African Transformation Report 2021

Integrating to Transform

ACET African Center for Economic Transformation

Published By

The **African Center for EconomicTransformation** is a pan-African economic policy institute supporting Africa's long-term growth through transformation. We produce research, offer policy advice, and convene key stakeholders so that African countries are better positioned for smart, inclusive, and sustainable development. Based in Accra, Ghana, we have worked in nearly two dozen African countries since our founding in 2008.

Contact
African Center for Economic Transformation (ACET)

Ghana
Office Location
7 Yiyiwa Drive
Abelemkpe, Accra - Ghana
Digital address: GA-123-5982
Phone: +233 (0) 0242436858
E-mail: info@acetforafrica.org
Web: acetforafrica.org

Mailing address
Cantonments
PMB CT 4
Accra, Ghana

United States
1776 K Street, NW
Suite 200
Washington DC
20006
Phone +1 202 833 1919

Cover Photograph
Shutterstock | Freepik | Unsplash

Design
Dilucidar - www.dilucidar.com

Contents

ACKNOWLEDGEMENTS ..... **IV**
FOREWORD ..... **VII**
PREFACE ..... **VIII**
OVERVIEW **1**
01. CREATING JOBS FOR YOUNG AFRICANS **45**
Africa's youth bulge 46
Equipping the workforce of tomorrow: education and skills 49
Improving educational outcomes *49*
Shifting focus in education from quantity to quality *51*
Harnessing the power of new technologies *52*
Putting Africa's young people to work 53
Modernizing agriculture *53*
Expanding export-oriented manufacturing *56*
Digitizing services *56*
Harnessing tourism *57*
Supporting the emerging creative economy *58*
Promoting unfettered regional labor mobility *58*
Accelerating Africa's demographic transition 61
Reducing mortality *61*
Promoting the fertility transition *62*
Priorities for action 64
Scaling up education and skills training *64*
Creating opportunities for productive employment *65*
Increasing regional collaboration for labor mobility *66*
Accelerating the demographic transition *67*
References 68
End notes 71
02. FOSTERING DIGITAL INNOVATION **73**
Africa's digital and innovation landscape 75
Africa's digital and innovation ecosystems 77
Tech hubs *77*
Corporate trailblazers *79*
E-commerce *80*
E-agriculture *81*
E-government *84*
Barriers to, and opportunities for, innovation and digital transformation *86*
Innovation and digital opportunity from COVID-19 ..... *88*

Broad policy agenda for innovation and digital initiatives 89
Comprehensive national strategies 91
Updating policies and regulations 93
Keeping markets open 93
Privacy, security, and consumer protection 94
Engaging more stakeholders 95
Linking digital innovation to job creation 96
Priorities for action 98
Formulating strategies and establishing policy frameworks 98
Integrating innovation ecosystems 99
Boosting investments in digital infrastructure and skill development 100
References 101
End notes 105
03. MANAGING CLIMATE RISKS 107
Surveying the risks of climate change 109
Agriculture under threat 110
Ecosystems under threat 111
Potential for renewable energy 112
Broad policy agenda to manage climate risks 113
Leveraging climate-smart agriculture 114
Managing Africa's ecosystems 120
Nature-based solutions 120
Forests 121
Coastal and ocean ecosystems 121
Harnessing renewable energy technologies 123
Priorities for action 126
Promoting climate-smart agriculture 127
Sustaining green and blue ecosystems 128
Developing and scaling up renewable energy 129
References 131
End notes 139
04. PURSUING REGIONAL COLLABORATION AS THE ROUTE TO INTEGRATION 141
Africa's regional agreements and structures 144
Broad policy agenda for regional collaboration 149
Spillovers 149
Benefits 149
Financing 150
Hydropower and regional water collaboration 150
Regional power markets 152
Road networks 155
Digital connectivity 156

Applying a problem-driven approach to providing regional public goods 157
COVID-19 as an opportunity to jump-start regional collaboration *161*
Priorities for action 162
Reframing regional collaboration as addressing national problems *162*
Assembling coalitions for change *164*
Using the AfCFTA's political momentum for wider regional public good implementation *165*
Collaborating to tackle the three frontline challenges covered in this report *165*
Ensuring productive employment *165*
Supporting digital innovation *166*
Managing climate risks *167*
References 169
End notes 172
ANNEX 175

INFOGRAPHICS / FIGURES / TABLES

Infographic 1: *Frontline Challenges* *3*
Infographic 2: *Growing Slower - Not Transforming* *6*
Infographic 3: *Trading For Growth With Depth* *8*
Infographic 4: *Nurturing Digital Innovation Ecosystems* *16*
Infographic 5: *Responding To Climate Change With Climate Change Policy* *22*
Infographic 6: *Managing Climate Risks* *24*
Infographic 7: *Integrating To Transform* *32*
Infographic 8: *National Priorities Have Regional Solutions* *35*
Infographic 9: *The Need For Visionary Leadership* *40*
Figure 1.1 *Most of the workforce in Africa is projected to enter the low paid informal sector* *47*
Figure 1.2 *Sub-Saharan Africa's Human Capital Index lags behind other regions* *49*
Figure 1.3 *Secondary enrollments in Sub-Saharan Africa lag far behind other regions* *50*
Infographic 2.1 *Nurturing digital innovation ecosystems* *78*
Table 2.1 *Digital agricultural technologies in Africa* *82*
Table 2.2 *Opportunities and barriers in innovation and digital transformation in Africa* *87*
Table 2.3 *Digital transformation opportunities can inform national strategies* *92*
Figure 3.1 *Africa has good potential for renewable energy* *112*
Infographic 4.1 *Integrating to transform* *143*
Figure 4.1 *Memberships intersect across regional organizations and regional economic communities* *145*
Figure 4.2 *Africa's international river basins and freshwater agreements* *151*
Figure 4.3 *Sub-Saharan regional power pools* *153*
Figure 4.4 *Complementing the traditional top-down approach with a bottom-up approach to collaborating for the provision of regional public goods* *163*
Annex A – Table 4.1 *Six steps of an iterative regional public good approach for policymakers* *176*

Acknowledgements

A core group of ACET staff and contributing policy experts comprised the research and writing team that produced the third African Transformation Report, *Integrating to Transform*. Within ACET, the team included Edward K. Brown, Senior Director; Rob Floyd, Director and Senior Advisor; Roberto Tibana, Director of Research; John Asafu-Adjaye, Senior Fellow; and Yohannis Tessema, ACET Transformation Fellow. External experts and consultants on the team included Chux Daniels, University of Sussex; Klaus Tilmes, Senior Advisor and Development Consultant; Bruce Byiers, European Centre for Development Policy Management; Jaime de Melo, Fondation Pour les Etudes et Recherches sur le Développement; and John May, George Mason University. Additional ACET senior leadership—including K.Y. Amoako, Founder and President; Mavis Owusu-Gyamfi, Executive Vice President; and Daniel Nti, Chief Operating Officer—provided strategic guidance and additional support throughout the production process.

The Transformation Leadership Panel (TLP) played an integral role in helping shape and refine the conceptual framework for the report and by providing valuable feedback and inputs around the thematic areas explored. Established by ACET in 2019, the TLP is a body of eminent figures from Africa and around the world united by a shared mission to influence, support and advise leaders on critical and necessary action to achieve transformative change in Africa. The Panel is chaired by Her Excellency, Ellen Johnson Sirleaf, former President of Liberia. Members include Masood Ahmed, President, Center for Global Development; K.Y. Amoako, Founder and President, ACET; Dolika Banda, former CEO, Africa Risk Capacity; Charles Boamah, former Senior Vice President, African Development Bank; Ann Cotton, Founder, CAMFED; Bineta Diop, Special Envoy on Women, Peace, and Security, African Union; Hafez Ghanem, Regional Vice President for Eastern and Southern Africa, World Bank; Agnes Kalibata, President, Alliance for a Green Revolution in Africa; Acha Leke, Chair, Africa Region, McKinsey & Company; Stefano Manservisi, former Director-General, DEVCO, European Commission; Ibrahim Mayaki, former Prime Minister, Niger and CEO of AUDA-NEPAD; James Mwangi, Managing Director and CEO, Equity Group Holdings; Ndidi Nwuneli, Co-founder and Managing Partner, Sahel Capital; Reeta Roy, President and CEO, Mastercard Foundation; Vera Songwe, Executive Secretary, UN Economic Commission for Africa; and Gayle Smith, President and CEO, ONE Campaign.

The research and writing process began with four issues papers that identified key questions, challenges and opportunities around the report's main thematic areas: regional integration, jobs, innovation and climate. The issue papers were reviewed by Sébastien Treyer and his team from Institut du Développement Durable et des Relations Internationales; Frank Mattheis, Université libre de Bruxelles, Belgium; Joyashree Roy, Asian Institute of Technology, Thailand; and Fredrick Soderbaum, University of Gothenburg, Sweden. After review, the papers were expanded into full policy research notes that informed the full report.

Integrating to Transform underwent an intensive peer review process coordinated by Shanta Devarajan, Georgetown University, and supported by World Bank experts in each of the four thematic areas: Wolfgang Fengler (regional integration), Paul Brenton (jobs), William Maloney (innovation) and Richard Damania (climate). Additionally, report revisions and the final draft were reviewed by Shanta Devarajan; Jim Cust and Deborah Wetzel, World Bank; and Alan Gelb, Gyude Moore and Michael Pisa, Center for Global Development.

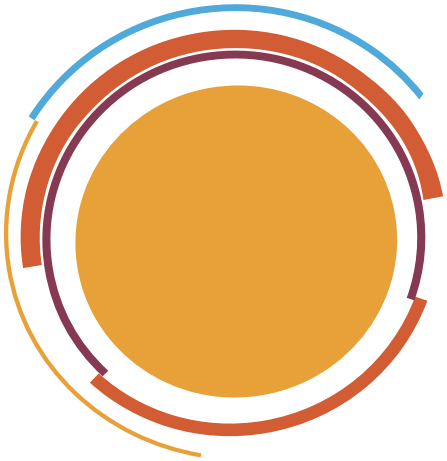
ACET wishes to express its sincere appreciation and gratitude to all reviewers who shared their time and expertise to provide very helpful comments, suggestions and feedback.

An outstanding group of collaborative partners contributed to the report's final production. Bruce Ross-Larson of Communications Development Incorporated in Washington, DC served as the principal editor, with support from Joe Caponio and Mike Crumplar. Dilucidar handled the layout and design with a global team including Carolina Rodriguez in Singapore, Mandy Kabasa in Zimbabwe, and Danielle Ferreira in Jordan.

The report also benefitted from the efforts of the ACET Communications team, led by Daniel Nti and including Belinda Ayamgha, Adwoa Banful, Amazing Grace Danso, Joel Kibazo, Rik Moors, John Osei, Abigail Parry, and Jason Thompson. Additional strategic support was provided by Djembe Consultants, led by Mitchell Prather and including James Deacon and Gilles Ametepe in Accra, Ghana.

Finally, *Integrating to Transform* is a direct result of the financial support of ACET's major sponsors, including the Mastercard Foundation, Government of the Netherlands, Open Society Foundations, and Government of Germany (GIZ) via the Think Africa Partnership (TAP), the World Bank Africa Region's flagship multi-partner trust fund. The generosity, support and collaborative partnership of all sponsors is gratefully acknowledged.

Over the past thirteen years, the African Center for Economic Transformation (ACET) has been at the forefront of Africa's transformation agenda. ACET's goal is to help governments and private sector deliver economic transformation that improves lives.



Foreword

The third *African Transformation Report* explores the critical need to give new impetus to Africa's transformation agenda in the aftermath of the debilitating COVID-19 pandemic that has set back development across much of the continent and undermined progress on reducing poverty.

Over the past 13 years, the African Center for Economic Transformation (ACET) has been at the forefront of Africa's transformation agenda. ACET's goal is to help governments and the private sector deliver economic transformation that improves lives. It does so through rigorous research and analysis, advice to policymakers through peer learning and best practices, and galvanizing action through advocacy, outreach, and convening for impact.

Through these approaches, ACET has helped shift the debate, regionally and globally, toward economic transformation as the way to achieve sustained growth and shared prosperity in Africa. As Chair of the Transformation Leadership Panel, established by ACET in 2019, I am delighted to support this bold approach to fostering deep-rooted change across Africa's 54 countries.

While many of Africa's economies were already on a recovery path, the pandemic has had devastating economic and social costs for most African countries, setting back the development agenda for some of the world's poorest and most vulnerable, and jeopardizing the achievement of the Sustainable Development Goals.

Making a success of the new African Continental Free Trade Area is one way to reinforce badly needed integration in Africa. Launched in January this year, it will create an integrated market with a combined gross domestic product of $3.4 trillion. This larger market will attract greater investments, boost productivity, provide better jobs, and improve human well-being—all supporting the continent's economic transformation.

My colleagues on the Transformation Leadership Panel join me in underscoring that now is the time to reinforce the push for African integration, not just through trade, but also through greater collaboration to provide regional public goods. Only then will Africa see its economies transform and develop the leadership and institutions to build the Africa we want.

Ellen Johnson Sirleaf
Former President
Republic of Liberia

Preface

The main message of the 2021 *African Transformation Report* is that Africa's economic transformation requires much more progress on regional integration. To integrate faster and deeper, countries should go beyond trade and markets and collaborate to deliver regional public goods such as building transport corridors, managing river basins, establishing cross-border digital connectivity, and controlling outbreaks of pests and disease. They should also tackle three frontline challenges that can make or break their efforts to transform their economies: finding productive work for a young and rapidly growing workforce, innovating with digital technologies, and managing climate risks—all national challenges with regional solutions.

The 2014 *African Transformation Report* argued that the continent's faster economic growth after the turn of the 21st century—growth attributable to broader macroeconomic reforms, better business environments, and higher commodity prices—would not by itself sustain economic development. To ensure that growth is sustainable and to transform their economies, countries would need to diversify their product and service lines, make their exports more competitive, Increase the productivity of firms, farms, and offices, and upgrade technology in agriculture, mining, manufacturing, and services—all to improve human economic well-being.

Over the past two decades, however, Africa's growth has on average been less than transformative—far less. True, growth rose briskly for some countries in the 2000s, with 6 of the world's 10 fastest growing economies in Sub-Saharan Africa. But it slowed after 2010, stalled during 2015–19, and then, with COVID-19, slipped further or even contracted in 2020. The continent's economies are set to bounce back in 2021, but only slowly, with many countries not expecting to have their GDPs recover to pre-COVID levels until 2023 or even later.

For Africa's economic transformation, the picture is grim, with its overall score on our African Transformation Index remaining in the narrow range of 33–37 on a 0–100 scale since 2000. A short-lived spike in 2001–03 was followed by declines through about 2008, and then another spike hit an all-time high in 2011—only to fall into a steady retreat to a score below that at the start of the century.

The 2014 report also made a compelling case for the potential of regional integration to accelerate economic transformation. Many Sub-Saharan economies are small and have to import most inputs for manufacturing. Most also lack a large domestic market that would provide their manufacturers with some natural protection from imports. Integrating national markets into larger regional markets would thus help countries overcome these disadvantages and seize opportunities to transform their economies.

The African Continental Free Trade Area gives fresh impetus to the integration project. In signing the agreement, countries affirmed the importance of accelerating intra-African trade and boosting Africa's competitiveness in global markets. In broad terms, the agreement envisages free trade areas that progressively eliminate tariff and nontariff barriers to trade among the member states. That would help countries boost growth, diversify their exports beyond unprocessed commodities, and attract more foreign and domestic investment. The agreement also envisages freer movement of labor and capital, making both more productive.

These encouraging developments are necessary for Africa's integration, but they are not sufficient. As this report argues, deepening regional integration requires shifting the integration narrative from pursuing not just regional market integration but also broader regional collaboration. One underexplored area of regional collaboration is the provision of public goods and services whose benefits cross borders—benefits such as increasing the efficiency of transport corridors, reducing the spread of disease, increasing the dissemination of knowledge about climate-smart agricultural techniques, reducing the pollution in river basins and oceans, harmonizing taxes on extractives across borders to avoid smuggling, reducing the regulatory obstacles to regional communications networks and financial markets.

The COVID-19 pandemic has highlighted the urgent need for regional approaches and integration in Africa.

Advancing the continent's economic integration and transformation will also depend in large part on tackling three frontline challenges.

First is creating jobs—ensuring productive employment for the world's youngest and fastest growing labor force by imparting skills for work in digital and technological fields. Second is supporting digital innovation—enabling the private sector to deliver the many benefits from digital technologies in creating jobs, boosting productivity, and reducing poverty. Third is managing climate risks—promoting climate-smart agriculture, protecting the continent's green and blue ecosystems, and exploiting renewable energy.

Why these three, among the plethora of challenges facing Africa? Because they will shape Africa's future, and they are on every policymaker's agenda. Tackling each of them supports the transformation agenda and requires, and fosters, regional collaboration.

The COVID-19 pandemic has also highlighted the urgent need for regional approaches and integration in Africa, and for new and expanded regional public goods. The disruption of regional and global supply chains points to the need for stronger regional and subregional supply chains and rapid cross-border movement of goods and services to ensure the sustainability of critical industries. African economies must now rebound quickly with transformative and forward-looking policies that embrace regional integration. In some cases, the crisis provided an opportunity for quick policy implementation that would not have been possible otherwise—and that will serve citizens well beyond the pandemic.

To advance on all these fronts, Africa needs dedicated leadership at all levels, starting with top political leaders and extending to government, private firms, academia, and civil society, all in pursuit of collective action for the common good.

So let's get on with collaborating to integrate. Let's get on with integrating to transform.

K.Y. Amoako
Founder and President
African Center for Economic Transformation

Overview

The main message of the 2021 African Transformation Report is that Africa's economies need to integrate if they are to transform. They have been transforming only slowly, if at all, as demonstrated by the continent's lackluster performance on Growth with DEPTH, ACET's measure of economic transformation.

The first African Transformation Report argued that the continent's faster economic growth after 2000 would not by itself sustain economic development. To ensure that growth is sustainable and to transform their economies, countries need to **D**iversify their product and service lines, make their **E**xports more competitive, Increase the **P**roductivity of firms, farms, and offices, and upgrade **T**echnology in agriculture, mining, manufacturing, and services—all to improve **H**uman economic well-being. In short, Growth with DEPTH.

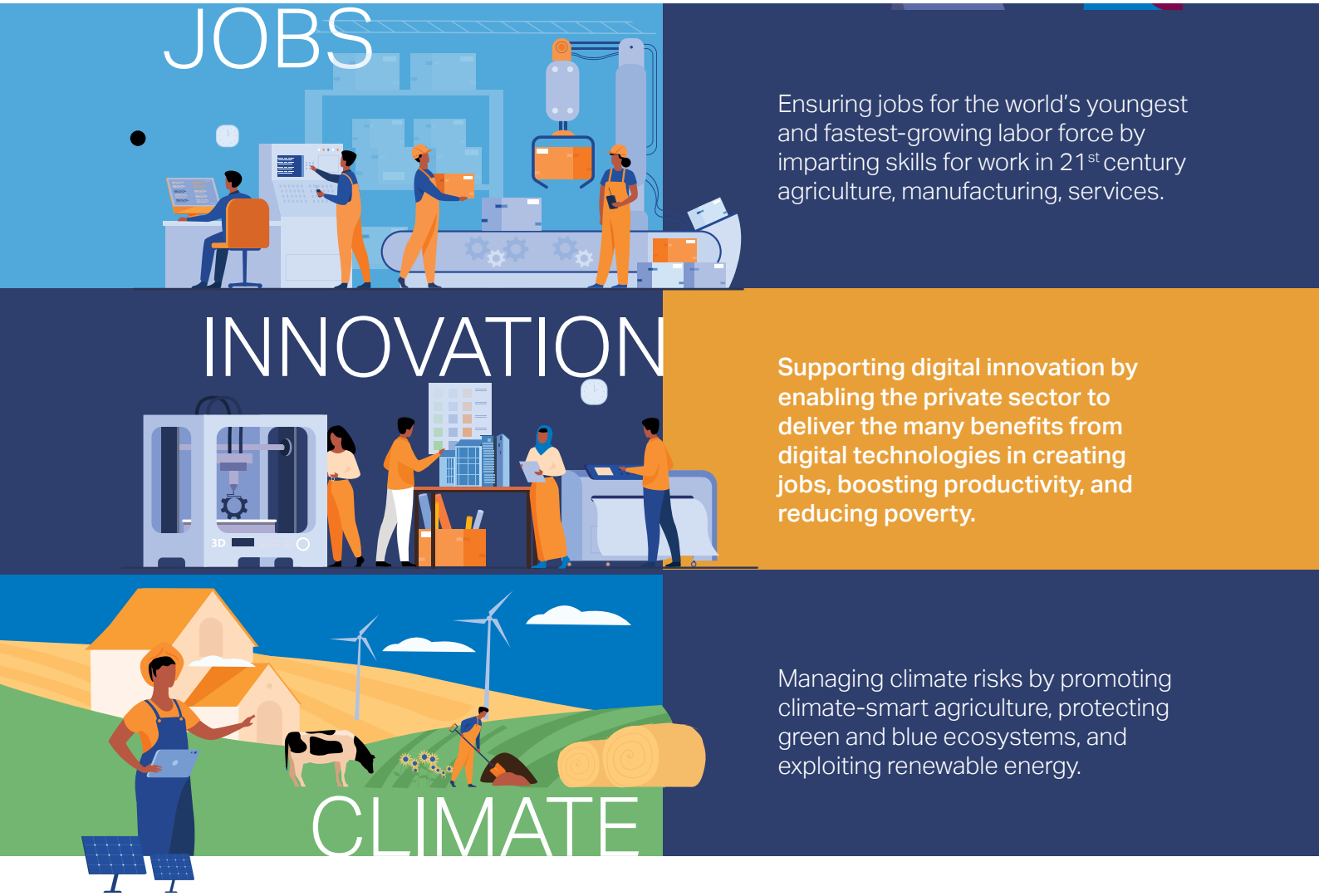
After a promising start in the 2000s, Africa's growth began to falter in the 2010s, with the rippling effects of the global financial crisis and then the end of the commodity supercycle and rising tensions in global trade. Africa's DEPTH, captured in our African Transformation Index, reversed earlier gains or continued earlier declines. Now, in the early 2020s, COVID-19 is attacking both growth and DEPTH. Most of the continent's economies slowed or contracted in 2020, and the pandemic negatively impacted all DEPTH attributes. As countries recover, they can act to do more than restore growth. They can also work with the private sector and civil society to tackle the three frontline challenges analyzed in this report. (Infographic 1)

- *Jobs:* Ensuring jobs for the world's youngest and fastest growing labor force by imparting skills for work in 21st century agriculture, manufacturing, and services.
- *Innovation:* Supporting digital innovation by enabling the private sector to deliver the many benefits from digital technologies in creating jobs, boosting productivity, and reducing poverty.
- *Climate:* Managing climate risks by promoting climate-smart agriculture, protecting green and blue ecosystems, and exploiting renewable energy.

Why these three, among the plethora of challenges facing Africa? Because they are the ones that will shape Africa's future, and they are on every policymaker's agenda. Tackling each of them supports the transformation agenda for Growth with DEPTH, and each requires and fosters regional collaboration.

As countries recover, they can act to do more than restore growth. They can also work with the private sector and civil society to tackle the three frontline challenges of ensuring jobs, supporting digital innovation, and managing climate risks.

INFOGRAPHIC 1: FRONTLINE CHALLENGES



Why these three, among the plethora of challenges facing Africa?

Because they are the ones that will shape Africa's future, and they are on every policymaker's agenda. Tackling each of them supports the transformation agenda for Growth with DEPTH, and each requires and fosters regional collaboration.

The African Continental Free Trade Area (AfCFTA), after starting in January 2021, gives fresh impetus to the integration project. In broad terms, the agreement envisages a free trade area that progressively eliminates tariff and nontariff barriers to trade among the member states. That will help countries boost growth, diversify their exports beyond unprocessed commodities, and attract more foreign and domestic investment. These go hand in hand with the jobs, innovation, and climate agendas.

But while past regional integration efforts have often struggled, Africa's transformation requires much more progress on regional integration. To achieve Growth with DEPTH, and for the AfCFTA to succeed, countries have to look beyond trade and markets and collaborate in delivering regional public goods such as transport corridors, free movement of people, well-managed river basins, cross-border digital connectivity, and systems to control future outbreaks of pests and disease. These will all help tackle the three frontline challenges of jobs, innovation, and climate—all national challenges with regional components. And in a self-reinforcing manner, collaboration to produce regional public goods will also help build experience and trust to pursue deeper regional economic integration, under the AfCFTA.

To advance on these fronts—collaborating to integrate and integrating to transform—will take dedicated leadership at all levels, starting with top political leaders and extending to government, private firms, academia, and civil society. Africa's leaders will need to promote visions that go beyond their national interest and to pursue collective action for the common good. Turning top-down visions into reality needs to be complemented by a bottom-up, more problem-driven approach to national and regional problems to help overcome the political economy barriers that have slowed progress in the past.

Pursuing Growth with DEPTH

The first African Transformation Report defined economic transformation as Growth with DEPTH. Here's the logic behind that definition:

- **D.** African countries, most of them relying on a narrow range of commodity exports, need to diversify the array of goods and services to hedge against external and internal shocks.
- **E.** Their exports, if competitive, allow them to exploit their comparative advantage to generate higher incomes, which help pay for the investments in skills, capital, and technology needed to solidify their comparative advantage over time.
- **P.** Productivity gains, starting in agriculture, allow agriculture to release labor to industry and services, produce more food to moderate hikes in urban industrial wages, supply raw materials for processing in industries, increase exports to pay for transformation inputs, and enhance the domestic market for industrial products.
- **T.** Technological upgrading sustains rising productivity and enables transforming economies to produce goods and services that command higher prices on global markets.
- **H.** Increasing incomes per capita and employment, together with health and education, as well as peace, justice, security, and the environment, help to improve human well-being—and thanks to human capital development will have feedback effects of productivity and growth.

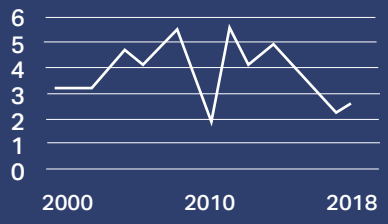
To track how countries are transforming their economies, ACET developed the African Transformation Index in 2014, based on a composite of the five elements of DEPTH. For 21 countries, the Index confirmed the slow progress of most African countries through 2010, with widely varying performance on the five depth subindexes. The second edition of the Index will contain data for 32 countries for the period of 1998-2019 and include a greater range of indicators.

Over the past two decades, Africa's growth has on average been less than transformative—far less. True, growth rose briskly in the 2000s, with 6 of the world's 10 fastest growing economies in Sub-Saharan Africa.[1] But it then slowed after 2010, stalled during 2015-19, and then, with COVID-19, slipped further or even contracted in 2020. The continent's economies are set to bounce back in 2021, but only slowly, with many countries not expecting to have their GDPs recover to pre-COVID levels until 2023.

INFOGRAPHIC 2: GROWING SLOWER - NOT TRANSFORMING

African economies' average score on the African Transformation Index for 2018 is below where it stood at the beginning of this century

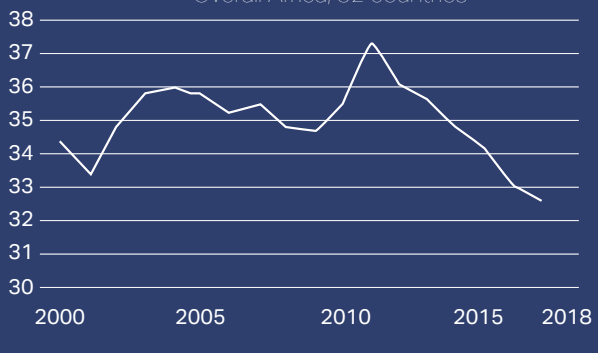
GDP growth (%)



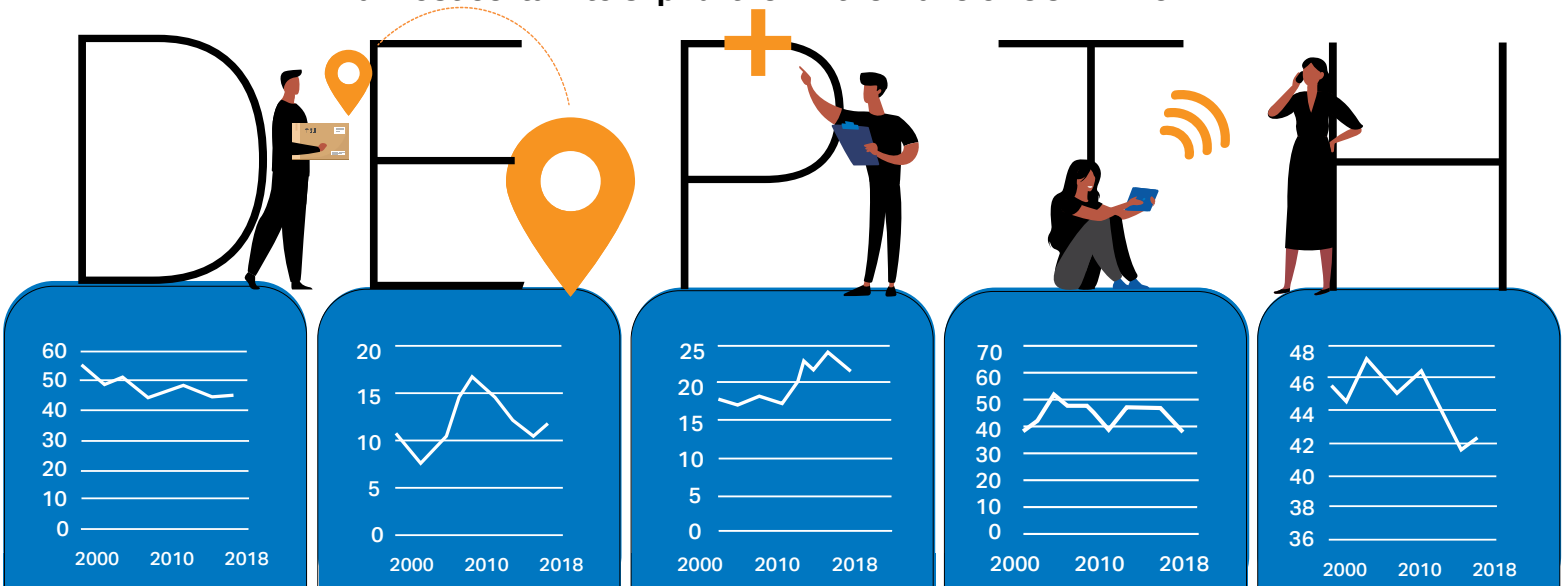
GDP growth slowed after 2011, as the African Transformation Index went into a steep decline.

AFRICAN TRANSFORMATION INDEX

Overall Africa, 32 countries



The Index is a composite of five subindexes for DEPTH, all slipping in the 2010s and almost certain to slip further in the wake of COVID-19



DIVERSIFICATION

Only by learning by doing can African countries diversify their economies based mainly on traditional agriculture and primary commodities to increasingly include modern agriculture, manufactures, and high-value services.

EXPORT COMPETITIVENESS

Exporting provides the opportunity to expand production, boost employment, reduce unit costs, and increase incomes. And the knowledge gained from exporting helps raise productivity and innovate with new products.

PRODUCTIVITY

Innovating with new processes and products underpins productivity gains that enable economies to produce more goods and services from existing resources and technologies, especially in agriculture.

TECHNOLOGICAL UPGRADING

A rising capability to introduce new and improved technologies enables an economy to sustain productivity growth over time and to produce goods that command higher prices on international markets.

HUMAN WELL-BEING

When opportunities for well-remunerated employment are expanding with rising GDP per capita, growth will be inclusive, prosperity will be widely shared, and poverty and inequality will be reduced.

The route to Growth with DEPTH:

Tackle the frontline issues of ensuring productive jobs, supporting digital innovation, and managing climate risks by collaborating in the provision of national and regional public goods.

For Africa's DEPTH, the picture is grim, with its overall score on a 0–100 scale remaining in the narrow range of 33-37 since 2000 (infographic 2). A short-lived spike in 2001–03 was followed by declines through about 2008, when another spike hit an all-time high in 2011—only to fall into a steady retreat to a score below that at the start of the century.

