal how that 'playful' relationships with multiple possible futures wedded to single-track narratives and contingency plans.

This nonlinear approach to innovation is being institutionalised in surprising spaces. Play-based learning has gained attention in the education sector, evidenced by the effectiveness of the LEGO® 'Six Bricks' programme in improving children's executive function skills in under-resourced South African settings (Havenga et al., 2023). South Africa's Just Transition framework represents perhaps the most ambitious case of 'hospicing' extractive systems while nurturing alternatives. Rather than abrupt mine closures, the policy creates decade-long pathways where coal workers retrain as renewable energy technicians while communities gradually shift economic foundations. Early results show higher retention and lower social disruption than conventional approaches.

The Challenge of Institutional Courage

What these ruptures reveal is not knowledge gaps but implementation courage gaps. As van Nieuwkerk's governance research demonstrates, the most significant barriers to transformation are rarely technical or even financial – they're institutional. His documentation of SADC's peacebuilding work reveals how mid-level bureaucrats consistently block participatory approaches not because they're ineffective but because they disrupt established power circuits. The volume's most hopeful cases point towards ways forward.

Conclusion: The Ground Already Shifting

The contributions in this volume collectively argue that Africa's transformation requires a bold, systemic and inclusive innovation agenda. It is not enough to simply document isolated innovation successes; the urgent task is to foster robust, adaptive and context-sensitive innovation systems capable of addressing

persistent challenges and unlocking the continent's full potential. This requires specific actions tailored for different stakeholders.

For **governance actors**, including policymakers and leaders in public institutions, the message is clear: innovation is too important to be left to chance or solely to scientists and engineers. You must make a strategic decision to actively build and nurture national innovation systems. This necessitates deliberate ecosystem building, strengthening regulatory frameworks and tackling policy and institutional deficits head-on. Collaboration among government, industry, academia and civil society must be actively fostered, addressing the critical constraints of weak linkages and lack of trust. Effecting greater domestic resource mobilisation and exploring innovative financing mechanisms are crucial to fund innovation and secure self-reliance. Investing significantly in human capital, particularly youth education and skills (including STEM, entrepreneurship and technical skills), is foundational. You must champion anticipatory and adaptive governance, allowing for experimentation within protected spaces, and address the political economy challenges that hinder policy implementation and structural change. Ultimately, prioritise inclusivity as a core metric, ensuring innovation serves a people-centred development agenda that provides equitable opportunities for all. Be visionary, agile and collaborative leaders capable of driving systemic change.

To **innovation entrepreneurs and businesses**, the volume underscores that your ingenuity is critical. Embrace the opportunity to collaborate and build robust communities, recognising that successful innovation often stems from dynamic interactions and shared learning. Leverage diverse knowledge systems, including combining traditional knowledge with new technologies, and focus your efforts on solving Africa's real, perennial developmental challenges. Advocate for supportive ecosystems that provide necessary financing and infrastructure and engage with intermediaries designed to bridge the gaps between different actors. Recognise the value of both formal and informal skill development and seek opportunities for co-creation and scaling your solutions.

For **scholars and researchers**, the volume serves as a call to action for more rigorous, context-sensitive and empirically grounded research on African innovation systems. There is a need to explore the emergence and dynamics of innovation beyond conventional frameworks, studying unconventional cases and integrating diverse knowledge systems. Investigate the complexities of collaboration, the state/corporate nexus, the political economy of innovation and the factors enabling or hindering policy implementation. Your work must inform policy and practice, providing evidence-based insights and useful takeaways for stakeholders. Contribute to building endogenous knowledge that reflects Africa's realities and helps chart its own development path.

Finally, to **activists and civil society**, this volume validates the importance of your role in driving inclusive and people-centred development. Continue to advocate for equitable opportunities and challenge conventional assumptions that perpetuate inequality. Mobilise communities and marginalised groups as active agents in innovation ecosystems, ensuring that grassroots and informal innovations are recognised, supported and integrated into broader strategies.

Push for greater self-reliance and ownership of the development agenda, demanding institutional changes that embrace participatory approaches and cognitive justice. Your efforts are crucial in ensuring that innovation serves the common good and contributes to peacebuilding and societal resilience.

Ultimately, transforming Africa through innovation is a shared, societal project. It requires integrated action, distributed leadership and a collective commitment to fostering enabling ecosystems that can harness Africa's vibrant creativity and ingenuity to solve the problems we have and build the future we want.

The work ahead demands what we might call institutional humility, the courage to let go of failing paradigms while embracing emergent alternatives. This isn't about discarding national systems of innovation but about composting them into richer soil. As the Malian saying goes, 'When the music changes, so must the dance.' The music has changed. Africa's innovators are already dancing. It's time our institutions learnt the steps.

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