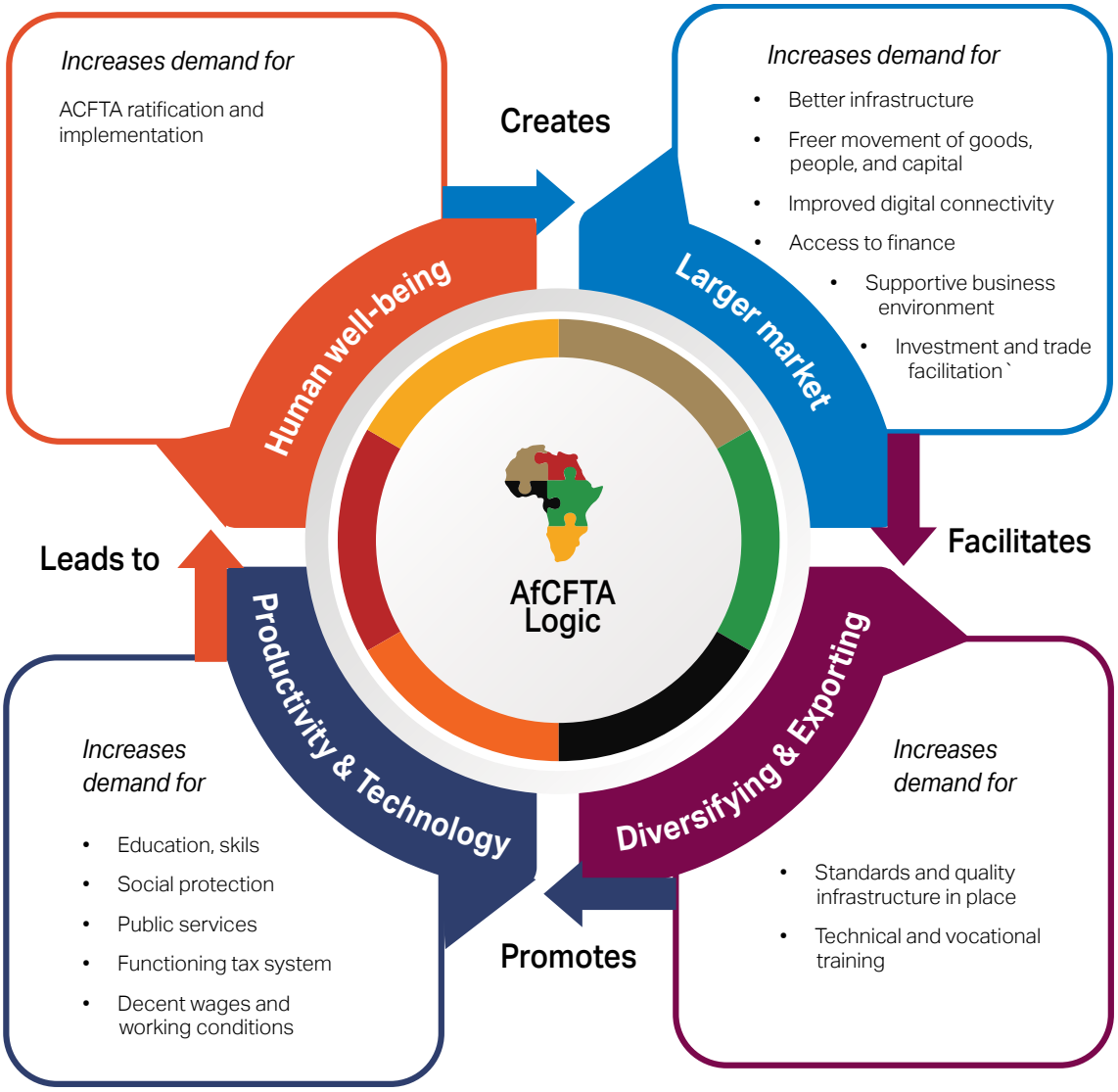
Keep in mind that these are averages, with half the continent, weighted by national GDPs, above average and half below. Ranging around these averages, the top African country had a score in 2018 of 64, and the bottom country, 19.

In sum: Declines in all five DEPTH elements account for the sharp decline in the overall ATI score from its peak in 2011, to a level below where it started in 2000. And those scores are almost certain to decline further in the wake of COVID-19. Their volatility is disconcerting: it suggests a vulnerability to shocks and thus a lack of resilience of the underlying structure of African economies.

The main implication of these preliminary results is that countries have to do more than get their economies back onto a path of faster economic growth. They have to take on the frontline challenges of ensuring productive jobs, supporting digital innovation, and managing climate risks—all of which can be supported by collaborating to deliver regional public goods, thus triggering a virtuous circle with faster and deeper regional integration and Growth with DEPTH, not least through the implementation of the AfCFTA and related agendas (infographic 3).

Declines in all five DEPTH elements account for the sharp decline in the overall ATI score from its peak in 2011, to a level below where it started in 2000. And those scores are almost certain to decline further in the wake of COVID–19. Their volatility is disconcerting: it suggests a vulnerability to shocks and thus a lack of resilience of the underlying structure of African economies.

INFOGRAPHIC 3: TRADING FOR GROWTH WITH DEPTH



The AfCTFA has the potential to unleash a virtuous circle where opportunities of larger markets trigger increasing trade and investment.

This leads to:

- export diversification
- productivity gains
- greater value added
- employment and improved incomes

All this increases the size of the market. Manufacturing trade stands to gain the most, but other service activities will too. Opportunities in agriculture and the digital market also stem from successful AfCFTA agreement and implementation. But this potential depends on having a majority of countries ratify and then implement the agreement.

Negotiations continue on key elements such as rules of origin and actual tariff reductions. In addition, many benefits rely on complimentary enabling policies that ensure that:

- people and goods can cross borders
- trade facilitation measures are in place
- business environments encourage investment
- structures are in place to allow upgrading and greater value addition, and
- all this translates into increasing incomes and livelihoods.

The AfCFTA can be very good for Growth with DEPTH - and thus for Africa's economic transformation. All this highlights the need to better understand all incentives and interests at play in implementing national and regional interconnected agendas.

Ensuring productive employment for young Africans

Africa's working-age population (15–64), now 750 million, is set to surpass 1 billion before 2030—as millions of young Africans enter the labor force—and to reach 1.2 billion by 2035.[2] Until now, Africa has not created enough good jobs for those entering the labor force, who mostly end up in the low productivity informal sector, which accounts on average for 80% of employment. So, providing productive work for the 18–20 million young people entering the workforce each year is going to be daunting—and essential.[3]

If new entrants to the labor force have access to more productive work and the necessary skills, they will start to generate an economic surplus that can improve human capital and increase productivity—delivering a demographic dividend. But most employment today remains informal on small farms and in small firms. On current trends, three-quarters of entrants to the labor market are projected to work in low-productivity self-employment or in microenterprises. Some 20% will work for wages in the service sector, and only about 4%–5% will find a formal wage-paying job in industry.[4]

Only about 100 million of the 450 million Africans expected to reach working age through 2035 can hope to find a well-paid job. What about the other 350 million? National policies and programs should target sectors with high potential for job creation and productivity growth.

Modernizing agriculture can create jobs by catalyzing a much larger agroprocessing sector, and supporting the private sector to expand off-farm activities will provide many productive jobs, as input dealers and large commercial farmers expand their operations. As agriculture commercializes on a larger scale, the need will grow for specialized transport services to meet time-sensitive delivery schedules, requiring drivers, packers, quality inspectors, and others. A more productive agriculture sector is also more attractive to young people with new ideas and new talent, important for rejuvenating a sector dominated by aging farmers. Given that demand in key urban agglomerations can be served by production centers in other countries, regional and continental trade in agricultural produce will be key to attracting further investment in this sector.

If new entrants to the labor force have access to more productive work and the necessary skills, they will start to generate an economic surplus that can improve human capital and increase productivity — delivering a demographic dividend.

Export-oriented manufacturing can focus on less automated sectors where technology adoption has been slow, such as food processing, wood processing, furniture, garments, and leather goods. These sectors could provide opportunities for labor-intensive local and regional market–focused manufacturing, under existing trade regimes and the AfCFTA. Taking advantage of those opportunities requires a continual focus on improving basic infrastructure—reliable power, telecommunications, roads, and railways, all of which have a regional component—and building industrial capabilities through technological upgrading and upskilling the labor force. And with the right policies and strategies, mastering traditional manufacturing can make it easier to jump into more complex digitized manufacturing.

Perhaps the greatest opportunities are in services. Although highly informal, the service sector is the fastest growing in job creation and value added in most African economies, in spite of the large numbers employed in low productivity informal services provision. The potential for job creation is even greater with digital technologies and the internet, and planned e-commerce negotiations under the AfCFTA, opening up markets beyond the national level. The application of mobile systems for payments and orders and the use of the internet and mobile phones to develop and roll out new products and services hold great promise. Examples include Jumia (an e-commerce platform), Zando (shoes and clothing), HelloFood (food delivery), EasyTaxi (cab-hailing), and Everjobs (classified ads). Kenya-based M-Pesa, the biggest money transfer system in the world, allows people to pay for all kinds of services by mobile phone and is rapidly formalizing the informal sector by bringing many transactions online. Also fast-growing are some high-productivity services, including horticulture, logistics, and business process outsourcing.

Equipping young Africans with the skills required to meet the growing and fast-evolving demands of the labor market will be crucial. African policymakers should expand the access and improve the quality and relevance of secondary and technical and vocational training, which will be a key entry point for young Africans to enter the world of work. However, the vast majority of African youth transition into the world of work before entering tertiary education—only 9% of primary school students reach higher education. So secondary education will be critical in preparing young Africans to earn a decent living. Indeed, educating young girls to complete secondary can increase their labor force participation and accelerate the demographic transition to lower death and birth rates—and reap the demographic dividend. Promoting universal secondary education will thus be crucial in ensuring a future-ready workforce.

The job creation potential and transformative impact of national industrial policies and programs can be amplified through regional collaboration on cross-border labor mobility and labor market information systems.

The job creation potential and transformative impact of national industrial policies and programs can be amplified through regional collaboration on cross-border labor mobility and labor market information systems. Such policies can improve efficiencies in regional labor markets, and thus create an environment conducive to more investments in production factors to spur entrepreneurship, address skill shortages and mismatches, and enhance trade diversification and export competitiveness. Though sometimes politically sensitive, the momentum behind the AfCFTA is an opportunity to be seized by leaders to ensure its benefits are realized.

Priorities for action

The growing demographic bulge of young workers presents an opportunity to reap a demographic dividend that will spur Africa's economic growth.

The growing demographic bulge of young workers presents an opportunity to reap a demographic dividend that will spur Africa's economic growth. But this will not occur automatically. It requires a comprehensive and integrated strategy focusing on three policy priorities:

- Implementing education and skill development policies, particularly for girls, to ensure that each year's 18–20 million new entrants to the labor force are well equipped and productive.
- Creating opportunities for productive employment in labor-intensive sectors by encouraging investment to serve regional and continental markets under the AfCFTA.
- Accelerating the demographic transition to lower death and birth rates to reap the demographic dividends of having more workers than dependents.

Regional collaboration can give a big boost to achieving these outcomes through the investment opportunities and employment created and through mutual recognition of qualifications.

Scaling up education and skills training

Sub-Saharan Africa, having underinvested in its human capital, currently lags all other world regions based on the 2020 Human Capital Index. Although school enrollments have been increasing over time, enrollments in secondary and tertiary remain very low. Equally important is the need to focus on quality and the relevance of schooling while actively pursuing the basic education goals of universal literacy and numeracy. Not easy, since 87% of 10-year-olds in Sub-Saharan Africa cannot read and understand a simple story, leaving them unprepared for secondary education.[5]

Key priority actions:

- *Expand secondary and tertiary enrollment, and emphasize science, technology, engineering, and mathematics (STEM) with a focus on new technologies, especially digital technologies of the fourth industrial revolution.* Ghana introduced a free Senior High School policy in 2017, increasing enrollments by 69% in three years. But such a rapid surge in enrollment strains the existing physical infrastructure, calling for innovative approaches to expanding digital infrastructure to facilitate distant learning. The government has instituted a policy of 60% enrollment in science and 40% in arts and humanities to facilitate STEM uptake at the tertiary level.[6]

- *Address the gender bias in science and in technical and vocational education and training.* In Burkina Faso, Kenya, and Malawi, cash and in-kind transfers targeting girls increased their enrollment, attendance, and graduation.[7] Senegal tackled the gender imbalance in STEM education through awareness campaigns, performance-based contracts targeting women and girls in STEM, and teacher training to encourage women to pursue STEM education. Ghana introduced a teacher and learning portal in 125 schools to encourage STEM uptake, giving teachers and students access to online teaching and learning resources, with a focus on science and mathematics.[8]

- *Ensure that the education systems and technical and vocational education and training (TVET) programs respond closely to the needs of the market by partnering with the private sector for program design and financing.* Ghana and Uganda organized training programs to meet the needs of private employers. Nigeria certified and accredited private TVET providers if they met certain criteria. In South Africa, the government partners with banks to deliver effective education and training. Senegal also has a national TVET strategy to improve the access, quality, and relevance, providing 300,000 students with the opportunity to get on-the-job practical experience.[9]

- *Recognize work experience in the informal sector, which absorbs close to 80% of the Sub-Saharan workforce (outside South Africa).* Most countries have national qualification frameworks, but they struggle to accredit informal learning and apprenticeships. Ethiopia's government combined forces with NGOs, private agencies, and private schools to train workers in the informal sector. Federal and regional TVET agencies certify those with informal training through units of competency, and any worker with almost any skill can be examined by one of the agencies and certified for that skill.

Creating opportunities for productive employment

Invest heavily in sectors that have high job-creation potential, such as agriculture, export-oriented manufacturing, high value-added services, and the creative industries can create jobs for youth, particularly in the rural areas. Key priority actions:

Investing heavily in sectors that have high job-creation potential, such as agriculture, export-oriented manufacturing, high value-added services, and the creative industries can create jobs for youth, particularly in the rural areas.

- *Modernize agriculture by introducing high-yielding seeds, chemical fertilizers, and digital agricultural technologies and orient farmers toward commercial agriculture.* Several African countries have training centers that offer an innovative approach that improves the perception of agriculture at schools, proposes new learning methods that combine technical and social training, and stimulates agricultural research and development for young people. The Songhaï center in Benin conducts training, production, and research, combining modern and traditional methods. It favors an integrated production system where agriculture, livestock, and fisheries interact, and nothing is wasted. The Rural Trades Centers in Côte d'Ivoire support national nonformal training in agriculture and other rural trades.

- *Strengthen linkages along the agricultural value chain by incentivizing input dealers and commercial farmers to expand operations and upgrade input services, storage, and logistics to stimulate the larger agribusiness sector.* Malawi uses blockchain to certify food safety for tea and tracks supply chains for tea sold to the consumer goods giant Unilever and the British supermarket Sainsbury's. Tanzania introduced a bulk procurement system in 2017 for the government to import all the major fertilizers. The Fertilizer Regulatory Authority now consolidates orders, conducts competitive bidding, awards tenders, and sets maximum retail prices.[10]

Export-oriented manufacturing focusing on labor-intensive products offers good prospects for job creation in the medium term. Key priority actions:

- *Support traditional manufacturing in their transition to more complex digitized manufacturing.* In Kenya, companies in machinery–electronics–transport are the most digitized, followed by companies in chemicals–plastics–rubber. This growing trend toward digitization is linked to improvements in telecommunications, electricity, customs, and regulations.

- *Accelerate improvements in basic infrastructure—electricity, telecommunications, roads, and railways.* Côte d'Ivoire's transport sector was allocated more than $10 billion, or almost a quarter of the country's $44.2 billion budget for the economic blueprint, as part of the National Development Plan for 2016–20.

- *Give tourism particular attention due the strong job creation and productivity increases the sector generates through technological innovations, such as sharing economy platforms and the use of big data and social media to market tourist destinations.*

- *Foster the media and creative industries, which have high potential for job creation thanks to the ease of adoption of digital technologies.* Microfinance platforms, such as M-Changa in Kenya, help match investors to a range of individuals and projects in creative industries and thus support job creation.

All of these labor-demand elements can be supported by implementing the AfCFTA and by supporting regional public goods that help promote export-focused investment.

Increasing regional collaboration for labor mobility

Regional collaboration for cross-border labor mobility can also unleash the job creation potential and transformative impact of national industrial policies and programs. With the AfCfTA concerted regional collaboration and implementation of the Free Movement Protocol can facilitate the free movement of skilled labor to areas of demand. It can also align national education and skill development to regional labor market requirements. Key priority actions:

- *Promote mutual recognition agreements among member states.* East African Community (EAC) members have concluded such an agreement for architects, engineers, and accountants and are preparing to extend it to lawyers, pharmacists, and veterinarians. Similar arrangements have been initiated in West Africa under the pilot talent mobility program.

- *Strengthen labor market information systems where they exist and are weak or create one where they do not.* The right skills must be available at the right time and place in and across countries. As part of their labor market and migration policies, most African countries have such a system. But progress has been slow in making them effective. To adapt worker skills to changing market dynamics, countries can set up a sentinel system to gather intelligence on the skills available today and the skills needed in the future, as countries in Southeast Asia have done successfully.

Accelerating the demographic transition

Africa's demographic transition from high to low birth and death rates has been delayed by persistently high fertility. The demographic transition can be sped up by reducing high infant and maternal mortality rates, improving educational outcomes for girls, and empowering women by giving them more autonomy to make their own decisions about life choices. Key priority actions:

- *Expand immunization programs and other communicable disease prevention programs.*

- *Strengthen and adapt health systems to take a more structured approach to health care (including primary health care), to improve health data systems, and to boost the quality of clinical care.* Ghana deployed portable ultrasound machines in 500 health centers and community-based health planning and service compounds operated by midwives, improving maternal delivery outcomes.

- *Improve educational outcomes for girls and empower women by making further investments in secondary and tertiary education where enrollment rates remain the lowest.* There is also the need to improve educational quality and close the gender gap in secondary and tertiary education enrollments.
- *Reform laws and institutions that govern girls' and women's lives by increasing the age at first marriage, expanding contraceptive coverage, and recognizing women as equal citizens to own land.* Rwanda's health sector reform and expansion of contraceptive coverage reduced fertility in the rural areas from 6 children per woman in 2003 to 4.1 in 2013.[11] In Ethiopia, institutional reforms now enable women to assert their rights in the court system.

Supporting digital innovation

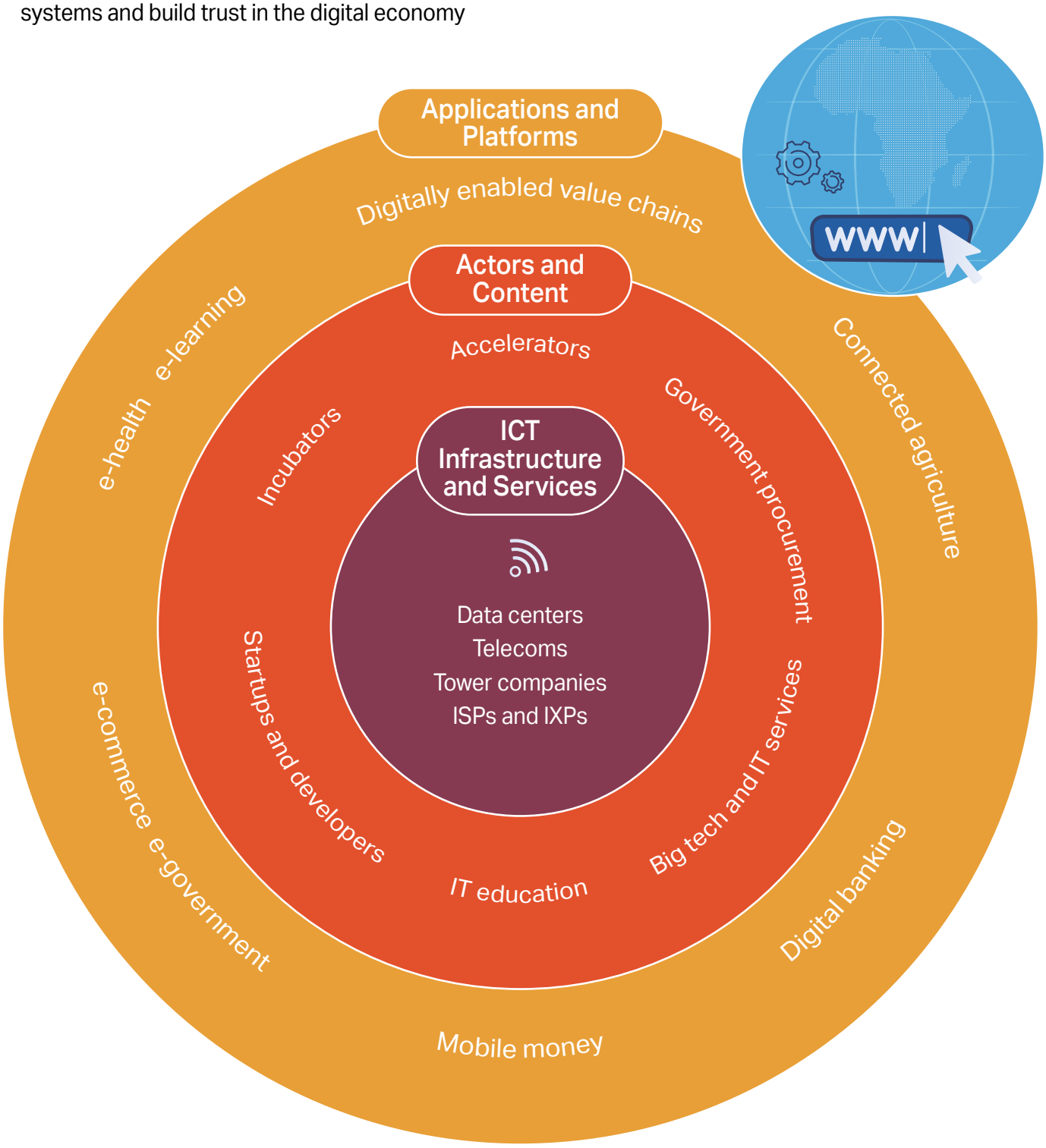
Early in 2020, Sub-Saharan Africa had 477 million subscribers to mobile services and 272 million mobile internet users. And its mobile industry contributed $155 billion to its gross domestic product, led by productivity gains in financial services, education, health, retail, agriculture, and government.[12] Yet internet adoption in Africa remains low. The continent lags the rest of the world in the availability, speed, and access of broadband, with landlocked countries and rural areas faring the worst. Most mobile phone subscribers do not have access to the internet, and nearly 300 million Africans live far from a fixed broadband connection.

Part of the reason: While there have been high profile successes in some countries—mostly related to mobile money—Africa's fragmented digital markets suffer from high taxes, expensive licenses, and regulatory gaps that permit excessive market concentration, limited competition, and the world's highest data prices. A move to regionally integrated innovation and digital ecosystems is essential for Africa's economic transformation (infographic 4).

Africa's fragmented digital markets suffer from high taxes, expensive licenses, and regulatory gaps that permit excessive market concentration, limited competition, and the world's highest data prices. A move to regionally integrated innovation and digital ecosystems is essential for Africa's economic transformation.

INFOGRAPHIC 4: NURTURING DIGITAL INNOVATION ECOSYSTEMS

Digital transformation takes place in a highly interactive ecosystem that requires government policies and institutions to coordinate systems and build trust in the digital economy



Digital transformation requires ICT infrastructure and services to enable the affordable and competitive provision of digital technologies, to expand access to the Internet, and to work with global ICT suppliers. It also requires a spectrum of skilled producers and users. And it requires digital application and new technological capabilities.

To govern the implementation, evaluation, and adaptation of innovation policy, countries can develop well-defined and well-coordinated policy frameworks. They can rapidly develop the capacity of a workforce and bureaucracy equipped with strong technical skills and digital capabilities to take advantage of Africa's demographic expansion. They can give space to the private sector until new markets and innovations are established. And they can identify key principles related to equity, inclusion, and accountability to shape innovation policy and technological advances. It will be crucial that such policy frameworks are informed by bottom-up consultation and respond to users and clients of digital services. Such clients and users include the private sector, both domestic and international, as well as citizens, academia and civil society. Likewise, such policy frameworks need to be rapidly scaled up with a minimum of bureaucratic hurdles and with a view to not thwart innovation and entrepreneurship.

Good innovation policy and digital technologies will also underpin regional collaboration and integration to create a single digital market.

With such a far-reaching agenda, countries can start by updating and revising their existing policies. To develop blueprints for an African digital trade and economy strategy, they could set up national and regional e-commerce stakeholder coalitions to identify key measures for harmonized national and regional regulatory systems and to engage in the AfCFTA e-commerce negotiations due to start soon. To achieve the goal of a pan-African policy for e-commerce, they need to settle legal uncertainties over privacy, consumer protection, e-transactions, spectrum licenses, and digital identity. To lower connectivity costs, they need transparent rules that foster regional integration of data markets. This could be accompanied by accelerating data legislation and providing technical support to help businesses comply with privacy regulations in overseas markets.

Digital technologies have already transformed many aspects of life for most people, and they are rapidly transforming commerce and finance. With appropriate policies, they will help transform entire economies and help achieve the necessary productive employment opportunities discussed above. Good innovation policy and digital technologies will also underpin regional collaboration and integration to create a single digital market and to improve the efficiency of regional power pools, the management of river basins, and the reach of tech-enabled regional road and rail networks. At the same time, governments can provide space for private sector experimentation and learning.

These advances will also equip policymakers with tools previously unavailable to deliver national and regional public goods with greater impact and sustainability. So will today's budding networks of innovators: The Innovation for Policy Alliance is an African network of more than 75 innovation hubs and 100 innovation partners pushing to engage with policymakers on investing in R&D and revamping educational curricula to emphasize e-learning, experimentation, and digital and financial literacy.

Priorities for action

African policymakers thus face a wide array of challenges in accelerating Africa's move to innovative and digital economies. The processes and policy actions must be prioritized and proceed in parallel.It is imperative that African leaders, policymakers, and digital and innovation stakeholders collectively develop a new policy mix to respond to pressing digital, innovation, and development challenges. The new policy mix will address the wide range of policy issues that are required to get the most from innovation and digital technologies.

The AU Digital Transformation Strategy identifies this mix as policies addressing digital infrastructure, digital skills, innovation, entrepreneurship, and the enabling policy environment, which covers access, pricing, licensing, cybersecurity, and data protection and privacy. The new policy mix will support:

- New digital platforms to develop, test, implement, learn from, and refine innovations and technology-driven applications—locally, nationally, and regionally.
- Fresh approaches to policies and regulations that recognize the shortcomings of purely national rules and uncoordinated sectoral policies and strategies.
- New approaches and mechanisms for transparency, oversight, and accountability.

Of the many elements in the broad policy agenda, the following actions are of particular relevance for Africa to take advantage of the emerging global innovation landscape.

Formulating strategies and establishing policy frameworks

With inputs and experience from across the digital and innovation ecosystems, African governments can formulate and implement robust digital and innovation strategies, backed by adequate policy frameworks. To date, much of the budding innovation policy across Africa is either reactive or piecemeal, lacking linkages to national or continental strategies. But such strategies and frameworks can ensure that different sectors and value chains reinforce each other and lead to multiplier effects, rather than limited change within silos. They can also ensure alignment of digital and innovation policies with broader macroeconomic, financial, and industrial policy—and avoid inadvertently creating competing or disincentivizing policies. Creating such strategies and frameworks requires taking into account the available national and global evidence, seeking inputs from all stakeholders, allocating adequate financial resources, and investing in human capacity for effective implementation.

The AU Digital Transformation Strategy provides a comprehensive starting point for all African governments, but their strategies and policies also need to reflect local contexts.[13] A few African countries have digital or innovation strategies under implementation, including Kenya, Mauritius, Morocco, South Africa, and Tunisia. But most countries do not have such strategies—and if they do, only on paper. They could benefit from studying Korea, Finland, and Singapore, which have excelled at implementing digital and innovation strategies. Singapore, for example, developed a strategy that, while designed by government, was implemented through well-managed partnerships with industry and university research institutes. This highlights the need for bottom-up approaches to match top-down strategies, nationally and regionally.

Integrating innovation ecosystems

Digital and innovation policy in Africa is largely new and untested. That makes informing policymaking within a highly interactive innovation ecosystem—anchored on a shared vision, adaptive strategies, sustained commitment, and institutional cooperation—critically important to ensure well designed, equitable, and sustainable policies. This involves:

- Promoting an environment for leaders, policymakers, and main stakeholders to agree on and adhere to a participatory process related to policies for innovation, technology, and research and development.
- Putting in place policy processes and approaches that are problem-driven, iterative and learn from failure, building feedback loops to guide implementation roadmaps.

Few, if any, African countries are adequately supporting such ecosystems. Nigeria and South Africa have the most advanced innovation ecosystems, boasting 85 and 80 tech hubs respectively. But they have not adequately crowded in the private sector, academia, and all-of-government approaches to that ecosystem. There are also efforts by corporates, particularly in fintech, to build out private ecosystems, but they are not well linked to policymaking processes. Around the globe, Europe has the most advanced innovation ecosystems for a multi-country block. A report for the EU Digital Transition Partnership identified 247 innovation ecosystems in 35 countries, covering almost all of Europe.[14] Such a robust ecosystem results from:

- Targeting policies and collaborations to convene stakeholders.
- Transparently seeking policy inputs.
- Incentivizing partnerships across government departments, private firms, academic, researchers, and other stakeholders.

There are other useful models where a single country is developing and nurturing innovation ecosystems. For example, China has now overtaken the European Union with research and development investments, equivalent to 2.1% of GDP.[15] Today, of the world's largest digital firms, not one is European, with China, India, and the United States investing aggressively in innovation and digital ecosystems. This points to the significant challenge of harmonizing priorities, regulations, and policies across multiple countries. These models provide good lessons, including whether government or industry should lead in championing innovation ecosystems.

Even with the most integrated ecosystems and best policy frameworks, digital innovation and technologies will not provide full benefits to Africa without investments in both digital infrastructure and human capability.

Boosting investments in digital infrastructure and skill development

Even with the most integrated ecosystems and best policy frameworks, digital innovation and technologies will not provide full benefits to Africa without investments in both digital infrastructure and human capability. Broadband connectivity alone is projected to require up to $110 billion in investment, much to be borne by national budgets. So ensuring that such investments are targeted and that donor and private funding is crowded in will be critical.

Nearly 300 million Africans live more than 50 km from a fiber or cable broadband connection, so the lack of widespread high-speed (broadband) internet remains a significant hurdle for Africa to fully harness the full potential of digital transformation. Investment in connectivity infrastructure should thus be a priority action and one where, again, regional collaboration will be important.

A very large part of the IT content consumed in Africa comes from outside the continent. Investment in data centers in Africa will foster the development of a local digital industry. The main benefit of this localization will be cost savings on international connectivity; a second benefit is sovereign control over data.

Critically important for all African governments is avoiding a multiplicity of investment initiatives and instead promoting the implementation of common infrastructures, building on the political momentum around the AfCFTA agreement while simultaneously providing a basis for the benefits to be realized.

Countries will also need to invest in privacy and security measures and application-programming interfaces (which allow two applications to talk with each other, as with making a hotel reservation online). This will involve prioritizing investments, particularly in budget-constrained environments made even tighter by the impacts of COVID-19. It will also involve promoting cross-sector and cross-border connections to reduce costs and ensure seamless trade and data exchange. And it may involve developing Africa-centric, lower-tech solutions—particularly for rural areas.

Building human capital for innovation and digital transformation is equally important. The AU estimates that it will cost nearly $20 billion to provide digital skills training to all Africans. Ensuring the widespread availability of digital skills will require revamping education curricula according to current needs and trends in the digital economy and in the labor market, with a focus on science, technology, engineering, and mathematics and on entrepreneurship and innovation.

At the same time, it will be important to mainstream digital technologies and capabilities across all aspects of life and ensure that online services are relevant to all citizens, including eGovernment, eLearning, and eHealth. This requires building digital skills so that more people can be active participants in digital society.

All of this will require mainstreaming digital education at all levels and accelerating public–private support for education and worker training. It will also entail complementing a problem-driven approach to addressing national challenges in the digital arena with regional and continental frameworks. Countries that prioritize these investments will reap greater benefits in the future as economies rely more on innovation and digitally enabled sectors.

Managing climate risks

African countries need to respond to climate change with policy actions on many fronts—local, national, regional, continental, and international. The focus here is on agriculture, natural ecosystems, and energy. Countries can leverage climate-smart agriculture to increase agricultural productivity and build farmers' resilience. They can adopt innovative natural resource management practices to improve ecosystem resilience and promote inclusive growth. And they can harness Africa's considerable renewable energy resources to speed up their economic transformations while accelerating the transition away from dependence on fossil fuels. But for many of these efforts, countries cannot work alone and must engage with their neighbors, whether for ensuring markets for agricultural produce, managing shared river basins and lake resources, or generating and transmitting energy.

Climate-smart agriculture solutions are being applied in various parts of Africa and the world and could be replicated elsewhere on the continent. Push–pull technology, implemented in parts of East Africa, involves intercropping cereals with perennial legumes while growing perennial grasses on the border of the intercrop. The practice not only increases productivity, but also reduces dependence on chemical fertilizers, thus mitigating climate change. Hello Tractor, founded in Nigeria and now active in East Africa, is a farm equipment sharing application that connects tractor owners and smallholder farmers. By facilitating payments on a mobile device, the service helps farmers easily gain access to mechanization services and increases their production efficiency. Larger markets, through regional integration, offer opportunities for economies of scale and specialization, while regional collaboration on research can help share technological solutions with farmers.

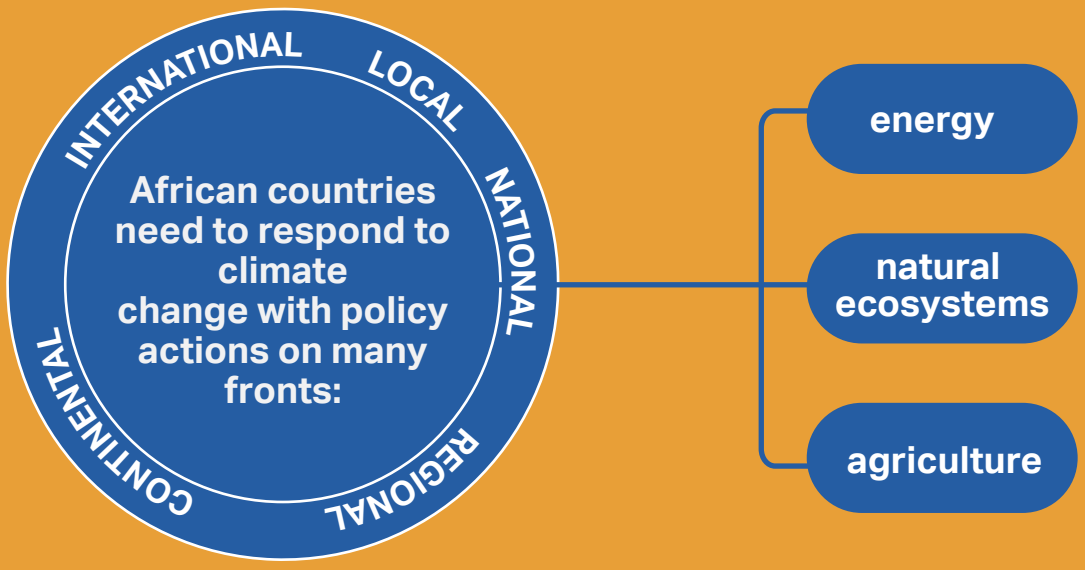
Climate-smart agriculture solutions are being applied in various parts of Africa and the world and could be replicated elsewhere on the continent.

To manage Africa's terrestrial and marine ecosystems, countries can implement natural resource management practices to improve the resilience of Africa's vulnerable ecosystems, integrating government regulations and customary laws in the management of natural resources, and cooperating with neighboring countries to come up with sustainable regional solutions. They can also increase the blue economy's contribution to economic transformation through a clear delineation of maritime boundaries and resolution of any maritime boundary disputes. And they can provide incentives for public–private partnerships and local communities to address climate change, deforestation, and ecosystem degradation. A variety of regional bodies cover forests in central Africa, lakes, and river basins and potentially offer a basis, beyond regional economic communities, for addressing climate threats to shared ecosystems.

To manage Africa's terrestrial and marine ecosystems, countries can implement natural resource management practices to improve the resilience of Africa's vulnerable ecosystems.

To harness renewable energy technologies, countries can attract investment by developing stable regulatory and policy environments, establishing competitive pricing to promote mini-grid solutions and stand-alone systems, and adopting other measures to attract domestic and foreign investors. They can also offer price incentives for investing in grid-connected and off-grid renewable energy systems. And they can overcome the steep upfront costs of renewable energy technologies for households and businesses through tax rebates, import duty reductions, and other innovative solutions. Again, regional collaboration can help in generating hydropower if countries can agree on terms to cooperate and manage water flows.

INFOGRAPHIC 5: RESPONDING TO CLIMATE CHANGE WITH POLICY ACTION



Climate-smart agriculture solutions are being applied in various parts of Africa and the world and could be replicated elsewhere on the continent.

Priorities for action

To manage climate risks, countries can do more to promote climate-smart agriculture, sustain green and blue ecosystems, and develop and scale up renewable energy. These policy priorities are consistent with three priorities of the Pan-African Negotiating Group in the Conference of Parties negotiations in global climate talks: to build healthy national and regional food systems; to promote climate resilience, environmental protection, and sustainable management of natural resources; and to facilitate access to affordable and sustainable energy.[16]

Promoting climate-smart agriculture

Adopting climate-smart agriculture will help African farmers increase their productivity, improve resilience, and mitigate climate change. Modern farm inputs (such as heat-tolerant crop varieties), improved management techniques (such as crop diversification), and innovations (such as precision agriculture) help optimize the use of farm inputs, increase farm productivity, and lower costs.

Key priority actions:

- *Increase farmers' technical skills and knowledge of technological innovations by boosting the capacity of national agricultural research and extension systems.* This can be done by increasing investments in research and development and in extension services. Kenya is strengthening the capacity of the local agricultural research and extension system to deliver training, knowledge, and advisory services to farmers.[17] The activities include upscaling climate-smart agriculture practices by financing interventions to promote and facilitate adoption of climate-smart agriculture practices, as well as supporting market, climate, advisory, and agrometeorological services.

- *Adopt, develop, and adapt technological innovations to local conditions.* Climate-smart agriculture solutions developed in advanced countries may not directly be applicable to conditions in Africa. So, it is essential to adapt them to the local conditions. In Kenya, the Ministry of Agriculture, Livestock, and Fisheries is also supporting the development, validation, and adoption of context-specific climate-smart agricultural practices. In Ghana, the Rain Forest Alliance is producing tailor-made online training materials to help cocoa farmers build resilience and end deforestation in the cocoa supply chain.

- *Improve rural coverage of digital applications and ensure that farmers have access to them.* Improve telecommunications coverage particularly in the rural areas to enable farmers to access digital applications. To increase farmers' access to these applications, the service providers also need to come up with products that are affordable. This can be achieved through public–private partnerships, with government providing incentives to private sector operators. In Tunisia, Plantix Tunisia is a mobile-based crop advisory application

for farmers and extension workers.[18] It can diagnose pest damage, plant diseases, and nutritional deficiencies affecting crops and offer treatment measures. To improve coverage and access, the project is training young agriculture graduates to be deployed across the country.

- *Promote regional collaboration in agricultural research.* To share knowledge and experiences in the production of climate-smart agricultural practices tailored to specific agroclimatic zones and subzones requires regional collaboration among national agricultural systems. Agricultural research in Africa is highly fragmented given the large number of countries and the wide variety of agroecological zones and farming systems. Much of Africa's agricultural research and development investment has come from donors, with limited private sector involvement. Regional collaboration is therefore required to develop an African funding base to support supranational research and reduce the current dependency on donors. In the absence of such a funding structure, existing models of supranational research—such as the West Africa Agricultural Productivity Program and the East Africa Agricultural Productivity Program—can be leveraged to promote regional spillovers.

INFOGRAPHIC 6: MANAGING CLIMATE RISKS

Sustaining green and blue ecosystems

Sustainable management of both the green and blue ecosystems can be enhanced by deepening regional collaboration.

A key policy priority for Africa is to sustain its green and blue ecosystems. Sustainable use of the green ecosystem can be achieved by devising and applying nature-based solutions to address land use problems, while blue ecosystems can be sustainably managed by using innovative coastal zone management approaches such as blue carbon projects. Sustainable management of both the green and blue ecosystems can be enhanced by deepening regional collaboration. Key priority actions:

- *Devise and apply nature-based solutions to address land use problems.* To sustainably manage Africa's green ecosystems, countries can apply nature-based solutions, which involve using natural alternatives to solve land use problems such as deforestation and water scarcity. Examples include afforestation, agroforestry, and integrated watershed and catchment management. Co-designed by government agencies, civil society, and local communities, they provide incentives for public-private partnerships to address climate change and ecosystem degradation. Payments from NBS-related initiatives such as REDD+ or the Clean Development Mechanism provide financial incentives to forest-dwelling communities to plant trees and reduce deforestation.

  For afforestation, the Humbo community project in the southwestern Ethiopia involves the restoration of indigenous tree species. A collaboration under the Clean Development Mechanism, it involves local and regional governments, local communities, the Ethiopian Environmental Protection Agency, and development partners. It was the first in Africa to sell temporary Certified Emissions Reductions, which were purchased by the World Bank BioCarbon Fund. Revenue from the carbon credits is managed by the community-owned forest management cooperatives and is being used to improve the livelihoods of the people through investments in micro businesses, agroprocessing, and environmental protection.[19]

  For agroforestry, integrating trees on farms and rangelands, with a view to reduce farmer dependence on a single staple crop and thus to diversify their livelihoods, is a nature-based solution in the Lushoto District in northeastern Tanzania, where more than 60% of the land is eroded. An integrated watershed and catchment management approach controls runoff and reduces soil erosion. In the Uluguru mountain range in eastern Tanzania, a hydrological assessment in the catchment had revealed an overall decrease in water quality due to a dramatic increase in sediment loading in the Ruvu River, the main water source in the area. To address the problem, upstream farmers received payments from downstream buyers (industry, sewage plants) for adopting agricultural practices to control runoff and soil erosion while improving crop production. The approach included construction of bench terraces, reforestation, intercropping crops with fruit trees, mulching, and fertilizing with animal manure.

- *Sustain blue ecosystems by promoting blue carbon projects in coastal areas.* Africa's blue economy plays a key role in providing employment, food security and nutrition. More than 12 million people are employed in fisheries, the largest blue economy sector, providing food security and nutrition for more than 200 million Africans and generating value added estimated at more than $24 billion, or 1.3% of African GDP.[20]

Blue carbon projects involve the rehabilitation, protection, and sustainable use of mangroves in coastal areas. Seagrasses, salt marshes, and mangroves sequester and store carbon dioxide, referred to as "blue carbon." Blue carbon projects can generate carbon credits that can be sold on carbon markets under the mangrove REDD+ or Clean Development Mechanism. An example is the Mikoko Pamoja project, currently implemented in Gazi Bay, Kenya.[21] The local community depends on the mangroves for their livelihoods, with 80% of the people making their living from fishing-related activities. Revenues from selling the credits go for mangrove planting and conservation and community development.

- *Deepen regional collaboration for Africa's green and blue economies.* To optimize the benefits of Africa's green and blue economies, a regional approach to addressing forest governance would make it easier for countries to access climate finance initiatives such as REDD+ to help achieve their nationally determined contributions under the Paris Agreement on climate. The Central African Commission on Forestry seeks to play this role for its member states. Regional collaboration is also required to resolve maritime boundary disputes and to address piracy, illegal fishing, and plastic pollution. The Economic Community of Central African States has integrated maritime security for its member states, including joint patrols, harmonized actions at sea, a regional maritime tax regime, and information sharing and management.

Developing and scaling up renewable energy

Africa has the lowest electricity access in the world but is endowed with abundant renewable energy resources that remain underexploited. Two key barriers to developing them are lack of investment and steep upfront costs of renewable technologies. Key priority actions:'

- *Increase investment by strengthening the policy and regulatory frameworks.* Developing robust legal and regulatory frameworks and independent regulatory bodies will provide a sense of security and certainty to potential investors, both domestic and foreign. Nigeria established a new entity, Nigerian Bulk Electricity Trading, to buy electricity from independent power producers and provide capital and market guarantees.

Africa has the lowest electricity access in the world but is endowed with abundant renewable energy resources that remain underexploited.

Innovative policy instruments can provide price incentives for investing in grid-connected and off-grid renewable energy systems. Feed-in tariffs in South Africa require the state-owned utility, Eskom, to purchase renewable energy from independent power producers at predetermined prices,[22] which reduce financial risk and increase market certainty for renewable energy developers and private investors.

- *Broaden access to renewable energy technologies by reducing the steep up-front costs.* Access to renewable energy can be improved by promoting digital technology and innovative business models that can help to reduce the costs, especially for poor households. In a scheme operated by M–KOPA Solar in Kenya, customers pay a small deposit for a solar home system and repay the balance in small installments on a pay-as-you-go basis using M–PESA.

  In Rwanda, the Infrastructure Gender Mainstreaming Strategy 2017–2022 has special provisions to address gaps in women's involvement in the energy value chain, such as access to finance. And in many parts of Africa, wireless carrier MTN Group addresses the lack of access to banking facilities and credit by allowing its mobile money subscribers to make single or bulk payments without having a bank account.

- *Deepen regional collaboration to reduce electricity costs and increase access.* Deeper regional collaboration on energy resource-sharing will help maximize the benefits from Africa's renewable energy resources and increase regional energy security. This can be done by integrating regional energy markets to facilitate cross-border energy trade. Increasing cross-border energy trade can drive down costs, create economies of scale, and stimulate investment, and thus boost electricity access across the region. Regional energy integration could save an estimated $63 billion of the $450 billion in investments needed to quadruple electricity use by 2040.[23] And the returns on cross-border transmission investment could be 20–30% across much of the region, rising to 120% for Southern Africa.[24]

  The decision by African Union Commission to launch the African Single Electricity Market in 2021 is a step in the right direction. When fully operational in 2040, it will be the world's largest single electricity market, covering 55 member states and serving 1.5 billion consumers.

Collaborating to integrate—by providing regional public goods

Each of the three key challenges that are the focus of this report—jobs, innovation, and climate—could benefit from greater regional collaboration to provide regional public goods and support countries in achieving their transformation goals.

Regional collaboration and integration have long been high on the agenda in Africa, as with the Abuja Road Map to create the African Economic Community and most recently the AfCFTA. Along with the African Peace and Security Architecture, the Programme for Infrastructure Development in Africa, and others, the AfCFTA reflects African leaders' recognition of their nations' interdependence and a stated ambition to deepen it.

But implementing regional frameworks has for the most part been slower than planned. One reason is low implementation capacity and inadequate financing. Aspirations are bold, with achievements too often elusive. But the reasons for slow progress go beyond capacity and financing. They are mired in the weak incentives for countries to engage politically when the gains are uncertain or small, especially for the large economies, and the reluctance to give up control over some of their national policies to regional and continental organizations is considerable.

There is thus a gap between the regional politics that shape the agreements that heads of state sign and the domestic politics that shape what governments implement and how. In countries with weak administration and uncertain rule of law and accountability (particularly in imposing credible sanctions for noncompliance), implementation takes place only when the incentives align to support it.

Jobs, innovation, and climate could benefit from greater regional collaboration to provide regional public goods and support countries in achieving their transformation goals.

Many of the challenges that countries face can be addressed by deepening regional integration and collaborating to promote regional public goods. But this requires understanding the nature of the regional public good being sought, to help overcome implementation barriers. It also requires shifting the integration narrative from pursuing not just regional market integration but also broader regional collaboration. That can create a virtuous circle where greater collaboration in other areas will help ensure the benefits of the trade agenda at the national level.

This raises the need to provide regional public goods and services whose benefits cross borders—such as integrated labor markets, digital infrastructures to support region-wide innovation, cross-border natural resource protection and development, as well as completing transport corridors, reducing the spread of disease, disseminating knowledge about climate-smart agricultural techniques, or integrating regional communications networks and financial markets. Thinking in terms of regional public goods can help both in the analysis of what type of regional collaboration is required and where the blockages lie—and in shifting the narrative toward the need to look beyond trade for the benefits of the AfCFTA to emerge.

The AfCFTA aims to create a single market for goods and services by removing tariffs for trade among African countries. Successive rounds of negotiations set protocols for trade in goods, trade in services, and dispute settlement. Agreements on tariff concessions on trade in goods, rules of origin, and commitments for trade in services and e-commerce are expected to further accelerate intra-African trade.

Upholding the provisions of the agreement will be crucial for the AfCFTA's success. The AfCFTA secretariat will have the legal authority to conduct negotiations, monitoring, and oversight on behalf of member states, along with the capacity to provide technical assistance and practical guidance. An institutionally strong secretariat—with the authority and capacity to oversee trade rules in line with the text of the agreement—will build credibility and reduce trade policy uncertainty and strengthen Africa's position in external trade negotiations.

A perfect example of a regional, indeed global, public good is reigning in the COVID-19 pandemic, a sinister public bad. For health, countries need to quickly acquire medical equipment to relieve pressure on hospitals and get vaccines to shield the public. For wealth, countries need flatten the infection curve while minimize the costs of curtailing economic activities.[25] The African Medical

Supplies Platform—a joint effort of the African Union, the African Centers for Disease Control, the regional economic communities, and other regional organizations—is linking national health providers with global suppliers of vaccines, personal protective equipment, ventilators, and other equipment to battle this and any other future pandemic. It is precisely the kind of regional collaboration that can lead to deeper regional and global integration (box 1).

Priorities for action

A regional public goods approach requires complementing the traditional top-down approach with regional organizations taking the lead in converting regional commitments to national actions—with a bottom-up approach that identifies local or national problems with a regional reach and formulates policy responses. This requires linking national development plans and programs with regional plans and programs (infographic 5).

The bottom-up problem-solving approach to providing regional public goods determines the interests of countries, the incentives of domestic players, and the type of policies that are appropriate, thus helping to overcome implementation gaps. It starts by asking what domestic problem needs the provision of a regional public good and gradually builds coalitions of relevant actors, and the capabilities of countries and organizations through repeated cycles of program implementation and adaptation, increasing the feasibility of further collaboration. The Maputo Development Corridor in Southern Africa and the Northern Corridor in East and Central Africa succeeded more from this bottom-up approach than from the Southern African Development Community (SADC) or EAC secretariats, though they served to support regional goals.

A regional public goods approach requires complementing the traditional top-down approach with regional organizations taking the lead in converting regional commitments to national actions—with a bottom-up approach that identifies local or national problems with a regional reach and formulates policy responses.

Box 1. Line of attack for using the regional public goods approach

1. Analyze the problem

- Why is greater regional collaboration needed, and for whom?
- Which regional public good (RPG) is underprovided?

2. Understand the type of RPG

- What type of RPG is underprovided?
- How does this shape the long-term interests of countries in providing or not providing the RPG?
- What other factors—geographic, historic, economic, political—define interests and incentives around providing the RPG?

3. Identify necessary services and policies

- What services or solutions are needed for the RPG to be provided?
- What are the RPG characteristics of those services or solutions? For example, is one a weakest link solution, where the eventual provision is determined by the smallest effort or by no effort? Or is it a weighted sum solution, where all members must be mobilized to do their part?
- What minimum combination of services and solutions is needed for the RPG to be provided?

4. Choose a suitable coalition and framework for collaboration

- Is the issue more likely to be successfully addressed through bilateral collaboration, through a regional group of countries, or through a combination?
- Does everyone need to be equally on board, or just a few, for the RPG to be provided?
- Does a suitable regional framework already exist? Is it flexible enough?
- What coalitions or alliances need to be created or promoted for the RPG to be provided?

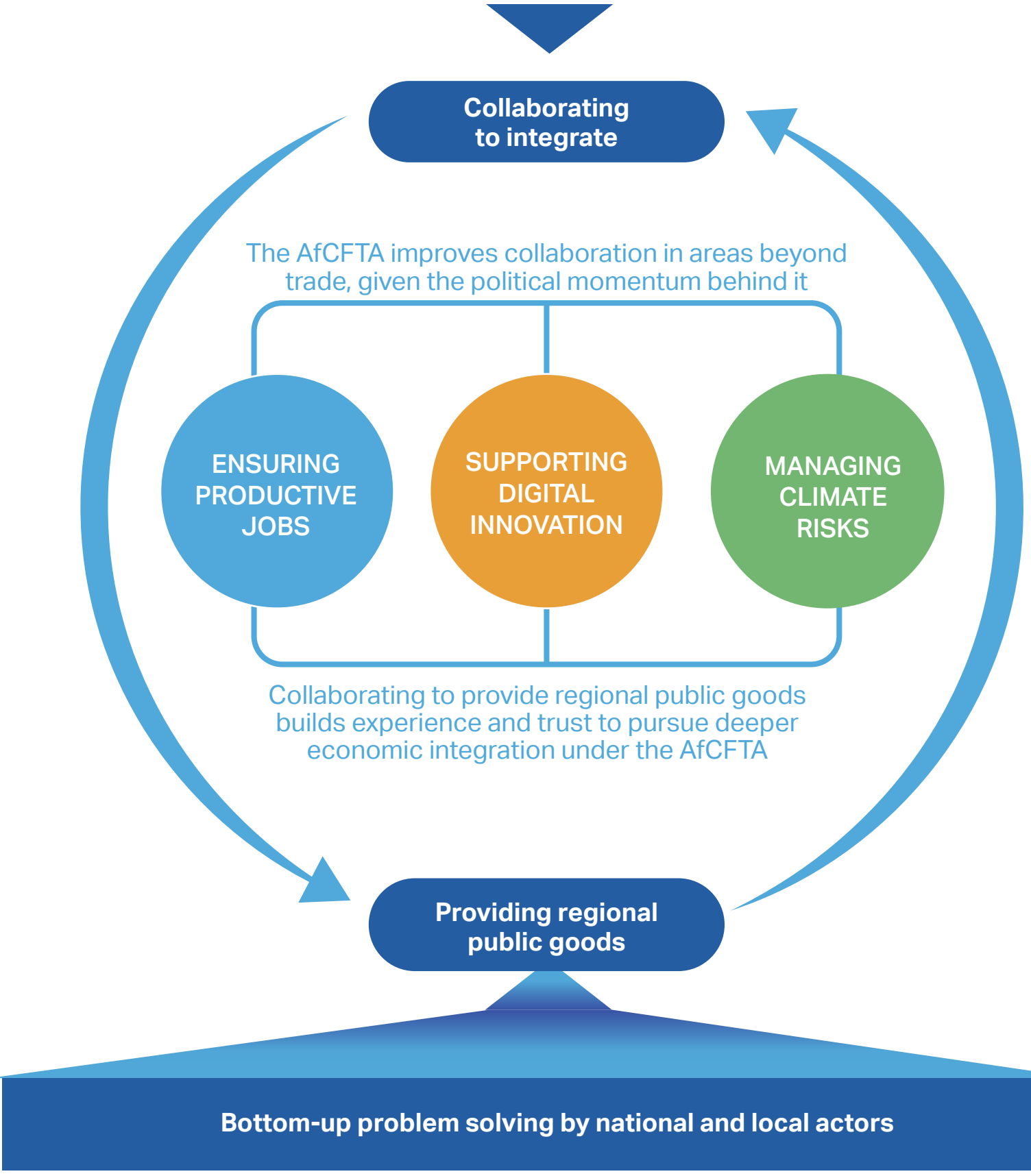
5. Act

- What type of policy implementation is it—fairly easy or very difficult?
- How can national contributions be incentivized?
- At what level should most efforts be focused to ensure real organizational change—for example, the regional level for best shot and policymaking/elite services, or the local level for weakest link and implementation-intensive service delivery?
- What short-term or partial solutions can change the environment and increase traction for regional collaboration?
- How can negative forces and disincentives be lessened to muster support for implementation?

6. Adapt and repeat

- What has not worked in the past, and why?
- Does the initial problem analysis (step 1) hold?
- What can be improved, and how?
- Do previous actions open new doors for advancing RPG provision?

INFOGRAPHIC 7: INTEGRATING TO TRANSFORM



Reframing regional collaboration as addressing national problems

One way to address past hurdles in regional cooperation is to reframe these top-down processes as entry points for addressing problems at the local or national level. That requires understanding some of the needs or ambitions of stakeholders that could be advanced by collective, regional approaches. It also requires understanding how the high-level trade or other regional collaboration agreements might help provide a useful framework to address those needs. The One Network Area mobile phone network in East Africa was a bottom-up approach to regional integration, where the private sector was able to negotiate to provide a regional mobile network, thus further facilitating regional communication and trade.

The AfCFTA can arguably help firms find new markets or source inputs from beyond their regional trade bloc—which are those firms, and how to ensure their current difficulties are addressed? That is an agenda that is ongoing now.

In the realm of water management and renewable energy, regional collaboration around dam construction and water levels can help address issues of renewable energy production, access, and irrigation, and can facilitate financing national priority projects. Framing problems in this way can help generate greater buy-in and momentum for implementing agreements. While the Renaissance Dam on the Nile remains somewhat controversial given a lack of trust among countries, the Nile Basin Initiative has continued to provide a platform for sharing technical data and seeking joint solutions to energy provision and transmission, as well as water flow and irrigation at a more local level.

Assembling coalitions for change

Identifying the problem should be followed by understanding what type of regional public good is involved, and which actors, within and across affected countries, can champion and help undertake implementation and at what level. Is the issue more likely to be successfully addressed through national, bilateral, or a larger regional group of countries? Does everyone need to be equally involved, or just a few, for the regional public goods to be provided? Does a suitable collaboration framework already exist? Is it flexible enough?

A common assumption is that regional collaboration and integration must take place through regional organizations. Experience shows that this is not always the case. Regional secretariats and commissions are important actors for convening and providing forums for discussion, but they are not always well-placed or indeed mandated to lead or promote implementation of the agreements they have helped foster.

One way to address past hurdles in regional cooperation is to reframe top-down processes as entry points for addressing problems at the local or national level. That requires understanding some of the needs or ambitions of stakeholders that could be advanced by collective, regional approaches.

Thinking in terms of regional public goods can help identify where blockages might arise, and where to focus support efforts by understanding the types of regional public goods in question for implementation.

Thinking in terms of regional public goods can help identify where blockages might arise, and where to focus support efforts by understanding the types of regional public goods in question for implementation. Does implementation require collective action across multiple countries for the benefits to be realized, as in creating a free trade area or a communications network, where all participants must be mobilized (a summation regional public good)? Is it a weakest link issue, where the focus has to be on key bottlenecks, as in managing epidemics or transport corridor blockages due to nontariff barriers (if border officials demand side-payments)? Or is it something where a best shot from any participant will ensure benefits for all, as with a vaccine or climate-smart seed variety? Identifying the type of regional public good characteristic of different types and at different stages of collaboration can help identify the services and solutions essential for implementation.

For example, the TradeMark East Africa model of flexible donor support to reduce regional trade costs reflects this way of matching top-down objectives and agreements with bottom-up problem-solving initiatives around different types of regional public goods, adapting the support to the type and needs. The technology for the electronic cargo tracking system they helped roll out in East Africa is a best shot regional public good—not all participants need to come up with their own system to benefit. But whereas best shot public goods are relatively easy, weakest-link public goods such as the Niger and Nile regional water systems can suffer if a single country takes unilateral decisions about flows, thus undermining the benefits to all, unless an agreement can be reached. The risk is focusing only on best shot regional public goods, which are easier—such as writing a strategy or the text for the AfCFTA agreement—than implementing it. A summation public good like a trade area requires implementation by all participants to reap the full benefits.

Sometimes reform coalitions can stem from high-level political initiatives, but they often require a combination of different regional, national, and perhaps even local actors to be on board—thus providing demand for the regional good. The Maputo Development Corridor fits this approach, mixing high-level engagement with private sector engagement and wider initiatives for those less directly involved.

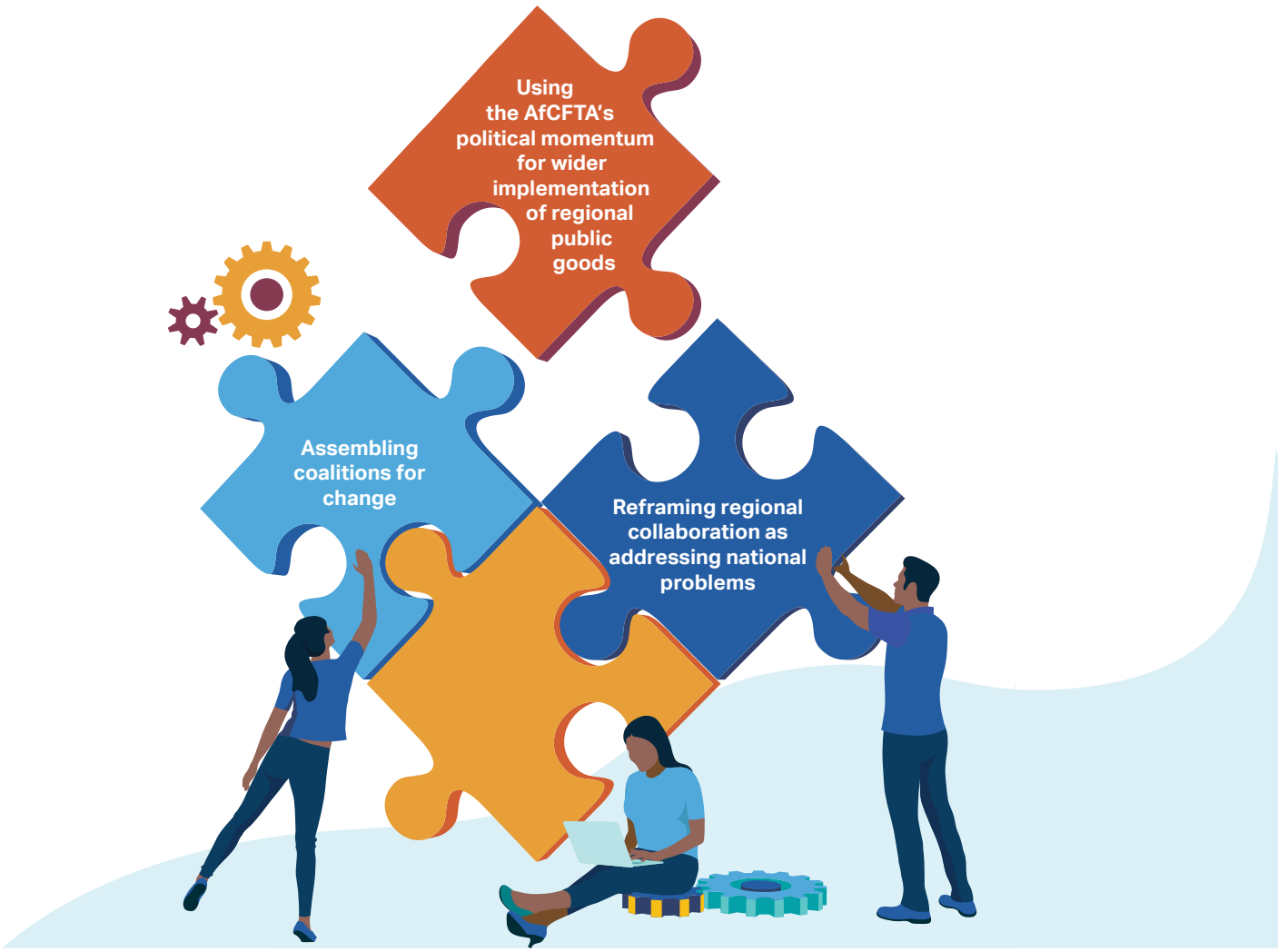
Resolving problems is about working with and for specific constituencies, as with private firms seeking to trade more easily, civil society seeking to protect citizens engaged in cross-border movements of livestock, or public agencies seeking to apply formal rules in complex and fragile circumstances. Of course, some stakeholders may stand to lose from certain aspects of regional collaboration, requiring that solutions be sought by engaging with these groups, and potentially offset their losses.

Work to help roll out the Common Market for Eastern and Southern Africa (COMESA) Simplified Trade Regime sought to build such coalitions around key border posts where the regime will be implemented. Civil society organizations that seek to train, inform, and support informal traders in West Africa can also help the Economic Community of West African States implement its customs union.

Using the AfCFTA's political momentum for wider implementation of regional public goods

The AfCFTA currently enjoys a lot of political momentum and attention. But for the main benefits to flow, other regional public goods have to be in place—not just existing regional trade liberalization agendas on which the AfCFTA builds, or hard and soft trade and transport infrastructures, or better aligned quality and standards frameworks. It will also require cross-border energy connections and markets to ensure viable energy distribution and wider access to it; regional arrangements for reliable and appropriately priced mobile telephony roaming and internet connections; more flexible movements of people and labor, recognizing qualifications; and coordinated responses to insecurity and climate change. All are forms of regional public good provision—addressing different problems, with different regional public good characteristics, requiring different coalitions of reform. At the same time, existing regional collaboration frameworks and agreements have often struggled with implementation.

INFOGRAPHIC 8: NATIONAL PRIORITIES HAVE REGIONAL SOLUTIONS



Each of these additional regional agendas is an important facilitator for delivering AfCFTA benefits, but in a circular way they can also benefit from the political momentum behind the AfCFTA. The AfCFTA can thus be an impetus for why more regional collaboration and integration are necessary. It can also promote dialogue on how best to pursue regional collaboration, and how to prepare different actors to contribute to delivering the greatest benefits.

Collaborating to tackle the three frontline challenges covered in this report

Ensuring productive employment

The free movement of workers and business people is a big issue for Africa's labor market. Though the AfCFTA garners much of the attention, the closely connected Protocol on the Free Movement of People garners far less, with only four countries having ratified it.

Consider this political matter in terms of the bottom-up problem-solving approach proposed here: Creating a common market with the free movement of people requires all countries to implement one. But it may be possible to address movement at a narrower, sectoral level, addressing specific markets. In a regional framework, different actors could agree to allow increased movement in agreed sectors. A coalition of interested private and public parties from two or more countries could then coordinate their efforts to increase political traction, all framed as making the AfCFTA a reality given the need for cross-border services to support trade in goods.

In the East African Community, the private sector identified the lack of mutual recognition of professional qualifications across borders as hindering the regional market. Without the lead of a regional body, groups from sectors such as accounting found ways to ensure mutual recognition of qualifications among professional associations to allow better cross-border integration of professional services. For accountancy services, an agreement was signed by all the professional institutes without substantial preparatory work. For engineering services, an agreement initiated by the registrars in Kenya, Tanzania, and Uganda was signed only by the engineering boards, which saw their underlying qualifications and forms of regulation as sufficiently similar to allow for mutual recognition. For architectural services, and agreement was initiated by the East Africa Institute for Architects, a regionwide umbrella organization for the bodies representing architects in each country.

Other examples include regional training centers. The COMESA African Leather and Leather Products Institute training centers—though not regional as such—take place in one country with wider regional benefits (a best shot). They also address the problem of how to add value to the large livestock population in several COMESA countries, again working with a coalition of interested parties, including the Zambia government, to increase buy-in for the approach.

Supporting digital innovation

For innovation to fully benefit Africa requires well-integrated digital infrastructure across the continent. While regional agreements to harmonize standards are necessary, they often are not enough. Some technologies call for agreement on leadership, which suggests a transfer of decisionmaking to a frontrunner that can provide a public good to the benefit of multiple consumers. The East Africa One Network Area roaming initiative lowers the cost of roaming and communications among Kenya, Rwanda, South Sudan, and Uganda through regulatory intervention and coordination—and Tanzania joined in January 2021. Again, the case for connecting digital infrastructure to benefit from the AfCFTA is quite clear.

Aligning national innovation systems may offer another opportunity, but it needs to be clear for whom and for what. Similarly, aligning national digital innovation strategies with the AU digital transformation strategy may seem attainable (best shot), but the challenge is in the implementation. Technological and regional solutions can be helpful, and organizations and capacities exist to provide them, but only if responding to demand and need: What is the issue they seek to address?

Having identified the problem that innovation systems seek to address, the question is to see what kind of regional public good is envisaged—is it about a framework, or about eliminating weakest links and therefore which actors need to be involved? While the AfCFTA will lead to negotiations on the digital economy, broader innovation systems will complement the AfCFTA with new business models and technology applications that will produce more jobs.

For innovation to fully benefit Africa requires well-integrated digital infrastructure across the continent. While regional agreements to harmonize standards are necessary, they often are not enough.

Managing climate risks

Preserving blue and green ecosystems requires regional collaboration on multiple issues and in multiple forms, so a more problem-focused approach can help get beyond broad climate-related policies to implementation. Even if regional organizations exist for this, enforcing and implementing agreements remains a country responsibility. Focusing on specific bottom-up problems within these broader issues can help identify where to zoom in on specific aspects of water conservation, or energy generation and how to address the tradeoffs between and within countries.

Renewable energy, particularly through hydropower, is a good example, where upstream energy generating capacity in one country can affect downstream water availability for irrigation in another. Gathering technical data from across the river basin—helped by new tools to simplify data-sharing—can then identify key bottlenecks and tensions, specify the key actors that will be affected, and seek to address specific problems, all while addressing the broader problem of energy distribution for broader economic transformation.

Regional power pools have the potential to bring down unsustainably high energy costs for both producing and consuming countries, and accelerate the transition to renewable energy by increasing the potential market, and ensuring that infrastructure can run at full capacity (even if domestic consumption is low). While a sophisticated regional market mechanism can be set up, as in Southern and East Africa, it requires sufficient installed capacity and good interconnections, and it must be driven by some key actors. The initial success of the Southern African Power Pool came from solving the problem of changing domestic and regional energy capacities and meeting South Africa's growing energy needs.

Preserving blue and green ecosystems requires regional collaboration on multiple issues and in multiple forms, so a more problem-focused approach can help get beyond broad climate-related policies to implementation.

Integrating to transform demands visionary leadership

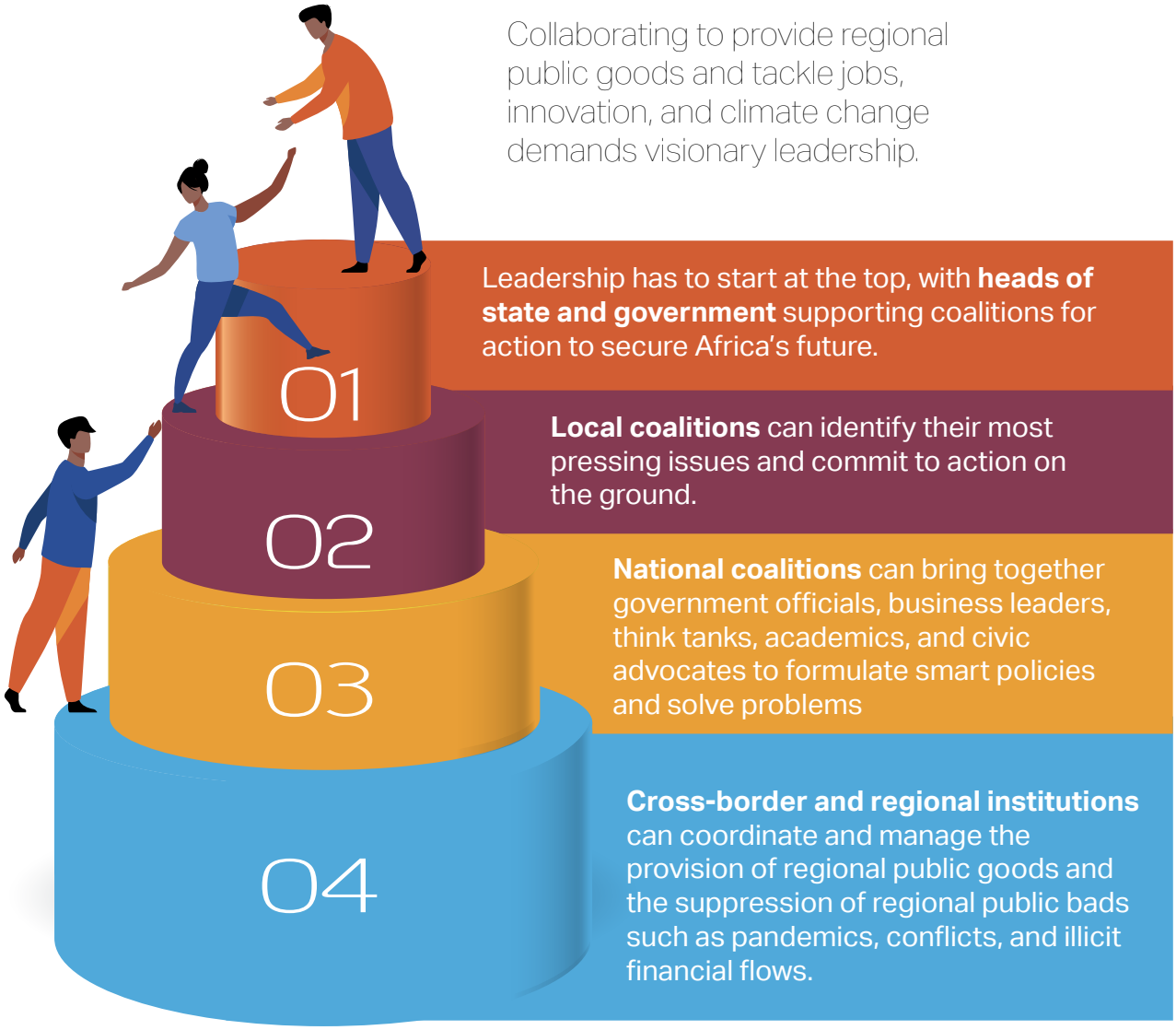
Recovering from the COVID-19 crisis is an opportunity to build trust in government institutions and between government leaders and citizens to seize the moment in taking difficult policy decisions.

Collaborating to provide regional public goods and tackle jobs, innovation, and climate change demands visionary leadership. And that leadership has to start at the top, with heads of state and government supporting coalitions for action to secure Africa's future. Local coalitions can identify their most pressing issues and commit to action on the ground. National coalitions can bring together government officials, business leaders, think tanks, academics, and civic advocates to formulate smart policies and solve problems. Cross-border and regional institutions can coordinate and manage the provision of regional public goods and the suppression of regional public bads such as pandemics, conflicts, and illicit financial flows.

Now, both regional integration and collaboration have been set back by the spread of COVID-19. Most African economies are expected to see their growth slow or recede, some considerably. The impacts will take a toll on all five elements of DEPTH. They will also deflect attention from tackling the frontline challenges of innovation, demographics, and climate. As countries recover, they should act not just to restore growth. They should work with the private sector and civil society to tackle the frontline challenges analyzed in this report in ways that support growth with depth. If they can get on a sustainable trajectory to transform their economies, they will be much more resilient to the future shocks that are certain to befall them.

African leaders should seize this moment to work with business, civil society, and the international community to drive the economic transformation agenda and ensure that it is not derailed. Recovering from the COVID-19 crisis is an opportunity to build trust in government institutions and between government leaders and citizens to seize the moment in taking difficult policy decisions. This increased trust can facilitate the acceleration of reforms during the recovery and strengthen transparency and accountability. It can also turn successful short-term policy measures into medium to long-term reforms by creating new incentives for stakeholders to support the new agenda. And it can foster support for increasing the capacity and preparedness to deal with economic shocks—to secure Africa's future by integrating to transform.

INFOGRAPHIC 9: THE NEED FOR VISIONARY LEADERSHIP



References

ACET (African Center for Economic Transformation). 2014. *African Transformation Report: Growth with Depth*. Accra, Ghana.

AU (African Union). 2020. *The Digital Transformation Strategy for Africa (2020–2030)*. Addis Ababa.

Akresh, R., D. de Walque, and H. Kazianga. 2013. "Cash Transfers and Child Schooling: Evidence from a Randomized Evaluation of the Role of Conditionality." Policy Research Working Paper 6340, World Bank, Washington, DC.

AUDA-NEPAD (African Union Development Agency, New Partnership for Africa's Development). 2021. "Strategic Priorities." Available at: https://www.nepad.org/strategic-priorities.

Azevedo, J.P., A. Hasan, D. Goldemburg, S.A. Iqbal, and K. Geven. 2021. "Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes: A Set of Global Estimates." Policy Research Working Paper 9284, World Bank, Washington, DC.

Brookings. 2019. *Harnessing Africa's Youth Dividend: A New Approach for Large-scale Job Creation*. Washington, DC: Brookings Institution.

Brown, E. K., and H. Slater. 2018. *The Future of Work in Africa: Implications for Secondary Education and TVET Systems*. Background Paper for Master Card Foundation Study on Secondary Education in Africa. Accra, Ghana: African Center for Economic Transformation (ACET).

Eberhard, A., O. Rosnes, M. Shkaratan, and H. Vennemo. 2011. *Africa's Power Infrastructure: Investment, Integration, Efficiency*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/2290.

Energypedia. 2021. "South African Renewable Energy Feed-in Tariff." Available at: https://energypedia.info/wiki/South_African_Renewable_Energy_Feed-in_Tariff.

GSM Association. 2020. *The Mobile Economy—Sub-Saharan Africa 2020.* London, UK.

Komorowski, M. 2019. "Innovation Ecosystems in Europe: First Outline of an Innovation Ecosystem Index." Brussels: imec–VUB–SMIT (Vrije Universiteit Brussel, Studies on Media, Innovation and Technology).

McKinsey. 2015. *Brighter Africa: The Growth Potential of the Sub-Saharan Electricity Sector*. New York: McKinsey & Company. Available at: http://www.mckinsey.com/insights/energy_resources_materials/powering_africa.

Muhoza, D.N., P.C. Rutayisire, and A. Umubyeyi. 2016. "Measuring the Success of Family Planning Initiatives in Rwanda: A Multivariate Decomposition Analysis." *Journal of Population Research* 33 (4): 361–377.

Webmanagercenter. 2017. "Tunisia-GIZ: Plantix, A Smartphone Application Serving the Agricultural Sector." June 21. Available at: https://www.webmanagercenter.com/2017/06/21/407967/tunisie-giz-plantix-une-application-smartphone-au-service-du-secteur-agricole/.

UNECA (United Nations Economic Commission for Africa). 2016. *Africa's Blue Economy: Opportunities and Challenges to Bolster Sustainable Development and Economic Transformation*. Issues Paper. Addis Ababa: UNECA.

UNECA (United Nations Economic Commission for Africa) and AfDB (African Development Bank). 2018. *African Statistical Yearbook 2018*. Addis Ababa and Abidjan, Côte d'Ivoire: UNECA and AfDB.

UN (United Nations). 2019a. *World Population Prospects. The 2019 Revision*. New York: UN Department of Economic and Social Affairs, Population Division.

World Bank. 2021. "Kenya Climate Smart Project." Washington, DC: World Bank. https://projects.worldbank.org/en/projects-operations/project-detail/P154784.

World Economic Forum. 2018. "Global R&D spending is now dominated by two countries." Geneva, Switzerland.

WorldVision. 2021. "Humble Humbo's Carbon Trade Upgrade." Available at: https://www.worldvision.com.au/global-issues/work-we-do/climate-change/humble-humbo-carbon-trade-upgrade.

Wylie, L., A.E. Sutton-Grier, and A. Moore. 2016. "Keys to Successful Blue Carbon Projects: Lessons Learned from Global Case Studies." *Marine Policy* 65: 76–84.

End notes

1 ACET 2014.
2 United Nations 2019a.
3 Brown and Slater 2018.
4 Brookings 2019.
5 Azevedo 2021.
6 Brown and Slater 2018.
7 Akresh, de Walque, and Kazianga 2013.
8 Brown and Slater 2018.
9 Brown and Slater 2018.
10 UNECA and AfDB 2018.
11 Muhoza, Rutayisire, and Umubyeyi 2016.
12 GSM Association 2020.
13 AU 2020.
14 Komorowski 2019.
15 World Economic Forum 2018.
16 AUDA-NEPAD 2021.
17 World Bank 2021.
18 Webmanagercenter 2017.
19 World Vision 2021.
20 UNECA 2016.
21 Wylie, Sutton-Grier, and Moore 2016.
22 Energypedia 2021.
23 McKinsey 2015.
24 Eberhard et al. 2011.
25 Byiers et al. 2021.

To accelerate transformation, African countries must collaborate beyond trade to tackle shared challenges, harness regional opportunities, and enable economies to scale.

01

Creating jobs for young Africans

As African countries transition from a largely rural and agricultural society with high birth and death rates to a predominantly urban and service society with low birth and death rates, the labor force expands faster than the population of very young and old people. The transition can produce an economic surplus that, with the right policies in place, can be invested for faster growth and greater welfare—a demographic dividend.

Whether Africa's coming surge of young Africans is transformed into a demographic dividend or a ticking time bomb of discontent depends on how Africa's leaders respond to these demographic changes. In demographic transitions, mortality declines first and fertility later, with a lag. The length of that lag makes a big difference for the age structure of the population. Accelerating the demographic transition by reducing fertility rates more quickly can change the age structure, with fewer young dependent children and more working-age adults.

If new entrants to the labor force are well trained and have access to productive work, they can start to generate an economic surplus that can further improve human capital and increase productivity—delivering a demographic dividend. But the benefits will be realized only with simultaneous investments in infrastructure, job creation, and a supportive business climate.

Africa's youth bulge

According to United Nations projections, Africa's population, at a little over 1.3 billion today, is set to rise to 1.9 billion in 2035 and to 2.5 billion in 2050.[26] Of the 600 million increase, 500 million would be in Sub-Saharan Africa. And more than 80% of Africa's population growth will occur in cities, making it the world's fastest-urbanizing region. More than 80% of the increase to 2035—and almost 90% of the increase to 2050—will be in East, Central, and West Africa.

Sub-Saharan Africa is the world's youngest region, and this young population is growing rapidly.[27] At 750 million in 2019, Africa's working-age population (15–64) is set to surpass 1 billion before 2030 and to reach 1.1 billion by 2035,[28] with a bulge of young Africans (ages 15–24) entering the labor force at a rate of 18–20 million each year.[29]

In demographic transitions, mortality declines first and fertility later, with a lag. The length of that lag makes a big difference for the age structure of the population. In Africa, unlike in other developing regions of Asia and South America, declining fertility as one of the key drivers of demographic transition is coming late.[30] Rapid population growth and the youth bulge in Africa are being fueled by declining mortality, high and only slowly declining fertility,[31] resulting in a youthful age structure.[32]

Africa has not created enough good jobs for those entering the labor force. Despite faster economic growth since 2005, most of the youths entering the labor market end up in the informal sector, which on average accounts for 80% of employment, working under unsavory conditions on small farms and artisanal firms, at low productivity and incomes. On current trends, three-quarters of entrants to the labor market are projected to work in self-employment or in

microenterprises. Some 20% will work for wages in the service sector, and only about 4%–5% will find a formal wage-paying job in industry. Only about 100 million of the 450 million Africans expected to reach working age through 2035 can hope to find a well-paid job.[33] In Ghana, only 10% of the 200,000 annual entrants into the labor force find formal sector jobs. And labor force participation, employment opportunities, and earnings remain gravely skewed against women. This, together with still high (if falling) child and infant mortality rates interact to slow the pace of fertility decline.

FIGURE 1.1 THE AFRICAN WORKFORCE IS PROJECTED TO GROW TO 1.2 BILLION BY 2035

Source: United Nations 2019a; Brookings 2019.

Thus the fact that Africa has not created enough good jobs also does not help to accelerate a demographic transition. Providing productive work for the young is therefore a daunting yet urgent policy objective.[34] The youth bulge in Africa's population presents an opportunity to transform its economic and social landscape. Still, while Africa's youth bulge is late and its scale is unprecedented, the prospects of achieving the demographic transition are good. This is predicated on the fact that the share of youth in Africa's workforce today is similar to what it was in other regions back in the 1970s and 1980s. And at the same time Africa's economic performance today is also, by some measures, better than it was in other regions back when their youth populations peaked.[35]

Accelerating the demographic transition by accelerating a decline in fertility could dramatically alter the age structure, with fewer very young dependent children and more working-age adults. If the new working-age adults are appropriately trained and have access to economic opportunities and adequately remunerated employment, they can generate an economic surplus that can further improve human capital and increase productivity to deliver a demographic dividend.[36]

A combination of government policies and development outcomes can steer African societies

toward a path of reaping a demographic dividend out of the unfolding demographic transition. This includes supply-side and demand-side labor market policies to ensure the employability of the youth and increased the demand for labor by industries.

- The demographic transition can be accelerated by population and gender policies that promote the reduction of fertility rates more quickly to change the age structure of the population, with fewer young dependent children and more working-age adults.
- Education and skill development policies can be implemented to ensure that new entrants to the labor force are well educated and equipped with the requisite skills to engage in high productivity and high earnings work. That, in turn, would promote further improvements in human capital and increased productivity.
- National development policies, including a skillful targeting for accelerated investments in sectors with strong job creation potential and transformative impact on national economies.
- The impact of policies and programs in all these areas can be amplified through accelerated regional integration, including regional collaboration in facilitating cross-border labor mobility and labor market information systems.

Such policies can improve efficiencies in regional labor markets, and thus create an environment conducive to more investments in production factors to spur entrepreneurship, address skill shortages and mismatches, and enhance trade diversification and export competitiveness.

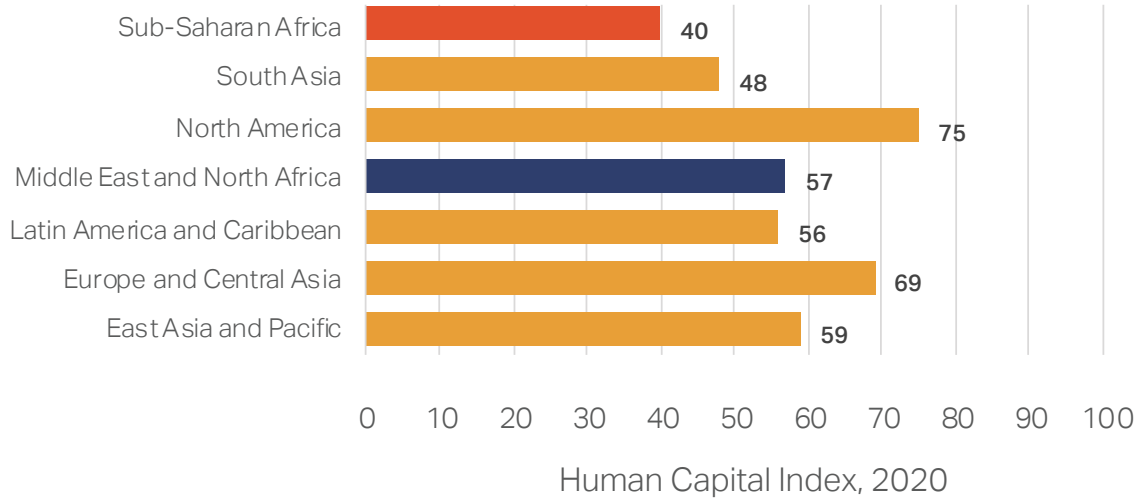
Providing productive work for the young is a daunting yet urgent policy objective. The youth bulge in Africa's population presents an opportunity to transform its economic and social landscape.

Equipping the workforce of tomorrow: education and skills

The World Bank's Human Capital Index (HCI) estimates the productivity as a future worker of a child born today, relative to his/her full potential (100) that could have been achieved with complete education and good health (figure 1.2).[37] It shows that the productivity of a Sub-Saharan African child born today is 60% below what could have been achieved as a future worker with complete education and full health.

While the HCI has limitations, it points to the need to enhance the productivity potential of the future young adults by investing in human capital. To develop their human capital, countries need to reassess and revamp their educational strategies for providing young boys and girls with basic competencies, skills, and vocational training, including exposure to new technologies, to become fully productive workers.

FIGURE 1.2 SUB-SAHARAN AFRICA'S HUMAN CAPITAL INDEX LAGS BEHIND OTHER REGIONS

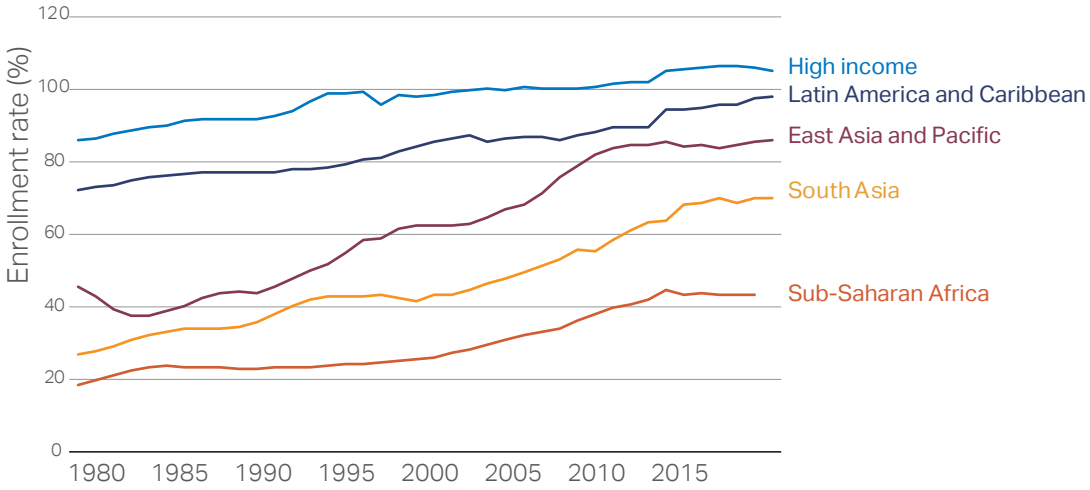


Source: World Bank 2020.

Improving educational outcomes

African countries have made great strides improving primary education outcomes, with enrollments now almost 100%.[38] But secondary enrollment rates are still low at 43% and remain the lowest globally (figure 1.3). Tertiary enrollment rates are even lower at 9%, though they are ramping up rapidly in some countries.[39] Better secondary and tertiary education improves human capital, enhances the capacity to develop new ideas and technologies, and spreads the knowledge to apply them.

FIGURE 1.3 SECONDARY ENROLLMENTS IN SUB-SAHARAN AFRICA LAG FAR BEHIND OTHER REGIONS



Source: World Bank Open Data.

The main goal of expanding education has been to bring more children to school and achieve higher enrollment rates. But the attention to numbers has detracted from the quality of education. In many countries, educational quality has even deteriorated. Most Sub-Saharan countries surveyed in the Programme for International Student Assessment fall far short of minimum proficiency in mathematics.[40] And for reading, 87% of 10 year olds are below minimum proficiency, suffering learning poverty, and not ready to enter secondary school.[41] The most efficient interventions to tackle these issues are to improve teaching and to enhance the delivery of education so that students can truly learn.

Many countries still have significant gender gaps at different levels of education. UNESCO estimates that girls are generally disadvantaged. In some countries such as the Central African Republic, Chad, and South Sudan, this challenge is particularly acute. In contrast, boys on average face disadvantages in the Republic of Congo, Gambia, Mauritania, and Senegal.[42] Greater gender equity in education is needed to promote women's empowerment and the access of girls to paying jobs. Some countries have fast-tracked gender equality policies in education, as in Zambia, which rolled out a re-entry policy for teenage mothers, requiring all schools to grant girls maternity leave and readmit them to continue their education.

The most difficult moment appears around the end of secondary education, when many girls drop out of school because they marry early. In Niger, parents are eager to marry off their girls at very early ages (often with older partners), purportedly to "establish" and "protect" them. Policies to mitigate these trends should include large-scale campaigns tailored to parents and especially to men to change traditional social norms, as well as to boys and young adults. In addition, girls need safer school environments, along with school programs that offer them skills they can use to take up income generating opportunities to sustain themselves and provide a sense of security as they negotiate their independence and fight for their rights.

Shifting focus in education from quantity to quality

To provide the foundations for achievement at subsequent levels of education and professional training, primary, secondary, and tertiary education need first to cover with greater quality the main educational goals—to impart basic skills such as literacy and numeracy. Curricula can be subject-centered, learner-centered, and problem-centered. And they can be more female-friendly, to enhance gender equity in education. They also need to focus on new technologies, such as fourth industrial revolution (4IR) technologies, to prepare the workforce of tomorrow.

Technical and vocational education and training (TVET) programs promote worker flexibility by providing them with continuing vocational training, broad-based technical knowledge, and skills that can be applied in different occupations. Ghana, for example, has introduced free senior high school and TVET placement to increase access to secondary education for young people, particularly from poorer backgrounds. It has also introduced information and communications technology and science, technology, engineering, and mathematics in its TVET curricula.[43]

Private support to TVET can take various forms. One is to organize specific training sessions to meet the short-term needs of employers, as in Ghana and Uganda. Another is to certify and accredit private providers if they meet certain criteria, as in Nigeria. A third is for private companies to partner with governments to deliver education and training, as in South Africa.[44]

Promoting female education can empower girls and women, integrate them into the economy, and boost productivity. Women who are employed usually have fewer children than women who are not. Similarly, increasing the retention of girls in lower secondary and increasing their progression to senior secondary and tertiary education will boost educational gender equity. Some Sub-Saharan countries have also deployed conditional cash transfers to families as an efficient tool to keep girls in school longer.[45]

TVET and learning systems need to be demand-driven or demand-led, responding closely to the needs of the market and the economy. Demand-driven learning systems merge work and learning in a third wave of postsecondary education, following the first wave of getting more people to enter higher education and the second wave of getting more students to earn certificates and degrees. Third-wave programs ensure that students are ready for decent jobs and primed for lifelong career success.[46] One mechanism to encourage a more market-driven education and training system is to rank schools by the job placements of their graduates.

Harnessing the power of new technologies

The technologies of 4IR are at the intersection of the physical, digital, and biological worlds. They are a fusion of transformative advances in robotics, the internet, 3D printing, quantum computing, artificial intelligence, genetic engineering, and other technologies such as drones, virtual reality, and blockchains (ledger records linked using cryptography). Variations in the use of 4IR technologies are wide among Sub-Saharan African countries, with Kenya, Mauritius, and South Africa at the forefront; and the type of technology adopted also varies, as in the the use of blockchains to certify food safety for tea in Malawi.

In most emerging market economies, the synergy between the public and the private sectors has spearheaded 4IR technologies, often in public–private partnerships. Tax and other incentives can also foster investments in 4IR technologies and businesses. For instance, Kenya and Rwanda consider information and communications technology equipment as capital goods, which are exempt from customs taxes. Another fiscal incentive in some Sub-Saharan countries is reducing the tax rates for information and communication technology investors.[47]

Countries should consider mechanisms to give students greater access to 4IR technologies, targeting senior high school, TVET, and tertiary education students with a much greater emphasis on science, technology, engineering, and mathematics. Specific interventions are needed to facilitate these reforms, including realignment of current educational and skill development systems with 4IR innovations and strong support from public–private partnerships.

African girls and women have less access than boys and men to all levels of education, TVET, and 4IR technologies. Interventions to foster gender equality in access to 4IR technologies include showcasing the public and private sectors as role models for shifting norms and outcomes—and designing gender-neutral social safety nets and government-mandated equality standards across all sectors.[48]

Artificial intelligence—the simulation of human intelligence processes by machines, particularly computer systems—includes learning (acquiring information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions), and self-correction. Applications of artificial intelligence include speech recognition, expert systems (computer systems emulating the decisionmaking ability of a human expert), and machine vision (technology and methods for automatic imaging-based inspection, analysis, and monitoring). All these technologies can improve education and training efficiency, reinforce African students' skills, and enable them to master technologies that will shape their future jobs.[49]

Equipping young Africans with the skills to meet the growing and fast-evolving demands of the labor market will be crucial. African policymakers should expand access and improve the quality and relevance of secondary and technical and vocational training, a key entry point for young Africans to enter the world of work. However, the vast majority of Africa's youth transitions into the world of work before entering tertiary education—only 9% of primary school students reach higher education. So, secondary education will be critical in preparing young Africans to earn a decent living. Indeed, educating young girls to complete secondary school can increase their labor force participation and accelerate the demographic transition to lower death and birth rates—and reap a demographic dividend. Promoting universal secondary education is thus crucial in ensuring a future ready workforce.

Technical and vocational education and training programs promote worker flexibility by providing them with continuing vocational training, broad-based technical knowledge, and skills that can be applied in different occupations.

Putting Africa's young people to work

During the past two decades, Sub-Saharan countries aimed to capitalize on their abundant labor to provide productive jobs and spur economic growth. They focused on reducing costs, improving the investment climate, and attracting labor-intensive manufacturing.[50] But rapid and disruptive technological change and its impacts on global production and trade are compelling countries to refine and extend their policies. More supportive business regulations can give micro and small firms opportunities to grow, innovate, and possibly move from the informal into the formal sector.[51] Improving infrastructure can allow new, higher productivity sectors to develop, foster the integration of Sub-Saharan economies into global value chains, and generate jobs for the rapidly growing young population. The International Monetary Fund projects that the region will need at least 18 million new jobs every year for 25 years.[52]

African countries can put their human capital to work by modernizing agriculture, expanding export-oriented manufacturing, modernizing services, harnessing the full potential of tourism, and supporting emerging creative industries. The focus should be on economic activities with high potential for job creation, productivity growth, and output growth.[53]

Modernizing agriculture

Modernizing agriculture entails a process of raising farm productivity to spur growth in the broader rural economy. In most African countries, farmers grow some of the food they consume, and thanks to growth in productivity and exposure to local and global markets, most produce some marketable produce (food surplus or pure cash crops) that sell in local markets. But a large share of rural incomes is already earned in the rural nonfarm economy as farm-nonfarm linkages and employment opportunities expand and most rural households engage in some form of nonfarm activity. Most of the structural change in Africa in recent years has been driven by workers leaving agriculture to work in informal services, many of which are agriculture-related (trading and transport of food and agricultural products). These informal services are not the kinds of high-productivity industrial jobs that dominated the East Asian experience, but their growth has helped reduce poverty in many parts of Africa.[54]

There is some evidence that Africa's urban consumers are increasingly driving demand for agricultural products.[55] Sub-Saharan Africa is now the world's fastest urbanizing region, with an urban population share projected to reach 55% by 2050, up from 30% today.[56] Africa has three megacities with more than 10 million inhabitants (Cairo, Kinshasa, and Lagos), and the number of large cities (populations of 5–10 million) is expected to nearly triple, from 5 in 2018 to 13 in 2030.[57] By 2050, Sub-Saharan Africa could have 15 megacities and 20 large cities, with 20% of urban residents living in a megacity, up from 5% in 2010.

Despite Africa's rapid urbanization, countries are not getting the most from the rural-urban transition. Although crowded, cities are not economically dense because investments have not kept pace with the rapid concentration of people. Cities are not creating jobs fast enough, especially for the youth expected to drive the demographic dividend. Most urban areas, having developed as collections of small neighborhoods or villages, are segmented and disconnected, lacking reliable transportation. And urban living is costly for households and firms because of high nominal wages and transaction costs.[58] New urban and rural development policies can ease these constraints and promote the rural–urban and farm–nonfarm linkages that will create jobs for youth.

Workers are migrating from agriculture to urban areas faster than they are finding work in the rural nonfarm economy. And with the growing congestion of urban centers, more people are likely to reside in peri-urban areas where rural–urban linkages are often strongest.[59] The nonfarm economy around cities and towns will therefore play an important role in creating work for rural job seekers, especially youth.

Modernizing agriculture to raise productivity and provide jobs to the burgeoning youth population will require tackling the challenges outlined above with the tools that today's science and technology provides and that were not available to the early modernizing regions of the world. This includes paying attention to the deployment of 4IR technologies to upgrade agricultural value chains and help to create medium-scale farming and strengthen balanced farm-nonfarm and rural–urban/periurban linkages.

A more productive agriculture sector is also more attractive to young people, important for rejuvenating a sector dominated by aging farmers. A modernized farm system, with a dynamic medium-scale commercial sector, can attract young people to become service providers to the sector.

Precision agriculture can increase productivity using big data and autonomous vehicles to optimize inputs. Information and communication platforms can help develop new business models that would attract youth.

Modernizing agriculture requires upgrading value-chain activities (logistics, input services, storage), which also stimulates a much larger agribusiness sector. Expanding off-farm activities to provide many productive jobs. Investors such as input dealers and commercial farmers can be incentivized to expand their operations and thus create new jobs.[60] As agriculture commercializes on a larger scale, the need will grow for specialized trucking services, including refrigerated trucks, to meet time-sensitive delivery schedules. This will provide employment opportunities for drivers, packers, quality inspectors, and others.[61]

A more productive agriculture sector is also more attractive to young people, important for rejuvenating a sector dominated by aging farmers. A modernized farm system, with a dynamic medium-scale commercial sector, can attract young people to become service providers to the sector. Farmers can buy input services such as spraying and mechanization. Modern farming can also spur a vibrant fabrication sector for making simple tools and machines and servicing agricultural machinery, creating more jobs.[62]

The impact of 4IR innovations would also mean fewer job losses in agriculture, which is likely to be energized by information and communication technologies helping to upgrade agricultural value chains. Precision agriculture can increase productivity using big data and autonomous vehicles to optimize inputs. Information and communication platforms can help develop new business models that would attract youth. Examples include enabling farmers to buy mechanization services by connecting them to service providers, such as "Trotro Tractor" in Ghana,[63] "Hello Tractor" in Nigeria, and the Esoko[64] platform in Ghana and Tanzania that connects farmers to markets. Blockchain technologies in Ethiopia and Malawi guarantee compliance with the food safety standards that are key to accessing lucrative international food markets.

The prospects are also good for creating the crucial missing middle in the farming ecosystem, the medium-scale farming segment that drives transformation by bringing in investment, market links, and know-how that spills over to smallholder farmers. This segment of commercial farmers—middle-class farmers able to farm remotely though "telephone farming"[65] based on big data and the internet of things—can contract with smallholder farmers and provide rural employment.[66] Although it is too early to estimate the job-creation potential of 4IR in the sector, evidence is growing that it could be substantial.

Expanding export-oriented manufacturing

Less automated sectors provide African countries with opportunities for labor-intensive manufacturing focused on local markets. While creating strong backward and forward linkages between firms can encourage more labor-absorbing growth paths, Africa's small domestic markets mean that manufacturing is unlikely to experience dynamic growth and job creation without a focus on exports.[67] But there are opportunities for African countries to focus on less automated sectors, where technology adoption has been slow.[68]

Automation varies greatly across manufacturing sectors. Automotive, electronics, extractives, and construction are at the forefront in automation, while food processing, wood processing, furniture production, garments, and leather production lag behind. These sectors could provide opportunities for labor-intensive local and regional market–focused manufacturing. As these industries gradually automate, African countries, with their lower labor costs, will have had a decade or longer to adjust before the cost of robots falls enough to replace human labor.[69]

A projection of automation in the furniture industry in Kenya reveals a 10-year window of opportunity for increasing productivity. Kenya can use the decade between the time that the cost of robotics falls below U.S. labor costs (roughly 2023) and the time that it falls below Kenyan labor costs (2032) to build manufacturing capabilities. Taking advantage of that opportunity requires a continual focus on improving basic infrastructure—reliable power, telecommunications, roads, and railways—and building industrial capabilities through technological upgrading and upskilling the labor force. With the right policies and strategies, mastering traditional manufacturing can make it easier to jump into more complex digitized manufacturing.

Digitizing services

Services are overtaking agriculture and industry in Africa in creating jobs and value added. Their potential is even greater when 4IR technologies are applied. Countries can use the time before services are automated to build skills and infrastructure to make the most of job opportunities created by 4IR technologies.

Although highly informal throughout Africa, the service sector is the fastest growing in job creation and value added in most African economies. The potential for increased job creation is even greater with 4IR. Productivity is the key to increasing jobs in services, particularly in the large informal segment. Applying mobile systems for payments and orders and using the internet and mobile phones to develop and roll out new services hold great promise. The Jumia Group (formerly Africa Internet Group) leveraged internet platforms to create the first billion-dollar internet business in Africa. Its businesses in Africa include Jumia (an e-commerce platform), Zando (shoes and clothing), HelloFood (a food delivery service), Kaymu (an online resale marketplace), Lamudi (a real estate classified ads platform), EasyTaxi (a cab-hailing service), Jovago (a hotel-booking portal), Everjobs (a jobs classified ads site), and Carmudi (a car-selling platform). Launched in 2012, the Jumia Group now operates in 23 African countries.

Mobile phones have brought banking, insurance, and other financial services to previously excluded people, particularly women and youth. Kenya-based M-Pesa, the biggest money transfer system in the world, allows people to pay for all kinds of services by mobile phone and is rapidly formalizing the informal sector by bringing many transactions online. The Accra Metropolitan Authority is exploring how to leverage big data technologies to optimize transportation systems by analyzing mobile phone data to learn how people move around the city.[70] In East Africa, M-Kopa is selling solar power to 500,000 poor households using an internet-of-things platform that connects solar panels and cooking stoves to the internet.[71]

Also fast-growing are some "smokestack-less services,"[72] including horticulture[73] and information and communications technology–based services such as transport, tourism, and business process outsourcing. Driven by new technologies, these services resemble manufacturing in being tradable, high in productivity, able to absorb large numbers of moderately skilled workers, and characterized by economies of scale and agglomeration. New industrial policies are needed for the service industries being spawned by 4IR innovation. Targeted reforms and interventions, particularly skills development, are crucial to becoming globally competitive in these service industries.

New technologies will make some jobs in these new services vulnerable to automation. Jobs in finance and accounting have high potential for automation through business process outsourcing. Customer service, sales, and human resourcing jobs are at lower risk in the short to medium term because of their higher interpersonal component, but they too will eventually be at risk of automation as technologies advance. Until then, countries can use the time to build the skills and the supportive infrastructure needed to make the most of job opportunities created by 4IR technologies higher up the value chain, as in software programming.

Harnessing tourism

Tourism is an assured pathway to economic transformation thanks to its capacity to create jobs—particularly for women and youth—and its links to other sectors.[74] Tourism, already an important source of jobs in Kenya, Mauritius, Rwanda, Senegal, South Africa, and Tanzania, has been projected to provide almost 16 million jobs in Sub-Saharan Africa by 2020.[75] A $250,000 investment in the tourism sector in Zambia would generate 182 full-time formal jobs, nearly 40% more than the same investment in agriculture.[76]

Although still underdeveloped in most places, the tourism industry in many African countries is benefiting from 4IR innovations and expanding job opportunities. Virtual reality technologies are a new marketing tool that allows people to sample places by visiting them virtually. New sharing economy platforms (Airbnb, Couchsurfing) are expanding the range of tourists, particularly among young people. Big data and social media provide opportunities for micro-targeting and marketing tourism to individuals. Anecdotal evidence suggests that these platforms are enticing micro and small entrepreneurs into the sector and creating jobs that did not exist before.

Although highly informal throughout Africa, the service sector is the fastest growing in job creation and value added in most African economies.

Supporting the emerging creative economy

Africa's share of the huge global creative goods and services sector is small, but with enormous potential for expansion, applying digital innovations to boost the job-creating and economy-fueling power of the sector. Creative industries offer great promise for using African culture and creativity as a unique selling point. They are labor intensive and generate both skilled and unskilled jobs producing local content.

The global creative goods and services sector is huge, with a global value in 2012 of around $2.2 trillion and world trade of $624 billion.[77] Africa's share remains small despite its ample endowments in arts, music, and culture. The reasons include limited supply, lack of intellectual property protection, obsolete policies and regulations, and underinvestment, particularly in infrastructure.

Even so, the rapid rise of the Nigerian movie industry ("Nollywood") shows that entrepreneurs are overcoming the obstacles. Nollywood is now the second biggest employer in Nigeria after agriculture, employing close to 300,000 people directly and more than 1 million indirectly.[78] Motion pictures, sound recording, and music production account for 1.4% of Nigeria's GDP.[79] Developing Africa's creative economy can build a value chain incorporating artists, entrepreneurs, distributors, and support services that provides modern jobs, especially for women and youth.

When creative and media industries join with digital technology, they can become a source of jobs and creativity for the whole economy. Creative industries are often the first to employ new technology. Music distribution has been transformed by technology and now occurs largely through digital channels. The innovations of the 4IR are also enabling new ways of creating products. Full-length feature films have been created using digitally created images. Artists and designers are using 3D printing to manufacture their own designs. Expanding smartphone and tablet ownership is creating a foundation for digital content development and dissemination.

Promoting unfettered regional labor mobility

Regional collaboration on cross-border labor mobility and labor market information systems can improve efficiencies in regional labor markets, and thus create an environment conducive to more investments in production factors to spur entrepreneurship, address skill shortages and mismatches, and enhance trade diversification and export competitiveness.

In Africa, most regional integration frameworks include the free movement of persons. The Economic Community of West African States (ECOWAS) Protocol, for example, guarantees that citizens can enter, reside, and establish economic activities in other member states. But the movement of labor, particularly skilled labor, is hampered by domestic regulations that impose discretionary limits and economic needs tests. Compounding the problem is the lack of national and regional systems for labor market information. Regional collaboration on these issues could make national and regional labor markets more efficient (box 1.1).

Box 1.1 Moving across borders—removing the barriers

Skilled talent in one country can meet the demand for labor in another, increasing the labor pool for firms looking to invest in Africa. An efficient regional migration system is critical for this arrangement; it ensures that receiving countries address the shortage of highly skilled professionals while offering source countries the opportunity to reduce unemployment.

To make intraregional trade work, and for the successful administration of the AfCFTA, the free movement of Africans needs to be guaranteed. To this end, the AU tabled the Protocol on Free Movement of Persons in Africa in 2018, which 30 member states signed, but only 4 countries have ratified. To tackle this implementation problem, the AU might consider an initiative piloted in ECOWAS using a bottom-up approach.

Adopting a bottom-up approach in 2014 Benin, Cote d'Ivoire, Ghana, and Sierra Leone—all members of ECOWAS—set out to establish mechanisms to accelerate economic integration, open borders, and promote common policies to ease constraints on intra-African labor mobility. The objective was to provide an open platform to increase the free movement of labor to fill skill gaps. ECOWAS had attempted for years to make it easier for Africans to move back and forth across member state borders. But its members made progress only on the right of entry and abolition of visas through a common ECOWAS passport and legal recognition of the right to residence.

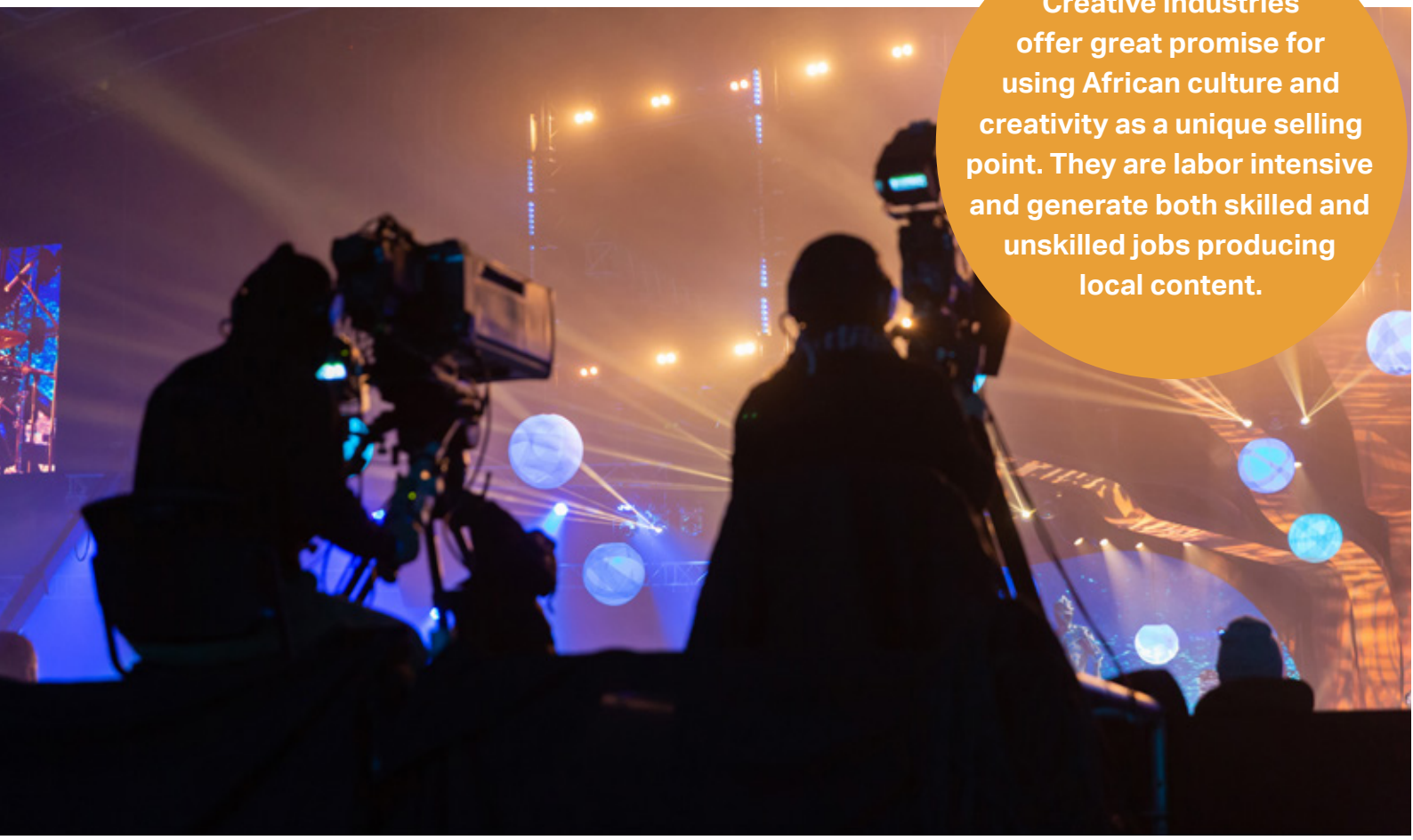
The four countries sought to remove the barriers to movement so that the right talent could get to the right place at the right time in the subregion. Building on ECOWAS Free Movement Protocols of 1979, they created a network of reformers and technical experts for peer learning and support. They conducted detailed analyses, including country assessments and policy briefs, on critical skill gaps and the likely impact of reforms to ease mobility constraints. They held national consultative forums, capacity building workshops, and training for policymakers and more than 500 stakeholders involved in the implementation of key reforms. And they organized high-level ministerial forums to align program objectives with ECOWAS frameworks and secure political buy-in for implementing new reforms. Their efforts culminated in a memorandum of understanding to streamline procedures for persons seeking temporary and permanent residence and employment, eliminate schemes that limit employer access to skilled persons and professionals, and adopt a common regulatory framework for granting residence and work permits.

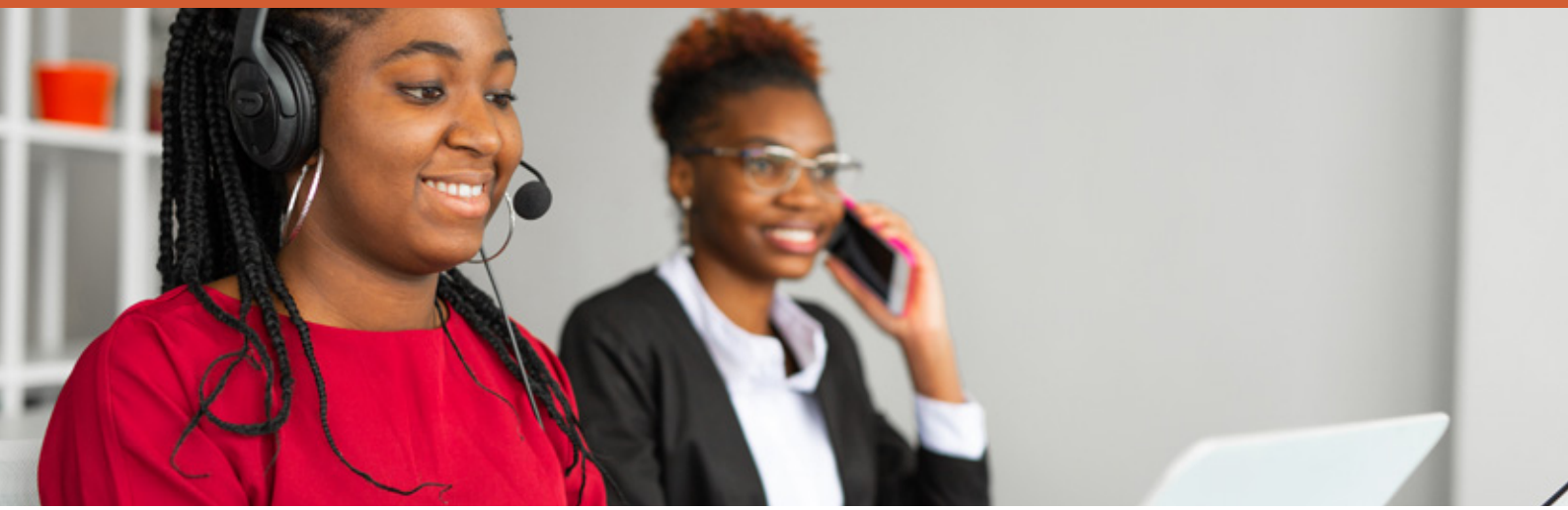
To ensure that the right skills are available at the right time and place in and across countries, governments should also spearhead labor market information systems. As part of their labor market and migration policies, most African countries have developed labor market information, funded by the World Bank and African Development Bank and supported by the International Labour Organization. Progress has been slow. Countries also need to adapt worker skills and the labor market's mix of talent to the changing market dynamics. A sentinel system can gather intelligence on the skills available and the skills needed today and in the future.

The alignment of national education and skill development policies and programs to labor market requirements can be enhanced through regional collaboration on training and standards. Countries and businesses eager to attract highly skilled professionals and talent across borders have to grapple with standards of training and recognition of certificates. This has been a major barrier to cross-border mobility of skills and talent. African policymakers have been exploring ways to harmonize and recognize other countries' certificates, diplomas, and accreditations through mutual recognition agreements, but progress has been slow. Stepping up efforts in this area is crucial to building an adaptable future-ready workforce.

For this to happen, policymakers need to develop a framework that eliminates subjectivity in accreditation by establishing common standards across countries. The mutual recognition agreement has a simple premise: participating countries trust one another's standards so that an individual's training in one country can be recognized in another. Adopting this approach can expand job opportunities, increase competition, and improve resource allocation across countries and activities.

Creative industries offer great promise for using African culture and creativity as a unique selling point. They are labor intensive and generate both skilled and unskilled jobs producing local content.





Accelerating Africa's demographic transition

To address its jobs challenge Africa needs to accelerate the demographic transition which has been delayed by high and slowly falling fertility rates in the face of rapidly declining mortality.[80] Of all the world regions, Africa has the highest fertility rate (4.3 births per woman). Reducing fertility will require concerted and intensified action on at least three fronts: reducing infant and maternal mortality, improving education outcomes, and enabling African women to have more power in making decisions about when they first marry and whether they use contraceptive.

Reducing mortality

Despite remarkable advances in child survival, infant and child mortality rates remain high in Sub-Saharan Africa. Infant mortality is more than 10 times higher in Sub-Saharan Africa than in more developed countries.[81] Deaths of children under five are mostly linked to neonatal, nutritional, and communicable diseases, with adults less prone to communicable diseases. An accelerated lowering of infant and child mortality would entice parents to have fewer children because of the greater assurance that their children will survive. African governments and their development partners need to sustain their efforts to tackle high infant and child mortality by expanding immunization programs, preventing communicable diseases (such as malaria), and conducting information, education, and communication campaigns.

Communicable diseases are expected to continue to decline, even with the recent outbreak of COVID-19. Sub-Saharan countries have tackled most communicable diseases with some success. But they are less prepared to face the unfolding epidemic of noncommunicable diseases, which occur in populations that are more affluent economically and less active physically.[82] These diseases include an array of ailments including cirrhosis, digestive diseases, neurological disorders, cardiovascular diseases, neoplasms (cancers or tumors), and chronic respiratory diseases, as well as diabetes and blood, endocrine, and urogenital diseases. In Uganda, the national prevalence of diabetes is expected to increase threefold between 2000 and 2030.[83] In Tanzania, the prevalence of communicable diseases has declined, as that of noncommunicable diseases increased between 2007 and 2017.

To tackle these new challenges, Sub-Saharan countries need to adapt their health systems—improving health data, enhancing the quality of clinical care, and strengthening health systems overall. Improving public health also requires promoting healthy behavior, through expanding education programs about good nutritional and lifestyle practices. These programs should also

be part of the general education of the population, starting in maternity clinics and schools, and reaching households and workplaces, and supplemented by large-scale campaigns of public awareness targeting all segments of society.

Promoting healthy behavior should focus on both communicable and noncommunicable diseases, and specific threats to health such as tobacco, alcohol, drug abuse, and road accidents should be more vigorously addressed. Promoting healthy behavior requires interventions through a wide spectrum of laws, regulations, advertising rules, import duties, and infrastructure improvement. These efforts need to be accompanied by vigorous and broad-based sensitization campaigns. South Africa, for example, became a party to the WHO Framework Convention on Tobacco Control and has since implemented far-reaching tobacco regulations.

Action on all these fronts has become even more urgent with the COVID-19 pandemic. By adding to mortality, the pandemic could slow the decline in fertility rates. By driving economies into slowdowns and even contractions, it compromises livelihoods. And by closing schools, it is reducing not just schooling but also learning, and for many students, it increases the likelihood of not returning to school, especially for girls.

Promoting the fertility transition

Women's empowerment lies at the core of efforts to reduce high fertility. It entails interventions to enable women to make their own decisions in life choices such as those for education and the desired number of children. It also entails promoting their economic opportunities including particularly those related to access to productive assets (land and finance) and to labor markets (employment).

In addition to education and general economic policies, legal reform is a critical part of fertility reduction policies, changing the rights and institutions that govern girls' and women's lives. Increasing the age at first marriage can reduce the birthrate by shortening the number of viable reproductive years. This also encourages girls to attend school longer and reduces adverse health outcomes often associated with young girls' pregnancies. Reforming laws to recognize women as equal citizens and as landholders can lead to an observable increase in the age at first marriage, contributing to reduced lifetime fertility.

Economic autonomy benefits women with legal reform, basic human rights, and enhanced economic opportunities, and curbs gender discrimination.[84] Greater autonomy allows women to make their own reproductive decisions, as in Ethiopia, where young women have asserted their rights in court. Women's autonomy also gives women the freedom to move—to leave rural areas and settle in urban or periurban areas.

In 2019, the average contraceptive prevalence rate for modern methods in Sub-Saharan Africa was 28% for women ages 15–49.[85] The increases have been modest in most countries—about 1 percentage point a year[86]—though some (such as Nigeria) have recently had larger increases. But higher levels of contraceptive use have not always translated into lower total fertility rates, because many women use contraception to space births rather than limit the number of children. Education and family planning should thus be geared to helping women to understand the advantages and to effectively practice fertility control by using contraceptives not only to space births, but also to choose and limit the number of their children.

African countries should consider strengthening their family planning and other population institutions to accelerate their demographic and especially their fertility transitions.[87] Such institutions, designed to implement national population policies and family planning programs, need to be well funded and staffed. Digital devices and the internet offer an immense opportunity to advance these objectives as they offer young girls and adult women the means and environments to access the required information and to trade in contraceptive services and products without the outside control of disagreeable partners, family members, or other agents in the community. Positive examples are flourishing with the additional advantage of establishing collaborative action across counties, as in the Sahel Women Empowerment and Demographic Dividend program,[88] which has observatories in Benin, Burkina Faso, Chad, Côte d'Ivoire, Mali, Mauritania, and Niger tasked with data collection, technical analysis, awareness raising, and overall monitoring of the efforts to capture a first demographic dividend.

Reforming laws to recognize women as equal citizens and as landholders can lead to an observable increase in the age at first marriage, contributing to reduced lifetime fertility.

Priorities for action

The growing demographic bulge of young workers presents an opportunity to reap a demographic dividend that will spur Africa's economic growth. But this will not occur automatically. It requires a comprehensive and integrated strategy focusing on three policy priorities:

- Implementing education and skill development policies, particularly for girls, to ensure that each year's 18–20 million new entrants to the labor force are well equipped and productive.
- Creating opportunities for productive employment in labor-intensive sectors.
- Accelerating the demographic transition to lower death and birth rates to reap the demographic dividends of having more workers than dependents.

Regional collaboration can give a big boost to achieving these outcomes.

Scaling up education and skills training

Sub-Saharan Africa, having underinvested in its human capital, currently lags all other world regions based on the 2020 Human Capital Index. Although school enrollments have been increasing over time, enrollments in secondary and tertiary remain very low. Equally important is the need to focus on quality and the relevance of schooling while actively pursuing the basic education goals of universal literacy and numeracy. Not easy, since 87% of 10-year-olds in Sub-Saharan Africa cannot read and understand a simple story, leaving them unprepared for secondary education.[89]

Key priority actions:

- *Expand secondary and tertiary enrollment, and emphasize science, technology, engineering, and mathematics (STEM) with a focus on new technologies, especially digital technologies of the fourth industrial revolution.* Ghana introduced a free Senior High School policy in 2017, increasing enrollments by 69% in three years. But such a rapid surge in enrollment strains the existing physical infrastructure, calling for innovative approaches to expanding digital infrastructure to facilitate distant learning. The government has instituted a policy of 60% enrollment in science and 40% in arts and humanities to facilitate STEM uptake at the tertiary level.[90]

Investing heavily in sectors that have high job-creation potential, such as agriculture, export-oriented manufacturing, high value-added services, and the creative industries can create jobs for youth, particularly in the rural areas.

- *Address the gender bias in science and in technical and vocational education and training.* In Burkina Faso, Kenya, and Malawi, cash and in-kind transfers targeting girls increased their enrollment, attendance, and graduation. Senegal tackled the gender imbalance in STEM education through awareness campaigns, performance-based contracts targeting females in STEM, and teacher training to encourage women to pursue STEM education. Ghana introduced a teacher and learning portal in 125 schools to encourage STEM uptake, giving teachers and students access to online teaching and learning resources, with a focus on science and mathematics.
- *Ensure that the education systems and technical and vocational education and training (TVET) programs respond closely to the needs of the market by partnering with the private sector for program design and financing.* Ghana and Uganda organized training programs to meet the needs of private employers. Nigeria certified and accredited private TVET providers if they met certain criteria. In South Africa, the government partners with banks to deliver effective education and training. Senegal also has a national TVET strategy to improve the access, quality, and relevance, providing 300,000 students with the opportunity to get on-the-job practical experience.
- *Recognize work experience in the informal sector, which absorbs close to 80% of the Sub-Saharan workforce (outside South Africa).* Most countries have national qualification frameworks, but they struggle to accredit informal learning and apprenticeships. Ethiopia's government combined forces with NGOs, private agencies, and private schools to train workers in the informal sector. Federal and regional TVET agencies certify those with informal training through units of competency, and any worker with almost any skill can be examined by one of the agencies and certified for that skill.

Creating opportunities for productive employment

Investing heavily in sectors that have high job-creation potential, such as agriculture, export-oriented manufacturing, high value-added services, and the creative industries can create jobs for youth, particularly in the rural areas. The priority actions:

- *Modernize agriculture by introducing high-yielding seeds, chemical fertilizers, and digital agricultural technologies and orient farmers toward commercial agriculture.* Several African countries have training centers that offer an innovative approach that improves the perception of agriculture at schools, proposes new learning methods that combine technical and social training, and stimulates agricultural research and development for young people. The Songhaï center in Benin conducts training, production, and research, combining modern and traditional methods. It favors an integrated production system where agriculture, livestock, and fisheries interact, and nothing is wasted. The Rural Trades Centers in Côte d'Ivoire support national nonformal training in agriculture and other rural trades.

- *Strengthen linkages along the agricultural value chain, by incentivizing input dealers and commercial farmers to expand operations and upgrade input services, storage, and logistics to stimulate the larger agribusiness sector.* Some countries use input subsidies to do this, ranging in 2016 from 12% of the subsidized input volume in Zimbabwe, 28% in Malawi, 69% in Burundi, 92% in Rwanda, and 100% in Ethiopia.[91] Malawi uses blockchain to certify food safety for tea and tracks supply chains for tea sold to the consumer goods giant Unilever and the British supermarket Sainsbury's. Tanzania introduced a bulk procurement system in 2017 for the government to import all the major fertilizers. The Fertilizer Regulatory Authority now consolidates orders, conducts competitive bidding, awards tenders, and sets maximum retail prices.[92]

Export-oriented manufacturing focusing on labor-intensive products offers good prospects for job creation in the medium term.

Key priority actions:

- *Support traditional manufacturing in their transition to more complex digitized manufacturing.* In Kenya, companies in machinery–electronics–transport are the most digitized, followed by companies in chemicals–plastics–rubber. This growing trend toward digitization is linked to improvements in telecommunications, electricity, customs, and regulations.

- *Accelerate improvements in basic infrastructure—electricity, telecommunications, roads, and railways.* Côte d'Ivoire's transport sector was allocated more than $10 billion, or almost a quarter of the country's total $44.2 billion budget for the economic blueprint, as part of the National Development Plan for 2016–20.

- *Give tourism particular attention due the strong job creation and productivity increases the sector generates through technological innovations, such as sharing economy platforms and promoting the use of big data and social media to market tourist destinations.* Foster the media and creative industries have high potential for job creation thanks to the ease of adoption of digital technologies. Microfinance platforms, such as M-Changa in Kenya, help match investors to a range of individuals and projects in creative industries and thus support job creation.

Increasing regional collaboration for labor mobility

Regional collaboration for cross-border labor mobility can also unleash the job creation potential and transformative impact of national industrial policies and programs. With the African Continental Free Trade Area (AfCFTA), concerted regional collaboration can facilitate the free movement of skilled labor to areas of demand. It can also align national education and skill development to regional labor market requirements. Two priority actions:

- *Promote mutual recognition agreements among member states.* East African Community (EAC) members have concluded such an agreement for architects, engineers, and accountants and are preparing to extend it to lawyers, pharmacists, and veterinarians. Similar arrangements have been initiated in West Africa under the pilot talent mobility program.

- *Strengthen labor market information systems where they exist and are weak or create one where they do not.* The right skills must be available at the right time and place in and across countries. As part of their labor market and migration policies, most African countries have such a system. But progress has been slow in making them effective. To adapt worker skills to changing market dynamics, countries can set up a sentinel system to gather intelligence on the skills available today and the skills needed in the future, as countries in Southeast Asia have done successfully.

Accelerating the demographic transition

Africa's demographic transition from high to low birth and death rates has been delayed by persistently high fertility. The demographic transition can be sped up by reducing high infant and maternal mortality rates, improving educational outcomes for girls, and empowering women by giving them more autonomy to make their own decisions about life choices.

Key priority actions:

- *Expand immunization programs and other communicable disease prevention programs—and strengthen and adapt health systems to take a more a structured approach to health care (including primary health care), to improve health data systems, and to boost the quality of clinical care.* Ghana deployed portable ultrasound machines in 500 health centers and community-based health planning and service compounds operated by midwives, improving maternal delivery outcomes.
- *Improve educational outcomes for girls and empower women by making further investments in secondary and tertiary education where enrollment rates remain the lowest.* There is also the need to improve educational quality and close the gender gap in secondary and tertiary education enrollments.
- *Reform laws and institutions that govern girls' and women's lives by increasing the age at first marriage, expanding contraceptive coverage, and recognizing women as equal citizens to own land.* Rwanda's health sector reform and expansion of contraceptive coverage reduced fertility in the rural areas from 6.0 children per woman in 2003 to 4.1 children per woman in 2013.[93] In Ethiopia, institutional reforms now enable women to assert their rights in the court system.

Regional collaboration for cross-border labor mobility can unleash the job creation potential and transformative impact of national industrial policies and programs.

References

ACET (African Center for Economic Transformation). 2014. *African Transformation Report: Growth with Depth*. Accra, Ghana.

ACET (African Center for Economic Transformation). 2017. *African Transformation Report: Agriculture Powering Africa.* Accra, Ghana.

AfDB (African Development Bank). 2018. *African Economic Outlook 2018*. Abidjan, Côte d'Ivoire.

Azevedo, J.P., A. Hasan, D. Goldemburg, S.A. Iqbal, and K. Geven. 2021. "Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes: A Set of Global Estimates." Policy Research Working Paper 9284, World Bank, Washington, DC.

Banga K., and D. W. te Velde. 2018. *Digitalisation and the Future of Manufacturing in Africa*. London: Overseas Development Institute.

Bhorat, H., F. Steenkamp, and C. Rooney. 2017. "Understanding the Determinants of Africa's Manufacturing Malaise." In A. Odusola, G. A. Cornia, H. Bhorat, and P. Conceição, eds. *Income Inequality Trends in Sub-Saharan Africa: Divergence, Determinants and Consequences*. New York: United Nations Development Program.

Brookings. 2019. *Harnessing Africa's Youth Dividend: A New Approach for Large-scale Job Creation*. Washington, DC: Brookings Institution.

Brown, E. K., and H. Slater. 2018. *The Future of Work in Africa: Implications for Secondary Education and TVET Systems*. Background Paper for Master Card Foundation Study on Secondary Education in Africa. Accra, Ghana: African Center for Economic Transformation (ACET).

Christie, I., E. Fernandes, H. Messerli, and L. Twining-Ward. 2013. *Tourism in Africa: Harnessing Tourism for Growth and Improved Livelihoods*. Washington, DC: World Bank.

Dorosh, P., and J. Thurlow. 2018. "Beyond Agriculture Versus Non-Agriculture: Decomposing Sectoral Growth–Poverty Linkages in Five African Countries." *World Development* 109 (September): 440–451.

Filmer, D., and L. Fox. 2014. *Youth Employment in Sub-Saharan Africa*. African Development Series. Washington, DC: World Bank.

Guengant, J. P. 2017. "Africa's Population: History, Current Status, and Projections." In H. Groth and J. F. May (Eds.), *Africa's Population: In Search of a Demographic Dividend*, 11–31. Cham, Switzerland: Springer.

Hruby, A. 2018. "Tap Creative Industries to Boost Africa's Economic Growth." *Financial Times*, March 22. https://www.ft.com/content/9807a468-2ddc-11e8-9b4b-bc4b9f08f381.

IMF (International Monetary Fund). 2015. *Regional Economic Outlook: Sub-Saharan Africa. Navigating Headwinds*. Washington, DC: IMF.

Lall, S. V., J. V. Henderson, and A. J. Venables. 2017. *Africa's Cities: Opening Doors to the World*. Washington, DC: World Bank.

Liu, G., and B. M. Fraumeni. 2020. "A Brief Introduction to Human Capital Measures." Working Paper 27561, National Bureau of Economic Research, Cambridge, MA. http://www.nber.org/papers/w27561.

Lopes, C. 2015. "How Can Africa Profit from Its Creative Industries?" World Economic Forum feature, September 3. https://www.weforum.org/agenda/2015/09/how-can-africa-profit-from-its-creative-industries/.

Maher et al. 2010.

Masquelier, B., and A. M. Kanté. 2017. "Mortality, Health, and Aging in Sub-Saharan Africa." In H. Groth and J. F. May (Eds.), *Africa's Population: In Search of a Demographic Dividend*, 267–281. Cham, Switzerland: Springer.

May, J. F. 2017b. "The Role of Public Population Institutions on Fertility Outcomes in Sub-Saharan Africa." *Population Horizons* 14 (1): 1–8.

May, J. F., and V. Turbat. 2017. "The Demographic Dividend in Sub-Saharan Africa: Two Issues that Need More Attention." *Journal of Demographic Economics* 83 (1): 77–84.

Mberu, B., D. Béguy, and A. C. Ezeh. 2017. "Internal Migration, Urbanization and Slums in Sub-Saharan Africa." In H. Groth and J. F. May (Eds.), *Africa's Population: In Search of a Demographic Dividend*, 315–332. Cham, Switzerland: Springer.

Monga, C., A. Shimeles, and A. Woldemichael (Eds.). 2019. *Creating Decent Jobs: Strategies, Policies, and Instruments*. Policy Research Document 2. Abidjan: African Development Bank.

Muhoza, D.N., P.C. Rutayisire, and A. Umubyeyi. 2016. "Measuring the Success of Family Planning Initiatives in Rwanda: A Multivariate Decomposition Analysis." *Journal of Population Research* 33 (4): 361–377.

OECD (Organisation for Economic Co-operation and Development). 2001. *The Well-being of Nations: The Role of Human and Social Capital*. Paris: OECD Publishing.

OECD (Organisation for Economic Co-operation and Development). 2017. PISA 2015 Results (Volume V): *Collaborative Problem Solving*. Paris: OECD, Programme for International Student Assessment (PISA).

Population Reference Bureau. 2019. *2019 World Population Data Sheet*. Washington, DC: Population Reference Bureau.

Schoumaker, B. 2019. "Stalls in Fertility Transitions in Sub-Saharan Africa: Revisiting the Evidence." *Studies in Family Planning* 50 (3): 257–278.

Smith, A. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations.* London: W. Strahan and T. Cadell.

Sperling, G. B., R. Winthrop, and C. Kwauk. 2016. *What Works in Girls' Education: Evidence for the World's Best Investment*. Washington, DC: Brookings Institution Press.

Strusani, D., and G. V. Houngbonon. 2019. "The Role of Artificial Intelligence in Supporting Development in Emerging Markets." *EM Compass*, Note 69, July 2019. Washington, DC: International Finance Corporation (IFC), World Bank.

Thurlow, J. 2020. "Does Rural Africa Have a "Youth Problem"?" *The Africa Report*, 11 February. https://www.theafricareport.com/23075/does-rural-africa-have-a-youth-problem/.

Thurlow, J., P. Dorosh, and B. Davis. 2018. "Demographic Change, Agriculture, and Rural Poverty." Chapter 3 in *Sustainable Food and Agriculture: An Integrated Approach.* Rome: FAO.

Tshirley, D., T. Reardon, M. Dolislager, and J. Snyder. 2015. "The Rise of a Middle Class in East and Southern Africa: Implications for Food System Transformation." *Journal of International Development* 27 (5): 628–646.

Tsui, A. O., W. Brown, and Q. Li. 2017. "Contraceptive Practice in Sub-Saharan Africa." In J. Casterline and J. Bongaarts (Eds.), *Fertility Transition in Sub-Saharan Africa, Population and Development Review* 43 (Suppl.): 166–191. New York, NY: The Population Council.

Turbat, V. 2017. "The Demographic Dividend: A Potential Surplus Generated by a Demographic Transition." In H. Groth and J. F. May (Eds.), *Africa's Population: In Search of a Demographic Dividend*, 181–195. Cham, Switzerland: Springer.

UN (United Nations). 2019a. *World Population Prospects. The 2019 Revision*. New York: UN Department of Economic and Social Affairs, Population Division.

UN (United Nations). 2019b. *World Urbanization Prospects. The 2018 Revision*. New York: UN Department of Economic and Social Affairs, Population Division.

UNDP and UNESCO 2013.

UNECA and AfDB 2018.

UNESCO (United Nations Educational, Scientific and Cultural Organization). 2019. *eAtlas of Gender Inequality in Education*. Paris: UNESCO.

World Bank. 2017. *World Development Indicators 2017*. Washington, DC: World Bank.

World Bank. 2019. *Doing Business 2019: Training for Reform*. Washington, DC: World Bank.

World Bank. 2020. *The Human Capital Index 2020 Update: Human Capital in the Time of COVID-19*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/34432 License: CC BY 3.0 IGO.

World Bank and China Development Bank. 2017. *Leapfrogging: The Key to Africa's Development?* Washington, DC: World Bank.

World Economic Forum. 2017. *Accelerating Gender Parity in the Fourth Industrial Revolution: An Agenda for Leaders to Shape the Future of Education, Gender and Work*. White Paper. Cologny/Geneva, Switzerland: World Economic Forum.

End notes

26 United Nations 2019a.

27 Brown and Slater 2018.

28 United Nations 2019a.

29 Brookings 2019.

30 Thurlow 2020. The focus here is on Sub-Saharan Africa, since North Africa is well advanced in its transition to lower death and birth rates.

31 Schoumaker 2019.

32 Guengant 2017.

33 Brookings 2019.

34 Thurlow 2020.

35 Thurlow 2020.

36 Turbat 2017; May and Turbat 2017.

37 While the notion of human capital as a tangible capital can be traced centuries back (Smith 1776), its recognition and wide use to investigate income and growth only sprung up in the thirty years since the early 1960s. Its current operationalization has resulted in at least six major measures of human capital being developed by a diversity of global organizations, each covering at least 130 countries. The two monetary versions of the measures of human capital are those by the World Bank and by the United Nations Environmental Program and the Urban Institute of Kyushu University. The four indicator versions are by the Institute of Health Metrics and Evaluation of the University of Washington, the United Nations Development Programme, the World Bank and the World Economic Forum. For a detailed description and a comparison of these indicators see Liu and Fraumeni (2020).

38 World Bank 2017.

39 2014 figures; see World Bank Group and China Development Bank (2017).

40 OECD 2017.

41 Azevedo et al. 20202021.

42 UNESCO 2019.

43 Brown and Slater 2018.

44 World Bank Group and China Development Bank 2017.

45 Sperling, Winthrop, and Kwauk 2016.

46 Monga, Shimeles, and Woldemichael 2019.

47 Brown and Slater 2018.

48 World Economic Forum 2017.

49 Strusani and Houngbonon 2019.

50 Brown and Slater 2018.

51 World Bank 2019.

52 International Monetary Fund 2015.

53 This section draws on ACET (2017).

54 Dorosh and Thurlow 2018.

55 Tshirley et al. 2015.

56 Population Reference Bureau 2019; Mberu, Béguy, and Ezeh 2017.

57 United Nations 2019b.

58 Lall, Henderson, and Venables 2017.

59 Thurlow, Dorosh, and Davis 2019.

60 ACET 2017.

61 ACET 2017.

62 ACET 2017; AfDB 2018.

63 http://www.trotrotractor.com/.

64 https://www.esoko.com/.

65 IBM's EZ-Farm project is exploring how sophisticated data analytics can help remote farmers keep in touch with what is happening on their farm. Sensors around the farm monitor water tank levels, moisture in the soil, and irrigation equipment. Infrared cameras measure photosynthesis, which can indicate whether crops are being watered too much or too little. All these data are streamed wirelessly to the cloud and accessed by the farmer via a smartphone app. http://www.bbc.com/news/business-33610593.

66 ACET 2017.

67 Bhorat et al. 2017.

68 Banga and te Velde 2018.

69 Banga and te Velde 2018.

70 http://www-03.ibm.com/press/us/en/pressrelease/40817.wss.

71 http://www.idgconnect.com/abstract/26156/how-iot-big-data-tackling-africa.

72 https://www.brookings.edu/multi-chapter-report/foresight-africa-top-priorities-for-the-continent-in-2018/.

73 Ethiopia, Ghana, Kenya, and Senegal all participate in global horticultural value chains. Ethiopia has achieved extraordinary success in flower exports.

74 ACET 2014.

75 ACET 2014.

76 Christie et al. 2013.

77 Lopes 2015; UNDP and UNESCO 2013.

78 Hruby 2018.

79 Lopes 2015.

80 Schoumaker 2019; Guengant 2017.

81 Population Reference Bureau 2019.

82 Masquelier and Kanté 2017.

83 Maher et al. 2010.

84 Filmer and Fox 2014.

85 Population Reference Bureau 2019.

86 Tsui, Brown, and Li 2017.

87 May 2017.

88 May 2017.

89 Azevedo 2021.

90 Brown and Slater 2018.

91 UNECA and AfDB 2018.

92 UNECA and AfDB 2018.

93 Muhoza, Rutayisire, and Umubyeyi 2016.

02

Fostering digital innovation

Africa's digital and innovation activities today are fragmented, with disconnected players, platforms, and services. A move to integrated digital ecosystems will greatly enhance the prospects for innovation and economic transformation.

Innovation and digital technologies have great potential to create jobs, boost productivity growth, reduce poverty, foster inclusion, and reduce inequality. They are vital for increasing the production of farms, firms, manufacturers, and service providers, and for accumulating knowledge capital. But they require collaboration by many actors working in digital and innovation ecosystems to ensure that they deliver benefits for society. This is not happening—yet.

Africa's digital and innovation activities today are fragmented, with disconnected players, platforms, and services. The dominant practice—with startups, telephone companies, and governments in the digital space working separately in silos—needs to be replaced by greater integration of services and online platforms. A move to integrated digital ecosystems will greatly enhance the prospects for innovation and economic transformation. The goal must be to transition from a fragmented landscape of closed proprietary systems—which lack interconnections between services and countries—to open integrated platforms and ecosystems, all interlinked.

Africa's move to digital and innovative economies is, of course, a vast topic, worthy of volumes, many already written. So the focus here is on policies and processes that can foster integrated digital and innovation ecosystems. Given the speed of technological advance, governments cannot burden digital innovation and entrepreneurship with unnecessary costs and regulations. Instead, working with private firms, academics, think tanks, and other stakeholders, they can support digital innovators and entrepreneurs by formulating national strategies, building digital infrastructure and online platforms, coordinating the policies and programs of line ministries, and ensuring that the workforce has the right set of skills for the continent's digital economies.

Africa's digital and innovation landscape

Early in 2020, Sub-Saharan Africa had 477 million subscribers to mobile services and 272 million mobile internet users. And its mobile industry contributed $155 billion to its gross domestic product, led by productivity gains in financial services, education, health, retail, agriculture, and government.[94] Yet internet adoption in Africa remains low. The continent lags behind the rest of the world in the availability, speed, and access to broadband, with landlocked countries and rural areas faring the worst. Most mobile phone subscribers do not have access to the internet, and nearly 300 million Africans live more than 35 miles from a fixed broadband connection.

Fragmented markets, high taxation, expensive licenses, and regulatory gaps contribute to excessive market concentration, limited competition, and the highest prices in the world.[95] In 15 African countries, one gigabyte costs more than 10% of the monthly average income, ranging from a low of 3% in Kenya and Rwanda to a high of 33% in the Democratic Republic of Congo.[96] In Kenya, a gigabyte of data costs 12 times more than the charges in India, and in Nigeria 15 times more, and in South Africa 48 times more. Most Africans cannot afford the price of one gigabyte of mobile data.[97] According to the International Telecommunication Union, 23 of the 25 most expensive countries for mobile cellular and 21 of the 25 most expensive for mobile and fixed broadband are in Africa.[98] New connectivity options, new business models, and targeted incentives offer potential solutions.[99]

Universal broadband connectivity is projected to require investments of $100–$110 billion by 2030. The World Bank Group and the African Development Bank have committed $25–$30 billion over the next decade, with the expectation of leveraging similar amounts from African governments, the private sector, and bilateral partners.[100] Private operators, both foreign and domestic, will be the primary drivers of broadband development in most countries. Achieving universal access to broadband in Africa is, for the most part, an infrastructure investment challenge. Around 30% of total requirements would have to be allocated to capital expenditures for broadband last mile and transmission networks capable of reaching and serving at least 90% of the population.[101]

To accelerate the build-out of internet connectivity, public infrastructure investments can encourage development in remote rural areas (estimated at $20 billion for satellite investments and a universal access fund). New business models, technologies, and regulatory incentives can promote the expansion of cross-border, cross-sector, and middle and last-mile connections (such as shared access to phone towers and electric grids). And lower-tech solutions can be developed, as with narrow-band wireless mobile for farmers.[102]

In many countries, innovation and digital technologies—coupled with appropriate policies, strategies, leadership, capabilities, and business environments—have helped drive transformative change. In Singapore, innovation supported by policies and research and development (R&D) helped turn the country into a global hub, while in Rwanda, efforts to foster innovation and expand the digital economy hold promise for socioeconomic development (box 2.1). Ethiopia and Nigeria's policies to support innovation, R&D, and digital technologies offer good prospects for transformation if they continue to tap deeper into innovation ecosystems.

Box 2.1 Singapore and Rwanda embrace the transformative power of innovation and digital technology

Over the 70 years following World War II, Singapore transformed itself into a regional powerhouse of innovation and research and development (R&D).[1] Under Lee Kuan Yew's leadership, the government attracted multinational corporations in the 1980s and 1990s to set up R&D centers to facilitate technology diffusion to local enterprises.

Singapore's innovation ecosystem—with high-quality infrastructure, a growing pool of dynamic startups, well-trained talent, and strong government backing—attracted global businesses. To avoid overreliance on foreign capital and expertise, the government encouraged local firms to pursue innovation, helped by a friendly business environment. Guided by five-year national science and technology plans, an innovation fund promoted high-technology local entrepreneurship by coinvesting in new businesses.

Singapore's strategy included broad participation in R&D by industry (61%), university research institutes (29%), and government institutions (10%). That activity, which amounted to 2.1% of GDP in 2013, made Singapore an ideal hub to test new products and services. The government set up regulatory "sandboxes" giving financial technology actors space to experiment with new business models in a lightly regulated environment. The experiments enabled the government to observe simulations in a controlled setting before authorizing their release.

Singapore is positioned to benefit from next-generation manufacturing technologies.[2] Its 2014 Smart Nation Initiative envisions the country becoming a "living lab" for new solutions with global potential in, for example, urban mobility and e-governance. Common access to information across all government agencies is an innovative aspect of the initiative. Motivating more local companies to engage in R&D, while also facilitating knowledge spillovers from multinationals, was a key challenge.

President Paul Kagame of Rwanda often refers to the country as the "Singapore of Africa."[3] Like Singapore, Rwanda has laid out a rigorous development strategy based on trade, finance, services, and a favorable business environment. And like Singapore, Rwanda has pursued its plan with extraordinary determination, seeking to become a regional hub of technology, trade, and finance by investing in health, infrastructure, technical education, and information technology. Rwanda's innovation, as illustrated by Zipline drones carrying medicine to remote rural areas, has attracted global attention.

Rwanda is pioneering smart-city engineering to pursue becoming a knowledge-based economy, part of a wider effort to increase digital access to public services through the Irembo platform, including national identification cards, community-based health insurance, e-payments of traffic fines, and transfers of land titles.[4] The Kigali Innovation City project, valued at $2 billion, aims to attract world-class universities, technology companies, biotech firms, and startups.[5] It will install more than 5,000 kilometers of fiber optic cable and deploy sensors to improve health care, public safety, and utility management.

Recent developments include Rwanda's first car plant (Volkswagen), plans to start ride hailing services, a ban on secondhand clothing imports to bolster the domestic textile industry, a joint venture with a major Kenyan seed company to reduce seed imports, and a series of high-level conferences to position Rwanda internationally. The investment landscape, especially for early startups, is still a work in progress, and the limited size of Rwanda's market tends to keep large capital away—for now.

1. Singapore was ranked first for innovation among Asian nations in 2017. Bloomberg's Innovation Index 2018 ranked Singapore as the third most innovative city in the world.
2. World Economic Forum 2018.
3. Caryl 2015.
4. https://irembo.gov.rw/rolportal/en/home.
5. https://smartmycity.com/projects/kigali-innovation-city.

Africa's digital and innovation ecosystems

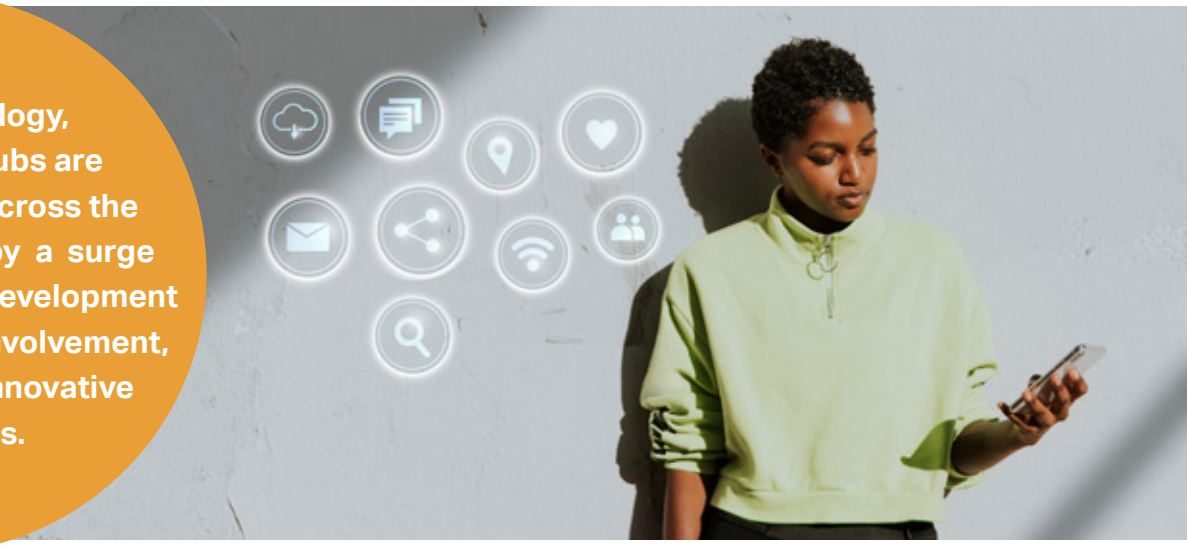
Digital transformation within a highly interactive ecosystem needs to be anchored on a shared vision, adaptive strategies, sustained commitment, and institutional cooperation (infographic 2.1). Enabling policies and institutions help coordinate and synergize the system and build trust in the digital economy. Mobile and information and communication technology (ICT) infrastructure and services enable the provision of affordable and competitive digital technologies, expand access to the internet and data, and partner with global ICT suppliers. Both users and producers must participate in policy formulation, technology development, entrepreneurship, and digital literacy. The state is linked with other actors in this ecosystem by setting broad policies, delivering services, and promoting digital diffusion and adoption.

Tech hubs

Digital, technology, and innovation hubs are rapidly spreading across the continent, boosted by a surge in venture funding, development finance, corporate involvement, and increasingly innovative communities.[103] The latest survey for early 2019 identified 618 active tech hubs, including incubators, accelerators, university-based innovation hubs, makerspaces, technology parks, and co-working spaces.[104]

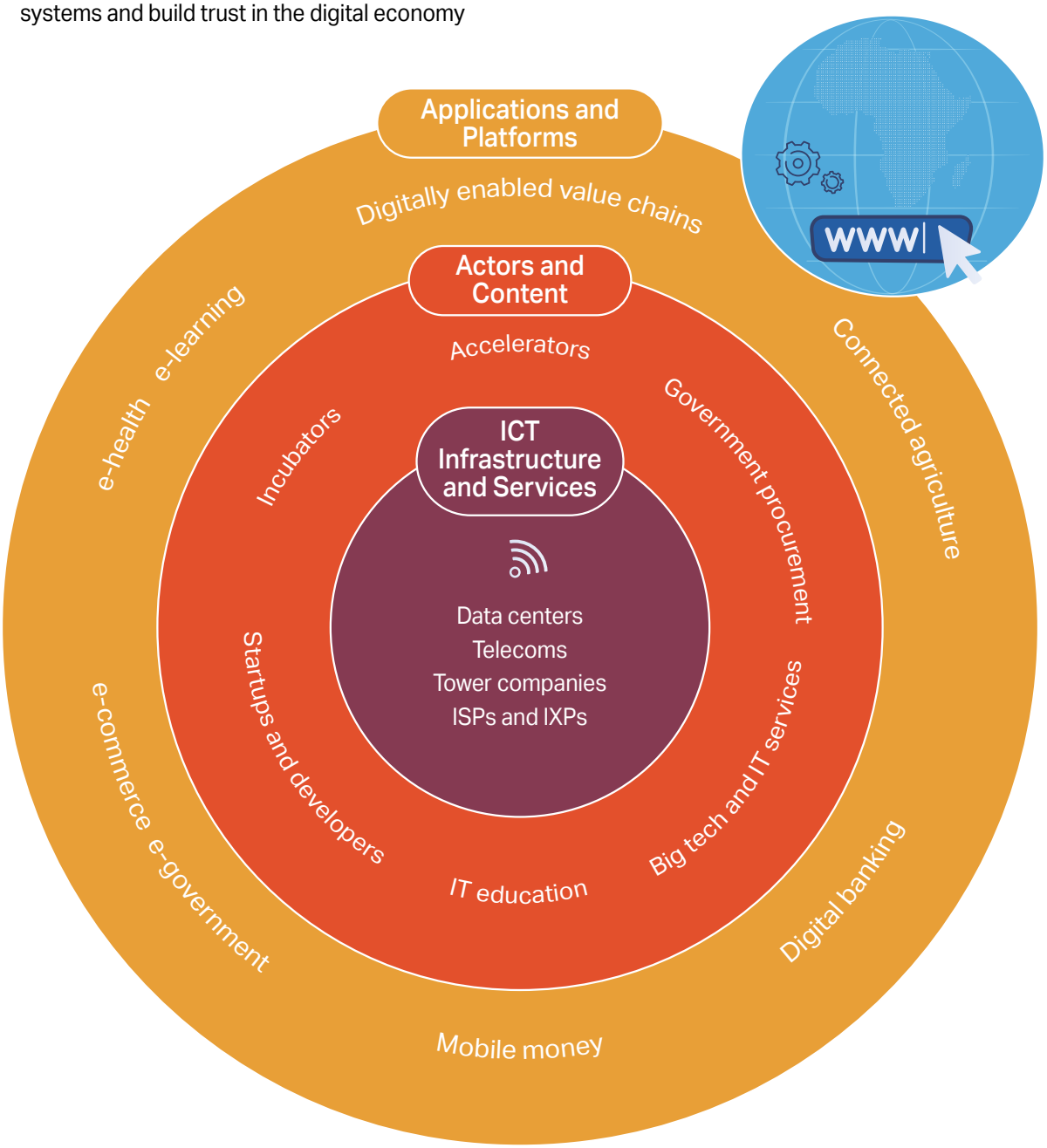
Four countries make up Africa's innovation quadrangle. Nigeria and South Africa have the most advanced innovation ecosystems, respectively boasting 85 and 80 tech hubs. Lagos is now the top urban destination for innovation (40+ tech hubs). Kenya, already as the heart of East Africa's technology ecosystem, regularly attracts new investors. Egypt, with 56 hubs, is bridging African and Middle Eastern ecosystems. The rise of North Africa's tech scene has also spilled over to Morocco (31 hubs) and Tunisia (29), where the government provides institutional support and corporate tax exemptions. Francophone West Africa has seen some of the fastest-growing ecosystems, with Côte d'Ivoire in the lead (20 hubs), followed by Senegal (15), Mali (14), and Togo (13). Rwanda's high-tech hub aims to bring technology to schools and hospitals and jumpstart circular businesses in urban areas. Emerging cities (Kumasi, Bulawayo, Lubumbashi, and Mombasa) are registering nascent technology scenes. Last year also saw the rise of tech initiatives in conflict-prone countries, including the Democratic Republic of Congo, Mozambique, and Somalia.[105]

Digital, technology, and innovation hubs are rapidly spreading across the continent, boosted by a surge in venture funding, development finance, corporate involvement, and increasingly innovative communities.



INFOGRAPHIC 2.1 NURTURING DIGITAL INNOVATION ECOSYSTEMS

Digital transformation takes place in a highly interactive ecosystem that requires government policies and institutions to coordinate systems and build trust in the digital economy



Digital transformation requires ICT infrastructure and services to enable the affordable and competitive provision of digital technologies, to expand access to the Internet, and to work with global ICT suppliers. It also requires a spectrum of skilled producers and users. And it requires digital application and new technological capabilities.

Tech hubs are forming coalitions[106] across Africa with a shared agenda to engage in a productive dialogue with government and corporate businesses, both within and across countries. This positive trend indicates changes in business models and organizational structures.

Increased corporate venture funding offers a win-win prospect for African businesses and technology startups. For relatively small investments, leading regional corporates could solidify their presence in the African ecosystem, fast-track innovations, and modernize their operations. Naspers' ecosystem portfolio offers a blueprint of sorts, combining multiple corporate innovation teams and seasoned industry mentors with strategic talent recruitment and venture funding to catalyze the next wave of African tech companies.

Another promising example is the World Bank's program to support Kenya's priority agenda for manufacturing and job creation by employing open innovation approaches to link industry with startups and academia, and to connect the local ecosystem to global best practices. The program is also introducing novel performance-based contracts to strengthen ecosystem intermediaries and support small and medium enterprises to grow, create local content, and strengthen links with local corporates and export markets.[107]

Corporate trailblazers

African corporates and global multinationals are building the foundations for digital operations in finance, retail, industrial goods, technology, and logistics. What distinguishes these corporate trailblazers is their field experience, proximity to decisionmakers, superior grasp of local markets, and know-how to navigate informal business environments.[108] Greenfield investments in key markets are reaping attractive returns for business infrastructure and manufacturing facilities.[109] Companies recognized for digitally enabled innovations include Kenya's Safaricom and M-Kopa, Nigeria's Jumia, and the Dutch fashion design firm Vlisco. A key dimension for successful expansion across Africa is the ability to attract, develop, and retain talent. Tanzania's MeTL group has announced a fourfold increase in its staff across Africa to more than 100,000 over the next four years. Morocco's OCP group, partnering with leading universities, has established a Polytechnic University to focus on mining and agricultural research, making it the country's preferred employer for young talent.

Mobile operators and internet providers have begun to partner with local tech hubs, which offer facilities and support for digital entrepreneurs. France's Orange has set up Fab Labs across West Africa, while MTN and Liquid Telecom have launched in-house innovation teams in several markets. Large tech companies are establishing footholds in key ecosystems. Examples include Google's AI Center in Accra and its Africa Launchpad Accelerator program, Facebook's Nigeria Hub in Lagos, Microsoft Centers in Nairobi and Lagos, IBM and Wits in South Africa, and Alipay's and WeChat's pursuit of local alliances in Kenya and South Africa.

More recently, traditional finance corporates (Standard Bank, Standard Chartered) have created incubators in several countries. Airbus has launched an aerospace accelerator through the #Africa4Future initiative. Nestle (sustainable science and technology solutions), Merck (health-care hackathon), and Sanofi (health-tech) are supporting local ecosystems through entrepreneurial contests. Global leaders, such as Y Combinator, Startup Bootcamp, and Founders Factory, have increased their presence. Alibaba's Jack Ma headlined the Netpreneur Prize Initiative in Ghana in 2020. South Africa's Naspers, with a market cap of $75 billion, is reaching millions of internet users in Africa with fintech and food delivery services and online classified advertising.

E-commerce

Africa's combined consumer and business spending is projected to reach $6.7 trillion by 2030, offering opportunities for investors, both foreign and domestic, to reach new markets and integrate into regional and global value chains.[110] Online marketplaces will be key, promising to open markets to otherwise isolated communities, meeting Africa's fast-growing consumer demand, and offering women and informal enterprises access to new business opportunities. Some 260 e-commerce startups are already operating in at least two dozen African countries, with the prospect of creating 3 million new jobs by 2025.

Barriers to accelerating the adoption of e-services in Africa include gaps in infrastructure (such as electricity access and in the affordability and reliability of internet and broadband services). They also include gaps in standardized digital building blocks (legally binding digital IDs, registries, and provisions for open data and access). And they include gaps in harmonized regulatory frameworks for data policies and cybersecurity.

According to the IMF, Africa is a global leader in mobile payments. In fact, it is the only region in the world where close to 10% of GDP in transactions occur through mobile money. This compares with just 7% of GDP in Asia and less than 2% of GDP in other regions. This can be leveraged for retail and business-to-business transactions.[111] Without this foundation, e-commerce may not reach its potential for creating new markets of sufficient size, ensuring the secure delivery of goods and services, and stimulating intra-African trade.

The development of an action agenda to shape Africa's e-commerce future merits priority attention.[112] The 2019 UN High-Level Panel on Digital Collaboration helped frame digital issues, such as taxation, competition, consumer and labor protection, cybersecurity, and intellectual property.[113] Challenges to address include fragmented markets, outdated regulations, too many unprofitable startups, lingering consumer suspicion of online transactions, an uncompetitive delivery infrastructure, and rising barriers to cross-border e-payments. To build momentum, e-commerce needs to be embedded in the AfCFTA negotiations and to receive support from the broader digital ecosystem. This involves ensuring appropriate taxation on e-commerce, addressing data security for financial transactions, and helping to ensure interoperability among e-commerce platforms across the continent. For full effectiveness, African governments will need to increase participation in the ongoing multilateral e-commerce negotiations at the World Trade Organization to champion the interests of smaller enterprises and advocate for a much-needed increase in aid-for-trade for digital support.

Africa's combined consumer and business spending is projected to reach $6.7 trillion by 2030, offering opportunities for investors, both foreign and domestic, to reach new markets and integrate into regional and global value chains.

E-agriculture

Africa's agrifood system will need to feed another half billion people by 2030 and possibly absorb about 70% of new entrants to the labor force. But for many commodities, productivity is just one-third the global average.[114] Many of Africa's 300 million rural inhabitants live in remote areas

without access to the trillion dollar global agrifood markets. Smallholder farmers struggle. The lack of aggregation and bargaining power prevents them from commanding larger margins in agricultural value chains. The unequal access to technologies, information, and markets particularly disadvantages low-skilled farmers in rural areas, leaving large segments of the population in rural areas behind.

By disrupting traditional value chains to achieve better results, digital agricultural technologies offer innovative solutions to these systemwide challenges, empowering farmers to increase output (table 2.1).[115] Digital agricultural technologies can lower the cost of connecting elements of the agrifood system through better use of data and wider access to financial services. They can also enable better-informed decisions by providing timely and location-specific price, weather, and agronomic data (see chapter 3). Climate change is making this kind of information much more important. The combination of precision biology, decentralized data-capture technologies, and predictive intelligence could be a game-changer for preventing famines and epidemics. The ability to predict food crises could identify areas where precision agriculture could increase food security by enhancing the resilience of crops to climate events. Even in poorly connected areas, digital agricultural technologies can improve access to hands-on instruction, information, and markets through new combinations of offline and online service models.

A recent Africa-wide stocktaking of some 200 digital agricultural technologies reveals that disruptive agritech is rapidly expanding as a field of innovation.[116] The trend is driven by low-cost connectivity, the adaptability and affordability of mobile and digital devices, advances in data analytics, and increased demand for local solutions. More than three-quarters of scalable agricultural technologies are digital, underscoring the importance of investing in this digital ecosystem. Many digital technologies operate as e-marketplaces or enable basic precision agriculture and can be deployed in low-connectivity rural environments. Mirroring the make-up of Africa's tech landscape, three-quarters of digital agricultural technologies are concentrated in Kenya, Nigeria, and South Africa. Youths are a large share of registered users.

Barriers to scaling up digital agricultural technologies include limited access to growth capital to build out operations; reluctance among smallholders, especially among women, to adopt and use new technological solutions;[117] and a lack of role models and mentoring for new entrepreneurs. Closing the adoption gap will require better market incentives to reward high-performing farmers, delivery of e-extension services with relevant local content,[118] better risk insurance for purchases of inputs, and greater access to value chains.

TABLE 2.1 DIGITAL AGRICULTURAL TECHNOLOGIES IN AFRICA

Framework challenge	Agricultural challenges	Standard solutions	Digital agricultural technology solutions	Examples
Agricultural productivity	Insufficient extension and advisory services and climate-smart services	Producer organizations, extension agents, radio, television	Agricultural extension and advisory services delivered through video and platforms linking experts	Digital Green in Ethiopia, Precision Agriculture for Development in Kenya
Resource availability and access to equipment	Not enough access to inputs (tractors) for land preparation	Manual, animal-aided, mechanized	Digitally enabled tractor hiring services	Hello Tractor in Nigeria
Agriculture management	Lack of systematic pest management	Observe and respond	Real-time alert system	Waterwatch cooperative in Kenya
Market links	Poor market access	Farmer cooperatives, intermediaries	Digital platforms for finding buyers and linking buyers and sellers	Tulaa and Farmshine in Kenya, Maano in Zambia, Zowasel in Nigeria
Farmer financial inclusion	Insufficient and unfair access to credit and financial products	Moneylenders, family, and friends	Platforms for input credit, e-wallets, and insurance products	Agri-wallet in Kenya
Data analytics	Little or no access to data for informed decisionmaking	Intuition based on observation, experience	Portable soil testers, satellite images, remote sensing	Agrocares based in Netherlands operating in Kenya, UjuziKilimo
Energy for agriculture	Poor irrigation energy infrastructure	Rainfed, manual, gravity-aided	Solar-powered irrigation pumps	SunCulture in Kenya

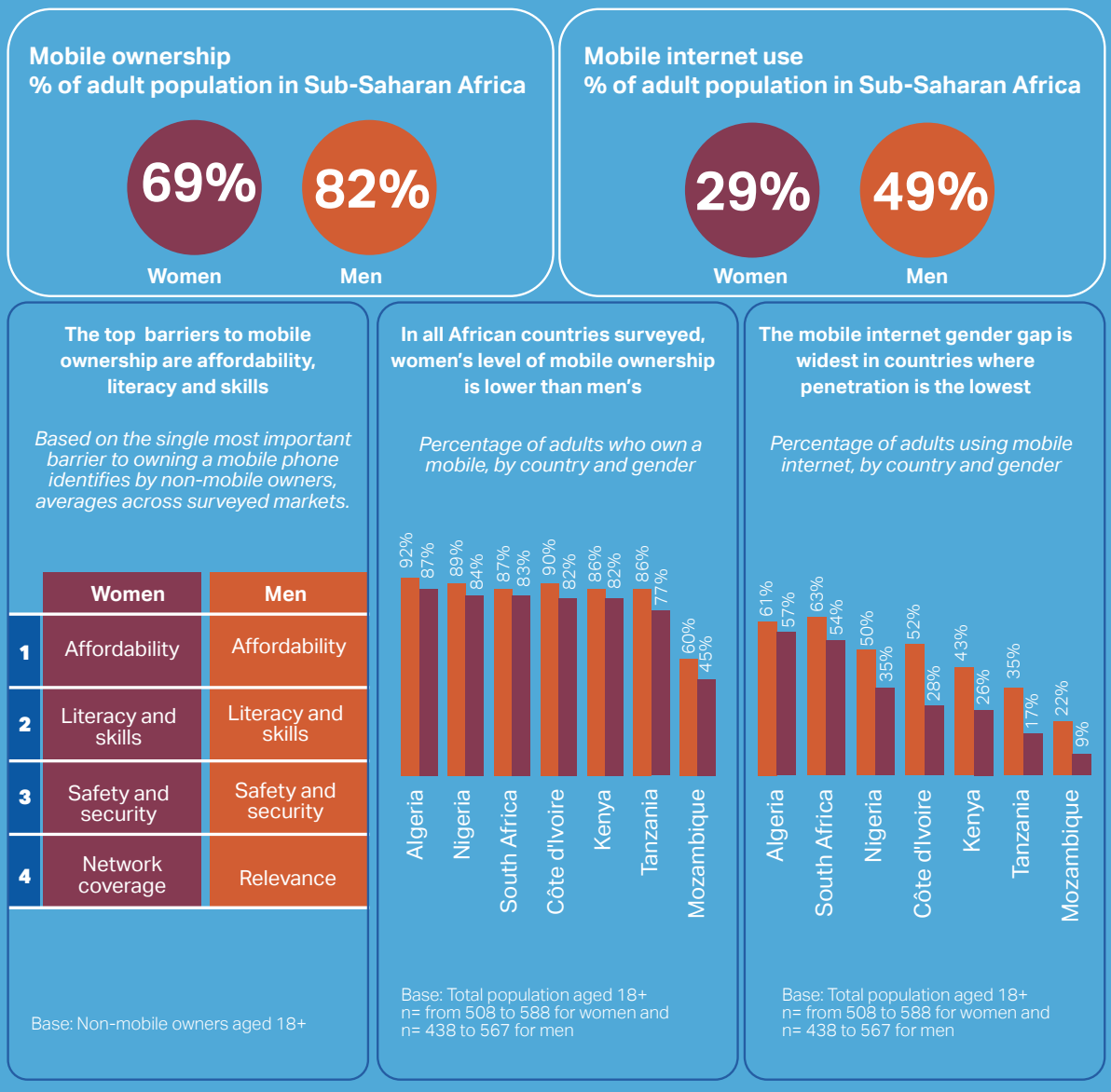
Source: World Bank and Dalberg Advisors 2019.

Technology is available and thus not the primary obstacle, so the challenge is scaling it up, which in turn requires dealing with complex policy issues. What's really missing is a framework, including policies and regulations, for startups in digital agricultural technology to enable them to operate and grow. Most innovative companies are still working to develop a viable business model by bundling agricultural services, including advisory, input supply, financial and payment services, and market access through mobile devices.[119] The revenues for these companies come from a share in business transactions and are paid by input companies, agribusiness companies, commodity buyers, and financial institutions. Many of these next-generation enterprises are run by young people and have a big impact on job opportunities in rural areas. Ministries of agriculture can support this trend by investing in knowledge, innovation, and incubation for digital entrepreneurship, especially among women and youth (box 2.2).

Box 2.2 Connecting women

While the digital gender gap has narrowed in the rest of the world, it remains wide in Africa. Narrowing the gap requires targeted programs to overcome barriers, change outdated social norms, and involve women in the design and implementation of products, services, and policies.

Box figure 1 The gender gap in mobile phone ownership and internet use in Africa is wide, 2018



Source: GSMA 2019.

Nigeria has launched several promising initiatives. The 1000 Girls in Training program seeks to create a female ICT talent pool. Girls in ICT, in partnership with two nongovernmental organizations (NGOs)—Women in Technology in Nigeria and the Women's Technology Empowerment Centre—encourages girls to choose ICT careers. The focus is on training in games, blogging, graphics design, animation, website development, software development, and computer programming. TechHer mentors female tech entrepreneurs and workers. Progress in these areas can deliver large commercial and economic returns and help advance national and regional development.

Widely accessible digital data platforms for farmer registries and digital agronomy data need to be scaled up to improve evidence-based decisionmaking by governments and farmers and to better target incentives and services.

Widely accessible digital data platforms for farmer registries and digital agronomy data need to be scaled up to improve evidence-based decisionmaking by governments and farmers and to better target incentives and services. A Digital Challenge event in Nairobi held in 2019 —One Million Farmers—brought together governments, entrepreneurs, and investors with a view to scaling up digital agricultural technologies.[120] The event laid the groundwork for a broad partnership to leverage resources, share data and research findings, and co-innovate with the private sector.[121] The entry of big tech players like Microsoft, Google, IBM, Bosch, and Alibaba and big agri-enterprises like Bayer, Syngenta, Yara, John Deere, and UPL is likely to transform the sector's scale and scope and could open opportunities for new local–global combinations.

E-government

Public e-service availability through email, mobile apps, and text messaging has doubled globally, especially in health and education.[122] Taking on new roles, the state can augment the limited digital governance expertise of analog public institutions in Africa,[123] fostering local and national ecosystems for digital transformation in ways that support building innovative and inclusive digital economies.

Industry, academia, and other nonstate actors can also contribute to an innovative digital economy by developing and testing platforms and technologies for the public sector and by adapting emerging digital technologies to the local context before scaling them up. Government procurement of digital technologies and services can promote competition among suppliers, foster open standards, and build capacity by working with local governments. Open government data are expected to increase the transparency and accountability of public agencies, strengthen citizen participation, and spur innovations. Breakthroughs in data-capturing technologies, geomapping, mobile applications, and data standards and storage are creating opportunities for fact-based decisionmaking and rapid-learning cycles. Such initiatives require partnerships among public agencies, content developers, industry, and civil society.

Providing accountable, inclusive, and trustworthy e-government services is becoming more complex. Governments can leverage the digital ecosystem to make the public sector more capable and responsive and adopt citizen-centric approaches to policymaking and service delivery.[124] Achieving these changes requires a long-term investment in digital modernization to increase digital knowledge in public institutions. A starting point is to capture cutting-edge practices in reforming public sector agencies and to reflect citizen aspirations for transparent, accountable, and participatory government. The most common online public services are utility payments, income tax filing, and new business registration.[125]

A major societal issue is whether digital technologies will reinforce or alleviate rising economic inequality. More than half the countries in Africa provide targeted online services to vulnerable groups, but more needs to be done to enable poor people to develop the skills to use digital technologies. Applying e-government at the local government level is a new frontier, especially in land use planning, inner-city public transit, and energy and water conservation.[126] Universal access funds can subsidize internet access for vulnerable groups. Similarly, grassroots innovation funds can promote social inclusion and community participation. Digital identification programs, rolled out on a massive scale across Africa, will provide a foundation for broader delivery of social services, financial inclusion, and business and property registration (box 2.3).[127]

Box 2.3 Malawi's digital ID rollout

Early in 2017, Malawi still lacked a comprehensive national registry or identification system. By November it had an integrated national biometric ID system for 9.1 million adults. How did it do the seemingly impossible? By hiring and training 4,200 young Malawians, mostly college and university students, as registration officers to blanket the country using portable solar-powered biometric registration kits, each with a laptop, digital camera, fingerprint scanner, and card reader.

For the intensive training, the project booked all the hotels in Lilongwe, the capital, for three months. Trainees were selected through an online test. Digital audio and video content were created from scratch. The digitally skilled workforce then carried out the mass registration in portable offices covering all 28 districts.

Impressed with the system, the Electoral Commission used the biometric registration kits for a voter registration drive, and the health ministry wants to equip its more than 800 healthcare facilities to collect vital statistics.

Many of the registration officers have moved on to apply their new technical schools in their advanced studies and in other government departments incorporating the ID system in their digital infrastructure, among them border management, immigration, and the tax and revenue authority.

Source: Center for Global Development 2020.

Barriers to, and opportunities for, innovation and digital transformation

Various assumptions underpin traditional innovation and policy prescriptions and approaches—such as those focusing on innovation for competitiveness in Organisation for Economic Co-operation and Development (OECD) countries (OECD Digital Economy Outlook 2020). They often include, for example, high or reasonably high R&D investment, a national innovation system with good linkages among actors, the necessary capabilities or absorptive capacity, and favorable conditions such as governance, regulations, and funding. In Africa, these conditions are missing or weak in most countries, districts, and municipalities.

Weak linkages among actors in national innovation systems form a major gap in Africa's innovation system. Across the continent, agencies and departments—under, say, a national ministry of science and technology—collaborate little if at all among themselves or with corporations on innovation and projects. A weak innovation culture raises barriers. And a misalignment or weak linkage disconnects formal sector R&D and innovation from the large informal economy. Strengthening the links among innovation actors through networking programs, digital platforms, and seed funding would enable innovation and digital policies to better advance Africa's transformation agenda.

Coordination challenges are not unique to Africa. To deal with them, countries across the globe, including Canada and the United Kingdom, develop calls for research projects requiring actors such as academia and industry to apply jointly and deliver the projects together. Joint project implementation helps actors understand each other's perspectives, deepens networks, builds trust, and attracts funding.

Barriers to innovation policies aligned with African contexts also have possible remedies. For example, Africa lags in domestic R&D spending in relation to GDP and in number of researchers in relation to size of population. Well-designed R&D policy instruments are among the most effective means of spurring innovation and productivity growth. R&D spending can target innovations with high impact potential. And policies can focus funding on specific economic, social, and environmental challenges, since simply increasing it does not guarantee that pressing societal challenges will be addressed. Africa faces barriers to realizing these opportunities (table 2.2).

A major societal issue is whether digital technologies will reinforce or alleviate rising economic inequality. More than half the countries in Africa provide targeted online services to vulnerable groups, but more needs to be done to enable poor people to develop the skills to use digital technologies.

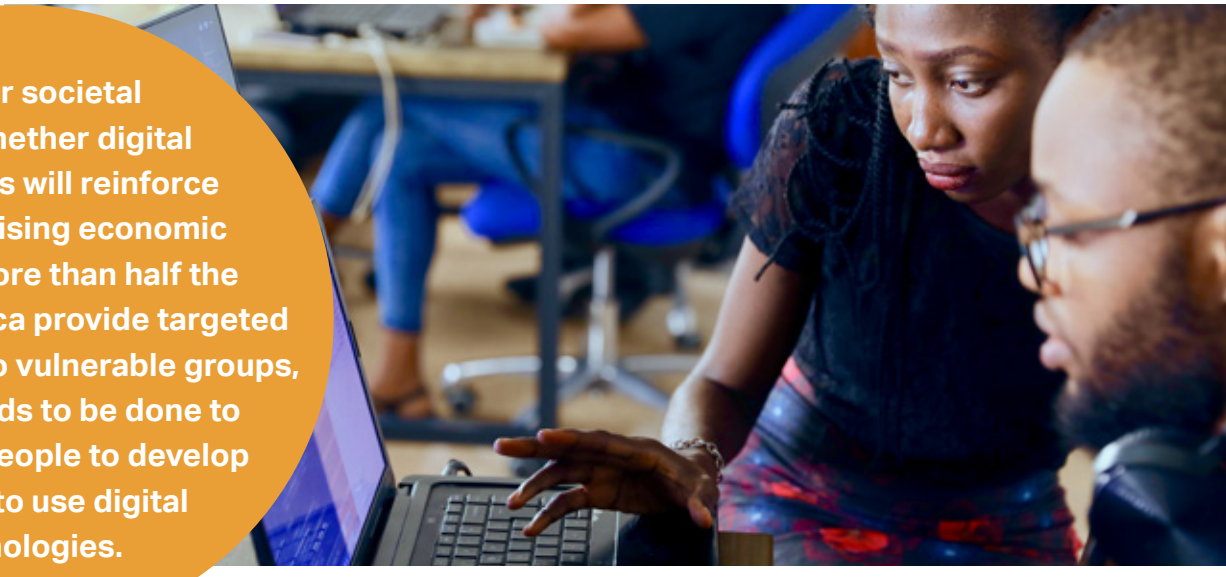


TABLE 2.2 OPPORTUNITIES AND BARRIERS IN INNOVATION AND DIGITAL TRANSFORMATION IN AFRICA

Opportunities	Barriers	Solutions/examples
Innovation model	Traditional OECD-informed model is ill-suited to African reality of predominantly informal economies	Rethink and adapt the innovation model to suit key industries and development/ societal priorities
Innovation ecosystem	Weak capabilities and linkages among actors, low R&D/innovation funding	Strengthen capabilities, intensify linkages, and increase funding
Innovation policies and approaches	Government-led with limited participation from other actors, linear policy model, poor implementation outcomes	Ensure truly participatory agenda-setting, strengthen implementation and evaluation
Digitization of governance and service delivery	Inadequate digital capacity; dominance of vertical, sector-based approaches	Improving infrastructure for digitization, co-innovation, and whole of government and digital-by-design approaches
Digitization of payment systems and financial inclusion	No interoperability of payment platforms; lagging adoption and interconnectivity, missing building blocks (digital ID)	Require interoperability, accelerate digital foundation, prioritize access for marginalized groups
Digitization of business models (for example, in energy, agriculture)	Inadequate modern digital framework, weak enabling environment, scarce funding	Foster experimentation; strengthen coalitions among technology hubs, entrepreneurs, and corporations; rethink business models
E-education	Little or no local content, nascent business models, local resistance to disruption	Target local content for adult learning, start delivery with hybrid methods, increase demand
Digital entrepreneurship	Insufficient finance, training, mentoring, and co-innovation, limited scalability due to large informal economies, multiple supply-driven initiatives, foreign acquisitions	Strengthen coalitions (for example, among tech hubs), linkages (between tech-hubs and corporations), thought leadership, and priority setting; protect the intellectual property of local innovators
Digitization of consumer markets, e-commerce	Inconvenience, foreign dependence, low trust among actors, constricting infrastructure and logistics (for example, postal address system)	Anticipate growing consumer demand, adapt delivery models to African contexts, improve cross-border policies and regulations

Innovation and digital opportunity from COVID-19

The COVID-19 crisis offers new opportunities for a far-reaching transformation of Africa's economic structure, service delivery, and social contract. Trends for digitalization, innovation, and regional collaboration are accelerating across the continent. A lasting impact could be a change of mentality to using online and mobile banking tools, which increased by 30% in key markets. Businesses could expand their online presence and respond to customers' increased demand for e-commerce and digital services by adopting "digital first" operating models. The crisis could also reshape Africa's manufacturing sector with a renewed focus on innovation, local production, and self-reliance—as long as governments and businesses tackle longstanding barriers to strengthening intra-African trade and supply chains.

Indeed, many governments have demonstrated new levels of decisiveness and taken the cue to speed up digitization. For example, several governments and technology companies have made data plans more affordable, regulators can work with banks to allow e-signatures, and governments can step up the provision of digital services and the use of data for decisionmaking. They can also enable broader digitalization in society and the economy by speeding the rollout of digital IDs and registries and accelerating infrastructure investments in backbone networks, last-mile connectivity, and electricity supply.

The crisis, in some cases, is triggering a digital transformation in education by reimagining the roles of schools, universities, homes, and communities. Already, new delivery channels have been set up. And the recognition that Africa needs a workforce with digital skills at the core of many jobs is creating new training pathways for basic skills, such as mobile transactions, and advanced ones, such as coding and graphic design.

The crisis has also laid bare the vulnerabilities of Africa's 250 million urban poor, whose living conditions make social distancing nearly impossible and increase the risk of infection. Governments can improve digital access to basic services, connectivity, and mobility. Longstanding inequalities and fragilities in Africa's health systems—including gaps in personnel, equipment, and data systems—are likely to lead to significant additional funding to build up resilience, strengthen digital health ecosystems, and innovate in service delivery (telemedicine, remote patient case management). South Africa's government, for instance, is using an interactive WhatsApp chatbot to answer common COVID-19 inquiries, so far used by 3.5 million people in five languages.

As Africa charts a course of gradual recovery and increased resilience against future crises, citizens will increase their expectations about government programs, which will increasingly rely on digital data to deliver targeted social assistance programs, provide transparent data-driven communications, and build buy-in through transparency and accountability.

A lasting impact of the COVID-19 crisis could be a change of mentality to using online and mobile banking tools, which increased by 30% in key markets.

Broad policy agenda for innovation and digital initiatives

Africa has seen many innovation and digital policies and programs over the last decade. While promising, these are only the first steps to overcome the persistent challenges and barriers. These initiatives need to be linked together and to grow into viable ecosystems that will allow vibrant innovation organizations to build on each other's offerings and comparative advantages for innovation.

Two lessons emerge from Africa's experience with encouraging innovation. First, standard prescriptions for building national innovation systems based on practices in advanced economies seldom apply in Africa. These ill-fitting approaches can be further distorted by supply-led external assistance and private engagement. Second, Africa's rising aspirations for improved living standards present a largely unexploited market potential for products and services within countries and across the continent. This potential can be realized by implementing a combination of innovation policy options in a partnership of governments, knowledge networks, and entrepreneurs.

The African Union's Agenda 2063: The Africa We Want outlines a comprehensive development approach for priority areas of transformation—economic, social, environmental, technological, leadership, and structural.[128] The Continental Education Strategy for Africa 2016–2025[129] and the Science, Technology, and Innovation Strategy for Africa (STISA) 2024 are complementary strategies for harnessing education and innovation in support of Africa's transformation agenda. STISA 2024 offers innovation strategies that cut across societies, systems, and structures to "accelerate Africa's transition to an innovation-led, knowledge-based economy."

The Digital Transformation Strategy for Africa 2020–2030, a recent addition to the continent's portfolio of policies, focuses on the digital foundation of innovation and transformation to address Africa's development priorities.[130]

It outlines political commitments and public expectations for visible progress. It is grounded in a frank assessment of barriers and weaknesses, notably the lack of coordination among continental institutions, limited policy and regulatory reforms to facilitate cross-border connections, and the shortage of finance and mentoring for digital entrepreneurs. Its four strategic pillars—enabling environment, digital infrastructure, digital skills and human capital, and digital innovation and entrepreneurship—offer a coherent framework and an overall direction (box 2.4). The proposed agenda for structural transformation includes economic diversification, productivity improvements, technology upgrading, and human capital investments. Its scope combines direct actions by governments, including measures to address digital market failures, with broader changes in Africa's economic, organizational, social, cultural, and research environments.

Box 2.4 The AU's Digital Transformation Strategy

Innovation policy remains a new field, particularly in the developing world. Only now are many African countries contemplating comprehensive policy related to new technologies, new business models, and new digital economies. To guide them, the African Union has broad innovation and digital policy objectives that will be translated into continentwide guidelines and protocols over time. Its Digital Transformation Strategy has identified four main policy areas:

- Regulations for licensing internet networks and service providers, data security, and governance of artificial intelligence.
- Digital infrastructure, such as broadband networks and fiber optic networks.
- Innovation and digital skills, including education curricula, STEM education, and technology-supported learning.
- Digital innovation and entrepreneurship, covering intellectual property rights, patents, and access to finance for digital and innovation start-ups.

The AU digital transformation strategy raises several questions:

- What mechanisms can adapt this Africa-wide strategy across highly diverse countries that, with few exceptions, have limited digital readiness and have not yet incorporated digital issues in key policy processes?
- What new dialogue is needed to achieve consensus on priorities, tradeoffs, roles, and timelines?
- What governance arrangements are needed?
- Given Africa's need to catch up digitally with the rest of the world, what dynamics will govern international digital competition and cooperation?
- Finally, can the necessary financing from public and private sources be mobilized and allocated without deepening digital divides?

It is essential for countries to align their strategies and policies with regional and continental strategies and policies. For such policies to be effective, governments must fully understand the need to work with the private sector and researchers in order to foster innovation ecosystems that encourage entrepreneurs to take risks and contribute to the continent's economic integration and transformation. A regional or continental regulatory body under the auspices of the AU could be established to coordinate and promote efficient functioning of the digital and innovation space, anchored in sound technical and commercial fundamentals.

With the draft Digital Transformation Strategy now in place, attention is shifting to implementation, coordination, and governance. A first step is a systematic review of research and development (R&D) spending in Africa, to reveal gaps and areas of high-impact programs. To make the most of scarce funding, African countries will need to build world-class higher education capabilities and research centers. Once countries have a critical mass of trained people with high-caliber capabilities, they will be able to increase R&D, manage research and science, technology, and innovation funds, and engage in other functions to strengthen the links among science, innovation, and digital ecosystems.

Comprehensive national strategies

The new digital age calls for comprehensive country-level innovation and digital strategies, as in Kenya,[131] Mauritius, Morocco, South Africa, and Tunisia.[132] Governments in the rest of Africa are formulating variants of innovation and digital strategies, often to address specific social and economic challenges. These may relate, for example, to the financial sector, but are not integrated into broader economic frameworks in the country. To be effective, strategies will be aligned with national development priorities, based on evidence, adequately financed, properly tailored to local realities, and action-oriented in support of a long-term vision shaped by stakeholders and assigns accountability.[133]

A starting point is to take stock of the digital portfolio and to consult broadly on how digitization in priority sectors can create opportunities for business formation, market efficiency, and job creation. South Africa, for instance, is proposing digitization in industry, mining, agriculture, utilities, and the blue economy. In addition, the government set up a Presidential Commission on the Fourth Industrial Revolution in March 2020, with a view to launching a national strategy.[134] Ghana is encouraging private partners to improve service delivery by adopting new professional standards in education, requiring interoperability in digital finance, and promoting investment and competition in ICT. These policy efforts respond to emerging opportunities for economic growth and job creation. For example, in recent country diagnostics by the World Bank Group, digitization is emerging as a cross-cutting enabler for market formation and service delivery (table 2.3). But to achieve policy coherence and encourage the expansion of private activities, reforms require sustained leadership commitment, close monitoring of market and technology trends, and strategic coordination among core ministries.

To make the most of scarce funding, African countries will need to build world-class higher education capabilities and research centers.

TABLE 2.3 DIGITAL TRANSFORMATION OPPORTUNITIES CAN INFORM NATIONAL STRATEGIES

Country	Market creation opportunities
Ghana	• Develop high-value export markets (horticulture, ICT-enabled services)
	• Private sector to leverage ICT to improve key sectors (agriculture, health, mobile banking)
	• Promote technology solutions for government activities and services
	• Promote efficiency and innovation in education and health
Burkina Faso	• Provide the necessary digital platforms and/or ICT applications in key sectors (mobile finance, agriculture value chains, e-commerce, government, e-health, and e-education)
Kenya	• Establish clear regulatory framework and facilitate infrastructure sharing to expand coverage; catalyze innovation in the ICT industry; facilitate full interoperability among mobile payment providers; foster digital partnerships between local tech-hubs and global ICT players
	• Invest in shared public data platforms on farmers, crops and production; develop public-private incubation platform to transform agriculture value chains; sponsor digital agriculture entrepreneurs
	• Support technology and innovation adoption to improve product complexity; link up digital start-up sector with corporate firms; strengthen firm's managerial capabilities
Rwanda	• Strengthen ICT services through Kigali Innovation City
	• Build up a market for provision of affordable housing
	• Develop high-value export crops; introduce complimentary agri-technology services (payments, services, weather, soil, composition, market access)
Angola	• Open telecom markets for competition
	• Support diversification of agribusiness
	• Increase private provision of essential transport services (port, airport) and logistics
Ethiopia	• Leverage digital economy approaches for creating jobs in light manufacturing, tourism, ICT
	• Foster linkages within domestic economy between large industrial firms/ SEZ and local SMEs
	• Increase the role complimentary services in the economy (finance, ICT, logistics, health, legal)

Source: IFC Country Private Sector Diagnostics.

Updating policies and regulations

To achieve the goal of a pan-African policy for e-commerce, African governments will need to strengthen key regulations and settle legal uncertainty on multi-jurisdictional issues, enlisting international support as needed.

The rise of the digital economy calls for new policies and regulations. With practice moving ahead of policy and regulation, governments are finding it hard to adapt in the modern and fast-paced innovation and digital ecosystems. A pragmatic policy mix requires monitoring technology trends; conducting joint pilots with industry, tech entrepreneurs, and civil society (regulatory sandboxes); introducing presumptive laissez-faire regulation;[135] rolling back outdated regulations; conducting ex post reviews; and engaging in periodic adaptation. The new policy mix should be informed by bottom-up consultation and respond to users and client of digital services. Such clients and users include the private sector, both domestic and international, as well as citizens, academia, and civil society. And the policy mix needs to be rapidly scaled up with a minimum of bureaucratic hurdles and with a view to supporting, not thwarting, innovation and entrepreneurship.

To update policies, national and regional e-commerce stakeholder groups can be set up to develop a blueprint for an African digital trade and economy strategy, and identify key measures for intraregional regulatory interoperability. To achieve the goal of a pan-African policy for e-commerce, African governments will need to strengthen key regulations and settle legal uncertainty on multi-jurisdictional issues (including e-transactions, privacy, consumer protection, digital identity, and cross-border), enlisting international support as needed. To lower connectivity costs, transparent rules will foster regional integration of data markets. This may be accompanied by accelerating data legislation, including ratification of the Malabo Convention, and providing technical support to help merchants comply with privacy regulations in overseas markets. Data cooperation and capacity building between Europe and Africa is a key proposal by the European Union–African Union Digital Economy Task Force, and is being taken up by the EU through its Digital4Development policy and by the AU through the Digital Transformation Strategy.[136]

Keeping markets open

Governments also need to weigh the benefits of keeping markets open to new entrants while encouraging innovation. The combination of network effects, economies of scale and scope, and innovative business models tends to encourage winner-take-all outcomes. That makes it harder to protect the market power of incumbents and also allow competitors to enter, recognizing that they may eventually be acquired by dominant platform providers. Regulating digital monopolies is particularly challenging in Africa, where few countries can implement and enforce digital competition rules.

The digitalization of the global economy makes many traditional tax and regulatory policies obsolete. Developing countries, African countries included, are increasing their share of digital service users. At the same time, frustration is growing that foreign-owned digital service providers without a physical presence in a country are capturing lucrative market segments, shutting

out or buying out local competitors, and collecting and monetizing user data—without paying taxes. In response, a growing number of African governments are introducing sales and value added taxes for online sales, digital apps, and mobile money transfers. Many people fear that this will undercut the growth of digital business and spur tax avoidance.[137] Protests and a drastic drop in internet use greeted Uganda's imposition of taxes on social media use. An alternative to encourage business formation and support government engagement with citizens would be to reduce local government levies and rates for business registration for tech firms.

Internationally, negotiations under the OECD–G20 Inclusive Framework on Base Erosion and Profit Shifting are working to forge a new consensus on taxing the global digital economy, which may result in fundamental changes to international tax rules. The OECD proposals call for allocating more taxing rights to "market jurisdictions"—such as African countries, whose citizens are mainly consumers of goods and services on digital platforms offered by entities based in offshore jurisdictions—where multinational corporations and digital platforms have a sufficient economic presence to generate revenues. African countries need to be part of the discussions, which are moving rapidly. A key negotiating point concerns the criteria for allocating the taxing rights on digital activities and profits to each country.[138] The African Tax Administration Forum has called on African governments to consolidate their positions to give them a unified, more powerful voice. The forum emphasizes the need for simplicity and for the protection of African countries' taxing rights as "growing economies."[139]

Privacy, security, and consumer protection

Most African countries need to develop or strengthen data privacy, cybersecurity, and consumer protection regulations. Three areas of particular concern are exposure to cyberattacks and cybercrimes;[140] the concentration of personal data in the hands of private companies and state actors without proper governance and accountability;[141] and the risk that surveillance tools, malicious misinformation,[142] automated decision algorithms, and state-sanctioned internet restrictions could further restrict data sovereignty and civil rights.[143]

The challenge is to devise a contestable framework that balances protecting people's privacy rights and cybersecurity with deriving economic value from data. The continent lacks a common enforceable data protection framework, like the European Union's General Data Protection Regulation. Africa risks missing out on data-sensitive foreign direct investment as corporations prefer to cater to Africa from outside Africa. This lack of foreign direct investment could curtail Africa-wide trade in digital services, thus limiting the future benefits of the AfCFTA to primary commodities.

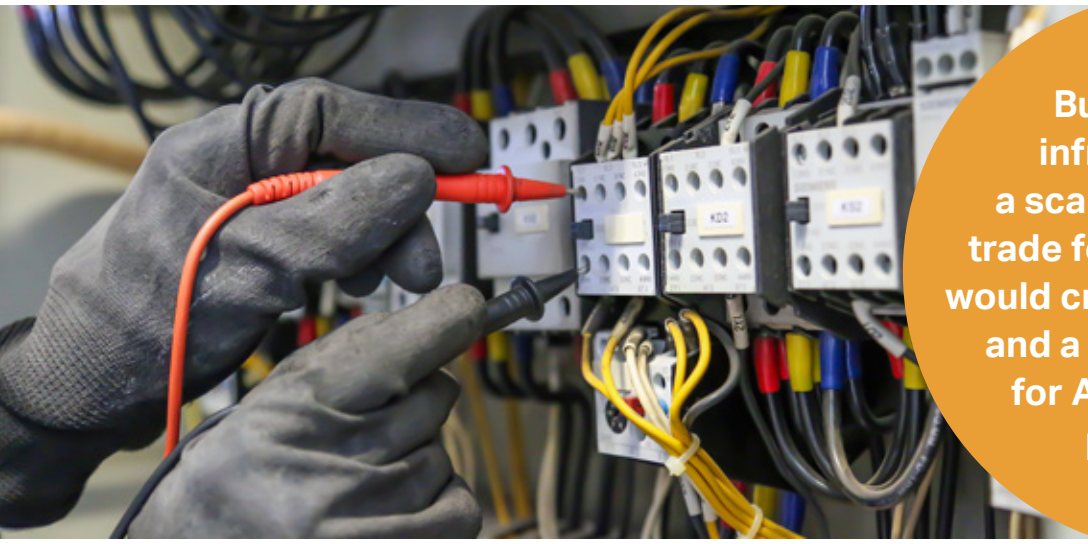
There is also a very real prospect of a cyber race, in which outside actors and large technology platforms compete for large datasets to gain economic and security influence. Kenya's new European Union–inspired data protection law, which sets a high bar on data handling and sharing by government and corporations, has encouraged Amazon Web Services to locate some of its data centers in the country as it expands operations in Africa.[144] Most African countries also need to establish computer emergency response units to protect critical national infrastructure against cyberattacks. Building digital infrastructure at a scale to enable free trade for a billion people would create opportunities and a sustainable path for Africa's growing population.

Africa-wide trade in the digital space will be possible after mechanisms are in place for cross-border data transfer, such as email addresses, standard contractual clauses, and binding corporate rules. To this end, the AfCFTA will engage the digital economy through increased data and consumer protection to build trust and encourage participation in Africa's continental trade initiative. The 2014 African Union Convention on Cyber Security and Personal Data Protection sets a strong baseline and it will be important that it is adopted by all African countries to create a coherent implementation framework. Similarly, African countries should consider ratifying the Council of Europe Modernized Convention 108 to facilitate data exchanges with the European Union on equal terms and expand Africa's digital businesses to global markets. At the African Union level, a protocol for a cross-border transfer framework could be negotiated to promote the free movement of data, prohibit data localization, and cooperate on cybersecurity.[145]

Engaging more stakeholders

Strengthening policies and strategies requires engaging a broader group of stakeholders in priority setting and policy formulation, to ensure their support for implementation (see chapter 4). Funding provisions will need to be established at the policy formulation phase to enable effective implementation. In addition, policymaking needs to be informed by a stronger emphasis on robust research and evidence. It is critical that co-creation and policy experimentation be a basis for moving from policy formulation to implementation. And capabilities for policymaking need to be strengthened to support learning and knowledge accumulation about policy processes.

Strategies to improve policy evaluation will need to start with developing a monitoring and evaluation framework for the continent. Recent work on a framework initiated by the African Observatory of Science, Technology, and Innovation and the Science Policy Research Unit of the University of Sussex is a good starting point,[146] though it requires further research and engagement with stakeholders to bring it to fruition. Some African countries, including South Africa, are developing evaluation frameworks. It will be important to also develop new indicators because existing global indicators do not adequately capture innovation in developing countries, especially in the informal sector. Even where science, technology, and innovation policy evaluation frameworks exist, they need to be updated to reflect the Sustainable Development Goals, as with the policy framework of the United Nations Conference on Trade and Development.[147]



Building digital infrastructure at a scale to enable free trade for a billion people would create opportunities and a sustainable path for Africa's growing population.

Governance of innovation policies currently resides mainly in national governments, led by ministries of science and technology. To be effective, improving policy governance has to start with consensus building as the basis for developing a governance framework with clear roles and responsibilities accepted by all actors. Continental and regional innovation policy governance frameworks will be more robust if they incorporate national formulation, implementation, evaluation, and governance practices and specify the roles of the many actors involved.

Innovation policies need to be linked to other policies (such as energy, finance, industry, trade, and environment). Locating the governance of innovation policies at the individual ministry level is unlikely to produce optimum and transformative outcomes. And in light of the AfCFTA's expectation of more cross-border trade, business, and financial transactions, governance of innovation policies and digital strategies may be more effective at the subregional level. That could help produce innovation-active organizations that build on the offerings and comparative advantages of other countries, sectors, and firms.

Building a robust innovation and digital policy framework requires a participatory, whole-of-government approach to agenda and priority setting, with knowledge-based and digital economies at the center. The traditional model of having government set the priorities and formulate the policies, passing implementation on to other actors, has not worked for Africa in most cases. And it certainly will not work for innovation. Given the unknowns of innovation policy, it will be even more important to focus on co-creating and co-innovating with nongovernment actors, right from the policy formulation stage. Building trust among actors from the beginning, in part through agreement on roles and responsibilities, can help ensure that the many actors support implementation.

Linking digital innovation to job creation

Job creation through digital innovation will depend on accelerating the rollout of the digital infrastructure backbone, providing affordable internet access for all, and expanding practical digital skills. Universal broadband connectivity is projected to require investments of $100–$110 billion by 2030. The World Bank Group and the African Development Bank have committed $25–$30 billion over the next decade, expecting to leverage similar amounts from African governments, the private sector, and bilateral partners.[148]

Private operators, both foreign and domestic, will be the primary drivers of broadband development in most countries. In a well-functioning market with a favorable business environment, broadband coverage could be provided to around 80%–85% of Africa's population through market competition, underscoring the critical importance of sustained political commitment and predictable rules for market structure, performance, and conduct.

To accelerate the build-out of internet connectivity, public infrastructure investments (estimated at $20 billion for satellite investments and a universal access fund) are one option to encourage development in remote rural areas. A second option is developing business models, technologies, and regulatory incentives to promote cross-border, cross-sector, and middle and last mile connections (such as shared access to phone towers and electric grids). And a third is to develop appropriate lower-tech solutions, such as narrow band access for farmers through mobile wireless.

Given the unknowns of innovation policy, it will be even more important to focus on co-creating and co-innovating with nongovernment actors, right from the policy formulation stage.

The massive influx of job seekers calls for radically new approaches to building human capital. As part of the AU Digital Transformation Strategy, providing digital skills training to all Africans is estimated to cost $18 billion. Starting from a low base, the number of people with digital skills is increasing rapidly in response to demand, which has increased with no reduction in the demand for low-skilled workers in areas where connections to faster internet have increased. The increase in jobs has been comparable across all education levels,[149] reflecting the entry of mobile, digital, and ICT-based firms and the productivity improvements of existing firms.

Mainstreaming educational innovations such as holistic online learning requires public–private support for education and worker training programs to rapidly scale up access to foundational digital literacy skills. It also requires leveraging digital technologies to increase the productivity of workers in their current jobs and to create new jobs in the formal sector adapted to new skill requirements (such as Andela in technical talent outsourcing and Jumia in e-commerce).[150]

A major challenge for Africa is to generate job growth through digital transformation of key sectors of the economy. Traditional manufacturing jobs, typically considered the most threatened by automation, represent only a small share of employment in Sub-Saharan Africa. To date, the automation of these sectors has been limited. Most promising for employment generation are the spillover effects and linkages generated by digitalization in key sectors of the economy. Industries without smokestacks—such as agriculture, urban services, consumer markets, tourism, transportation, logistics, commerce, education, and health—present ample opportunities for creating new jobs and upgrading value chains. Tapping into this potential requires upgrading core technical skills in high demand (coding, information architecture, data science, and data integration).

Strategic investments in entrepreneurial capabilities will be key. For instance, Ghana's Farmerline, an online digital platform used by 200,000 farmers in a dozen countries, is giving growing numbers of farmers mobile access to information, inputs, and tested agricultural practices. In Kenya, the World Bank is assembling digital innovators and agritech stakeholders in a single platform to source disruptive solutions and create trust among participants. The next step is to pilot this approach with 100,000 farmers to increase their profitability and productivity, with the ultimate goal of registering a million Kenyan farmers on a digital platform over the next three years. If successful, the plan is to launch similar platforms in Ethiopia, Nigeria, Rwanda, and other countries at similar starting positions. This is part of a broader initiative to form a global alliance for digitally enabled agriculture to support innovations in areas that include data, information technology, and telecom among agritech startups, producer organizations, agribusiness companies, commercial banks, fintech innovators, governments, research institutions, and development finance organizations.[151]

Digital and innovation policy in Africa is largely new and untested. That makes informing policymaking within a highly interactive innovation ecosystem critically important.

Priorities for action

African policymakers thus face a wide array of challenges in accelerating Africa's move to innovative and digital economies. The processes and policy actions must at the same time be prioritized and proceed in parallel. It is imperative that African leaders, policymakers, and digital and innovation stakeholders collectively develop a new policy mix to respond to pressing digital, innovation, and development challenges. The new policy mix will address the wide range of policy issues required to get the most from innovation and digital technologies.

The AU Digital Transformation Strategy identifies this mix as policies addressing digital infrastructure, digital skills, innovation, entrepreneurship, and the enabling policy environment, which covers access, pricing, licensing, cybersecurity, and data protection and privacy. The new policy mix will support:

- New digital platforms to develop, test, implement, learn from, and refine innovations and technology-driven applications—locally, nationally, and regionally.
- Fresh approaches to policies and regulations that recognize the shortcomings of purely national rules and uncoordinated sectoral policies and strategies.
- New approaches and mechanisms for transparency, oversight, and accountability.

Of the many elements in the broad policy agenda, the following actions are of particular relevance for Africa to take advantage of the emerging global innovation landscape.

Formulating strategies and establishing policy frameworks

With inputs and experience from across the digital and innovation ecosystems, African governments can formulate and implement robust digital and innovation strategies, backed by adequate policy frameworks. To date, much of the budding innovation policy across Africa is either reactive or piecemeal, lacking linkages to national or continental strategies. But such strategies and frameworks can ensure that different sectors and value chains reinforce each other and lead to multiplier effects, rather than limited change within silos. They can also ensure alignment of digital and innovation policies with broader macroeconomic, financial, and industrial policy—and avoid inadvertently creating competing or disincentivizing policies. Creating such strategies and frameworks requires taking into account the available national and global evidence, seeking inputs from all stakeholders, allocating adequate financial resources, and investing in human capacity for effective implementation.

The AU Digital Transformation Strategy provides a comprehensive starting point for all African governments, but their strategies and policies also need to reflect local contexts.[152] A few African countries have digital or innovation strategies under implementation, including Kenya, Mauritius, Morocco, South Africa, and Tunisia. But most countries do not have such strategies—and if they do, only on paper. They could benefit from studying South Korea, Finland, and Singapore, which have excelled at implementing digital and innovation strategies. Singapore, for example, developed a strategy that, while designed by government, was implemented through well-managed partnerships with industry and university research institutes.

Integrating innovation ecosystems

Digital and innovation policy in Africa is largely new and untested. That makes informing policymaking within a highly interactive innovation ecosystem—anchored on a shared vision, adaptive strategies, sustained commitment, and institutional cooperation—critically important to ensure well designed, equitable, and sustainable policies. This involves:

- Promoting an environment for leaders, policymakers, and main stakeholders to agree on and adhere to a participatory process related to policies for innovation, technology, and research and development.
- Putting in place policy processes and approaches that are iterative and learn from failure, building feedback loops to guide implementation roadmaps.

Few, if any, African countries are adequately supporting such ecosystems. Nigeria and South Africa have the most advanced innovation ecosystems, boasting 85 and 80 tech hubs respectively. But they have not adequately crowded in the private sector, academia, and all-of-government approaches to that ecosystem. There are also efforts by corporates, particularly in fintech, to build out private ecosystems, but they are not well linked to policymaking processes. Around the globe, Europe has the most advanced innovation ecosystems. A 2019 report for the EU Digital Transition Partnership identified 247 innovation ecosystems in 35 countries, covering almost all of Europe.[153] Such a robust ecosystem results from:

- Targeting policies and collaborations to convene stakeholders.
- Transparently seeking policy inputs.
- Incentivizing partnerships across government departments, private firms, academic, researchers, and other stakeholders.

There are other useful models where a single country is developing and nurturing innovation ecosystems. For example, China has now overtaken the European Union with research and development investments, equivalent to 2.1% of GDP.[154] Today, of the world's 15 largest digital firms, not one is European with China, India, and the United States investing aggressively in innovation and digital ecosystems. This points to the significant challenge of harmonizing priorities, regulations, and policies across multiple countries. These models provide good lessons, including whether government or industry should lead in championing innovation ecosystems.

Boosting investments in digital infrastructure and skill development

Even with the most integrated ecosystems and best policy frameworks, digital innovation and technologies will not provide full benefits to Africa without investments in both digital infrastructure and human capability. Broadband connectivity alone is projected to require up to $110 billion in investment, much to be borne by national budgets. So ensuring that such investments are targeted and that donor and private funding is crowded in will be critical.

Nearly 300 million Africans live more than 50 km from a fiber or cable broadband connection, so the lack of widespread high-speed (broadband) internet remains a significant hurdle for Africa to fully harness the full potential of digital transformation. Investment in connectivity infrastructure should thus be a priority action.

A very large part of the IT content consumed in Africa comes from outside the continent. Investment in data centers in Africa will foster the development of a local digital industry. The main benefit of this localization will be cost savings on international connectivity; a second benefit is sovereign control over data.

Critically important for all African governments is avoiding a multiplicity of investment initiatives and instead promoting the implementation of common infrastructures, building upon the AfCFTA.

Countries will also need to invest in data centers, privacy and security measures, and application-programming interfaces (which allow two applications to talk with each other, as with making a hotel reservation online). This will involve prioritizing investments, particularly in budget constrained environments made even tighter by the impacts of COVID-19. It will also involve promoting cross-sector and cross-border connections to reduce costs and ensure seamless trade and data exchange. And it may involve developing Africa-centric, lower-tech solutions—particularly for rural areas.

Equally important is building human capital for innovation and digital. The AU estimates that it will cost nearly $20 billion to provide digital skill training to all Africans. Ensuring the widespread availability of digital skills will require revamping education curricula according to current needs and trends in the digital economy and in the labor market, with a focus on science, technology, engineering, and mathematics and on entrepreneurship and innovation.

At the same time, it will be important to mainstream digital technologies and capabilities across all aspects of life and ensure that online services are relevant to all citizens, including e-government, e-learning, and e-health.. This requires building digital skills so that more people can be active participants in digital society.

All of this will require mainstreaming digital education at all levels and accelerating public–private support for education and worker training. Countries that prioritize these investments will reap greater benefits as economies rely more on innovation and digitally enabled sectors.

A very large part of the IT content consumed in Africa comes from outside the continent. Investment in data centers in Africa will foster the development of a local digital industry.

References

A4AI (Alliance for Affordable Internet). 2019. The 2019 Affordability Report. Washington, DC: Web Foundation. Available at: https://a4ai.org/affordability-report/report/2019/.

A4AI and Xalam Analytics. 2019. Modeling Investment Requirements to Achieve the Digital Moonshot for Africa, 2021 & 2030 Connectivity Targets. Preliminary Observations. May 2019.

AGRA (Alliance for a Green Revolution in Africa). 2019. Africa Agriculture Status Report 2019. The Hidden Middle. A Quiet Revolution in the Private Sector Driving Agricultural Transformaton. Nairobi, Kenya. Available at: https://agra.org/wp-content/uploads/2019/09/AASR2019-The-Hidden-Middleweb.pdf.

AUC (African Union Commission). 2014. Science, Technology and Innovation Strategy for Africa 2024 (STISA 2024). Addis Ababa, AUC.

AUC. 2015. Agenda 2063: The Africa We Want. A Shared Strategic Framework for Inclusive Growth and Sustainable Development: First Ten-Year Implementation Plan 2014–2023. Addis Ababa, Ethiopia.

AUC. 2016. Continental Education Strategy for Africa (CESA) CESA 2016–2025. Addis Ababa, Ethiopia.

AUC. 2019. The Draft Digital Transformation Strategy for Africa (2020–2030). Unpublished Paper. Addis Ababa, Ethiopia.

AU–EU DETF (The European Union–African Union Digital Economy Task Force). 2019. https://ec.europa.eu/digital-single-market/en/news/new-africa-europe-digital-economy-partnership-report-eu-au-digital-economy-task-force.

Boston Consulting Group. 2018. Pioneering One Africa. The Companies Blazing a Trail across the Continent. Retrieved from https://www.bcg.com/publications/2018/pioneering-one-africa-companies-blazing-trail-across-continent.aspx.

Broadband Commission for Sustainable Development. 2019. Connecting Africa through Broadband. A strategy for doubling connectivity by 2021 and reaching universal access by 2030. ITU. UNESCO. https://www.broadbandcommission.org/Documents/working-groups/DigitalMoonshotforAfrica_Report.pdf.

Center for Global Development. 2020. "Malawi's Journey towards Transformation: Lessons from its National ID Project." CGD Note. Washington, DC.

Dalberg Advisors. 2019. The Digitalization of African Agriculture Report 2018–19. Geneva, Switzerland.

Daniels, C. 2017. Science, Technology and Innovation in Africa: Conceptualisations, Relevance and Policy Directions, in What Do Science, Technology and Innovation Mean from Africa? Edited by C. Mavhunga. Chicago, USA: MIT Press.

Daniels, C., and B. Ting. 2019. TIPC Policy Brief – Transforming Science, Technology and Innovation Policies in Africa: Insights from Ghana, Senegal and South Africa, A Transformative Innovation Policy Consortium Policy Briefing Issue 3, November 2019. Available at: http://www.tipconsortium.net/publication/tipc-policy-brief-transforming-science-technology-and-innovation-policies-in-africa-insights-from-ghana-senegal-and-south-africa/.

Daniels, C., O. Ustyuzhantseva, and W. Yao. 2017. Innovation for inclusive development, public policy support and triple helix: perspectives from BRICS, African Journal of Science, Technology, Innovation and Development, 9, 5, 513-527.

Daniels, C., P. Mawoko, and A. Konte. 2018. Evaluating Public Policies in Africa: insights from the Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024), Policy@Sussex - https://blogs.sussex.ac.uk/policy-engagement/evaluating-public-policies-in-africa/.

DE4A (Digital Economy for Africa) and PASET (Partnership for Skills in Applied Science, Engineering and Technology). 2019. Digital Skills Country Action Plan for Africa. Washington, DC: World Bank.

Freedom House. 2018. Freedom on the Net 2018. The Rise of Digital Authoritarianism. Kenya Country Report. Retrieved from https://www.justice.gov/eoir/page/file/1112091/download.

Gebre, S. https://www.globalgovernmentforum.com/kenya-creates-africas-first-national-digital-id-scheme/. June 25, 2019.

Gelb, A. and A. Metz. 2018. Identification Revolution: Can Digital ID Be Harnessed for Development? Washington, DC: Center for Global Development.

Government of South Africa 2019. Presidential Commission on Fourth Industrial Revolution: Members and terms of reference, https://www.gov.za/documents/presidential-commission-fourth-industrial-revolution-members-and-terms-reference-9-apr; see also, http://www.thepresidency.gov.za/press-statements/president-appoints-commission-fourth-industrial-revolution.

GSM Association. 2020. The Mobile Economy—Sub-Saharan Africa 2020. London, UK.

GSMA. 2019. Briter Bridges (July 2019). 618 Active Tech Hubs in Africa. Retrieved from https://briterbridges.com/618-active-tech-hubs.

Hanna, N. 2016. Mastering Digital Transformation. Towards a Smarter Society, Economy, City and Nation. Bingley, UK: Emerald Group Publishing.

IOL. 2021. Business report. "SA ranks 136 worldwide for the cost of mobile data." Lusaka, Zambia. https://www.iol.co.za/business-report/companies/sa-ranks-136-worldwide-for-the-cost-of-mobile-data-e2536315-ed01-4eab-a0f5-ec101398a0d4.

ITU (International Telecommunications Union). 2019. World Telecommunication/ICT Indicators Database. 23rd Edition. Geneva, Switzerland. Retrieved from: https://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx.

ITU (International Telecommunications Union). 2020. World Telecommunication/ICT Indicators Database. 24th Edition. Geneva, Switzerland.

Jooste, R. https://www.dailymaverick.co.za/article/2019-10-28-new-digital-tax-africa-must-be-at-the-table-or-it-may-find-itself-on-the-menu/. October 28, 2019.

Korovkin, V. 2019. National digital economy strategies: A survey of Africa. ORF Issue Brief No 303. July 2019.

Manyika, J. et. al. 2013. Lions go digital: The internet's transformative potential in Africa. McKinsey Global Institute. Shanghai. London. San Franciso. https://www.mckinsey.com/~/media/McKinsey/Industries/Technology%20Media%20and%20Telecommunications/High%20Tech/Our%20Insights/Lions%20go%20digital%20The%20Internets%20transformative%20potential%20in%20Africa/MGI_Lions_go_digital_Full_report_Nov2013.ashx.

Pauwels, E. "The New Geopolitics of Converging Risks: The UN and Prevention in the Era of AI", United Nations University Centre for Policy Research, 29 April 2019.

Pilling, D. 2019. The Fight to Control Africa's Digital Revolution. Financial Times. Retrieved from https://www.ft.com/content/24b8b7b2-9272-11e9-aea1-2b1d33ac3271.

Ramachandran, V., J. Obado-Joel, R Fatai, J Sadiq Masood, and B. Omakwu. 2019. "The New Economy of Africa: Opportunities for Nigeria's Emerging Technology Sector." Washington, DC: Center for Global Development. https://www.cgdev.org/sites/default/files/new-economy-africa-opportunities-nigerias-emerging-technology-sector.pdf.

Rantanen, M., J. Koskinen, and S. Hyrynsalmi. 2019. E-Government Ecosystem: A new view to explain complex phenomenon. 10.23919/MIPRO.2019.8756909.

Republic of Kenya. 2019. Digital Economy Blueprint. Powering Kenya's Transformation. Nairobi.

Shah, Parmesh. 2019. Spore Magazine. https://spore.cta.int/en/spore-exclusive/article/building-an-alliance-for-disruptive-agri-tech-sid0341a5a73-cf3f-473e-94cc-f06a1590710b. October 1, 2019.

Signe, L., and K. Signe. 2018. Africa in Focus. "Cybersecurity in Africa: Securing businesses with a local approach with global standards." Washington, DC: Brookings Institution. https://www.brookings.edu/blog/africa-in-focus/2018/06/04/cybersecurity-in-africa-securing-businesses-with-a-local-approach-with-global-standards/.

UN Digital Cooperation Panel. 2019. The Age of Digital Interdependence. Report of UN Secretary-General's High-Level Panel on Digital Cooperation. New York: United Nations. Retrieved from https://digitalcooperation.org/.

UN IATT (Inter-Agency Task Team on Science, Technology and Innovation for the SDGs), 2019. A Guidebook for the Preparation of STI for SDG Roadmaps. Unpublished Manuscript. Washington DC and New York.

UNCTAD. 2019. Economic Development in Africa Report 2019. Made in Africa—Rules of Origin for Enhanced Intra-African Trade. Geneva: United Nations.

UNDESA (Department of Economic and Social Affairs). 2019. UN E-Government Survey. New York: United Nations.

World Bank. 2018. Innovative Business Models for Expanding Fiber-Optic Networks and Closing the Access Gaps. Washington DC: World Bank.

———. 2019. The Future of Work in Africa. Harnessing the Potential of Digital Technologies for All. Washington DC: World Bank.

World Economic Forum. 2018. "Global R&D spending is now dominated by two countries." Geneva, Switzerland.

World Bank and Dalberg Advisors. August 2019. Scaling up disruptive agricultural technologies in Africa. Executive summary. Washington DC: World Bank. Retrieved from https://olc.worldbank.org/system/files/59440_ASA%20Exec%20Summ_bleeds-crops.pdf.

World Economic Forum and International Trade Centre. Africa E-Commerce Agenda: Roadmap for Action. Geneva, Switzerland.

Yusuf, M. 2019. https://spore.cta.int/en/spore-exclusive/article/building-an-alliance-for-disruptive-agri-tech-sid0341a5a73-cf3f-473e-94cc-f06a1590710b. 1 September 2019.

End notes

94 Manyika 2013.

95 Broadband Commission 2019.

96 A4AI 2019.

97 GSM Association 2020.

98 ITU 2019.

99 World Bank 2018.

100 A4AI and Xalam Analytics 2018.

101 UNESCO Broadband Commission for Sustainable Development. Connecting Africa Through Broadband, International Telecommunications Union, Geneva (2019).

102 World Bank 2018.

103 GSMA 2019.

104 https://www.socialnetlink.org/2019/04/itw-kinshasa-digital-week-la-transformation-numerique-en-rdc-a-demarre/; https://www.gsma.com/mobilefordevelopment/blog/618-active-tech-hubs-the-backbone-of-africas-tech-ecosystem/.

105 https://reliefweb.int/report/somalia/mogadishu-tech-summit-closes-attendance-thousands-and-millions-dollars-pledged.

106 Afrilab has built an alliance with 150 members across 45 countries, with similar regional initiatives under way led by Nigeria and Kenya.

107 Kenya: World Bank Approves $50 Million to Boost Kenya's Small and Medium Enterprises, June 15, 2018, https://www.worldbank.org/en/news/press-release/2018/06/15/kenya-world-bank-approves-50-million-to-boost-kenyas-small-and-medium-enterprises.

108 Boston Consulting Group 2018.

109 Examples include factory expansions for cement (Dagote), building materials and housing (Addoha), and consumer goods (Samsung). China's Tecno has opened two digital equipment plants in Ethiopia.

110 CIO East Africa. October 17, 2018.

https://www.cio.co.ke/unlocking-markets-cross-border-trade-in-africa-using-technology/

111 IMF data. February 14, 2019. https://blogs.imf.org/2019/02/14/fintech-in-sub-saharan-africa-a-potential-game-changer/.

112 WEF and ITC 2019.

113 UN Digital Corporation Panel 2019.

114 Shah 2019.

115 Impact studies report average yield improvements with digital agricultural technologies of 70% for market linkages, 40% for digital financial services, and 20% for advisory services. Based on self-reported data, bundled service models seem to have increased potential, with yield improvements in the range of 50%–300% and income improvements around 20%–100% (Dalberg Advisors 2019).

116 World Bank and Dalberg Advisors 2019.

117 Digital for Agriculture solutions have already registered over 33 million smallholder farmers and pastoralists across the continent. A small minority of agritech firms (about 15, mostly in advisory services) have begun to reach 1 million registered farmers each. However, it is estimated that only 15%–30% of users are highly active.

118 http://www.kuza.one/. Illustration of community level advisory services. Smallholder farmers receive customized agribusiness mentorship and access to inputs, credit, markets, and technologies.

119 Dalberg Advisors 2019.

120 https://medium.com/@KuzaSocial/agricultural-innovations-on-the-horizon-a91da25176ed.

121 See also AGRA (2019).

122 Hanna 2016.

123 According to the 2018 UN E-Government Readiness Survey, only four African countries (Mauritius, South Africa, Tunisia, and Seychelles) are ranked in the top 100 (UNDESA 2019).

124 Rantanen, Koskinen, and Hyrynsalmi 2019.

125 UNDESA 2019.

126 According to UNDESA (2019), Cape Town is ranked second, ahead of London and Paris, as the top city for e-government services.

127 Gelb and Metz 2018; Gebre 2019.

128 AUC 2015

129 AUC 2016.

130 AUC 2019.

131 Republic of Kenya 2019.

132 Korovkin 2019.

133 UN IATT 2019a.

134 Government of South Africa 2019.

135 "Presumptive laissez-faire is not an argument that laissez-faire is optimal but an argument that state capacity is a limited resource that must be allocated wisely. This suggests that states with limited capacity should rely more on markets even when markets are imperfect. For states with limited government capacity, presumptive laissez-faire is also the optimal learning environment for states to grow capacity" (Alex Tabarrok, 23 September 2019) https://marginalrevolution.com/marginalrevolution/2019/09/premature-imitation-and-indias-flailing-state.html.

136 AU–EU DETF 2019.

137 Yusuf 2019.

138 https://www.forbes.com/sites/taxnotes/2019/11/11/interview-taxing-the-digital-economy-and-developing-countries/#4dfe311c406a.

139 Jooste 2019.

140 "Although Africa is relatively limited in terms of communications infrastructure, due to the high penetration rate of new technologies, it is increasingly a target for cybercriminals, as most African countries still have a low level of commitment to cybersecurity" (Signe and Signe 2018) https://www.brookings.edu/blog/africa-in-focus/2018/05/30/global-cybercrimes-and-weak-cybersecurity-threaten-businesses-in-africa/.

141 "Capacities in AI and biotech will allow tech-dominant countries to quietly capture the value of another country's bio-economy—its genomes, micro-biomes and ecosystems—for their own economic growth. Inequality between countries that are tech-leaders and those that are tech-takers will rise if this new 'cyber-colonization' happens without transfer of skills and financial benefit-sharing" (Pauwels 2019, p. 22).

142 Kenya, which has a vibrant social media landscape with a wide range of viewpoints represented, has seen a spike in semi-organized "bloggers for hire," who use their influence on platforms such as Twitter and Facebook "to shape public opinion and manipulate the online information landscape" (Freedom House 2018, p. 2).

143 Pilling 2019a.

144 https://qz.com/africa/1746202/kenya-has-passed-new-data-protection-laws-in-compliance-with-gdpr/.

145 The success of the AfCFTA also hinges on policies that address e-transactions and consumer protection, content restrictions and censorship laws, intellectual property protection, intermediary liability, and competition.

146 Daniels, Mawoko, and Konte 2018.

147 UNCTAD 2019.

148 A4AI and Xalam Analytics 2018.

149 World Bank 2019.

150 DE4A and PASET 2019.

151 Shah 2019.

152 African Union 2020. The Digital Transformation Strategy for Africa (2020–2030). Au.int. Addis Ababa. The

153 IMEC–SMIT–VUB. N.d. Innovation ecosystems in Europe. First outline of an innovation ecosystem index. Study conducted on behalf of the Digital Transition Partnership, by Marlen Komorowskip. Etterbeek, Belgium.

154 World Economic Forum 2018.

03

Managing climate risks

Many African countries, already experiencing climate-related stresses such as droughts, floods, and variable rainfall, are highly vulnerable to the impacts of climate change due to their low adaptive capacity. But by applying technological innovations to manage key climate-sensitive sectors such as agriculture, ecosystems, and energy for sustainable and inclusive growth, countries may be able to turn risks into opportunities.

Most African economies depend on rainfed agriculture and so are easily affected by agroclimatic conditions. Africa's green and blue ecosystems, which provide a number vital life support and livelihood services, will be negatively affected by climate and land use changes. Africa's energy sector is particularly vulnerable to climate change because of an overdependence on traditional biomass fuels (firewood and charcoal) for household thermal energy. Apart from causing thousands of deaths annually as a result of indoor pollution, burning biomass is also a major contributor to deforestation and increased carbon emissions on the continent.

Although climate change will have wide-ranging impacts on Africa, this chapter focuses on three key climate-sensitive areas—agriculture, ecosystems and energy—for two reasons. First, they are areas where urgent action is required to avert catastrophic environmental damage in the future. Second, addressing these issues in the next few years offers opportunities to accelerate Africa's economic transformation and achievement of the Sustainable Development Goals (SDGs).

Africa's leaders can leverage climate-smart agriculture to increase agricultural productivity and build farmers' resilience. They can also adopt innovative natural resource management practices to improve ecosystem resilience and promote inclusive growth. And they can harness Africa's considerable renewable energy resources to speed economic transformation while mitigating carbon emissions.

To leverage climate-smart agriculture, countries should build the capacity of national agricultural research systems and promote collaboration among national research systems to share knowledge and experiences on technologies. To manage Africa's ecosystems countries should implement innovative natural resource management practices such as nature-based solutions. And to harness renewable energy technologies, countries should attract domestic and foreign investment by developing stable regulatory and policy environments, establishing competitive pricing to promote mini-grid solutions and standalone systems.

By applying technological innovations to manage key climate sensitive sectors such as agriculture, ecosystems, and energy for sustainable and inclusive growth, countries may be able to turn risks into opportunities.

Climate change will affect both the availability and the quality of water. The impacts will be amplified by such drivers and stressors as population growth, urbanization, and land use changes.

Surveying the risks of climate change

Climate change is occurring faster than anticipated.[155] The average global temperature had already risen by 1°C above preindustrial levels by 2017, due to human-caused greenhouse gas emissions. Temperatures are heading toward a catastrophic 3°C rise in this century. The seemingly small 1°C increase increased the frequency and severity of extreme events, ranging from floods and droughts to heat waves, bush fires, and cyclones. The average global land and ocean surface temperature for October 2019 was 0.98°C above the 1980–2010 average. The 10 warmest Octobers on record have occurred since 2003, and the top five warmest months, since 2015. At a temperature rise of around 2°C above preindustrial levels, the planet could approach the threshold of an irreversible drift toward much hotter conditions—toward a Hothouse Earth that could not be substantially slowed or even steered.[156]

2020 continued a long series of record-breaking years, pointing to the unabated continuation of global warming. The world's oceans reached their hottest level in recorded history, contributing to extreme weather impacts. For example, there were a record 29 tropical storms in the Atlantic in 2020. Surface temperatures also rose in 2020 to the highest on record since modern temperature data collection began in 1880, with an average global air temperature that was 1.25°C higher than the preindustrial period.[157,158]

Climate change will affect both the availability and the quality of water. The impacts will be amplified by such drivers and stressors as population growth, urbanization, and land use changes. But the scale of the impact will vary considerably. Changes in water resources will be more important in water-stressed areas that are projected to become drier, including North Africa and parts of Southern Africa. In East Africa, reduced flows are projected for the Blue Nile due to a combination of climate change (higher temperatures and declining precipitation) and upstream water development for irrigation and hydropower.[159] In Southern Africa, all countries within the Zambezi River basin could experience increasing water shortages; the Okavango Delta also faces water shortages.

Agriculture under threat

Agriculture continues to be the foundation of African economies, underpinning the livelihoods of 7 in 10 Africans. It accounts for about a quarter of the gross domestic product (GDP) of African economies on average, and in some cases as much as 50%.[160] It relies almost completely on rainfall (96%) rather than irrigation, so it is at the whim of agroclimatic conditions.[161] Without adaptive measures, climate change will substantially reduce agricultural output, jeopardize food security, and slow poverty reduction. But technological innovations already available, such as climate-smart agriculture, can boost productivity, improve food security, build resilience to climate change, and mitigate greenhouse gas emissions.

Because agriculture is the most climate-sensitive sector, it will bear the brunt of the impacts of climate change. Rising temperatures reduce the water available for crops and livestock, make conditions more hospitable for parasites and diseases infecting both livestock and crops, and reduce labor productivity.[162] With no countering measures or policies, crop yields in Africa are projected to decline by 10%–20% by 2050 due to climate change, with wide regional variation.[163] Maize-based systems, particularly in Southern Africa, are among the most vulnerable.[164] Estimated yield losses at mid-century range from 18% for Southern Africa[165] to 22% across Sub-Saharan Africa, with yield losses for South Africa and Zimbabwe above 30%.[166] While higher carbon dioxide concentrations could benefit plant growth through carbon dioxide fertilization, that effect is uncertain and could be offset by the negative effects from increased ground-level ozone and reductions in the nutritional quality of many crops.[167]

Given the high dependence of African economies on agriculture, climate change will slow economic growth and economic transformation. By the 2050s, climate-induced productivity losses in agriculture alone could reduce GDP growth by 2 percentage points a year in Southern Africa and the rest of Sub-Saharan Africa.[168] Climate change is expected to lead to higher food prices, in turn reducing the food production and incomes of smallholder farmers and food's access and availability.[169]

With food insecurity worsening because of climate change, both the percentage and the number of people at risk of hunger will rise during the coming century. A disproportionate share of those affected will be women and children.[170] In October 2019, the UN food agencies reported that about 45 million people across the 16-nation Southern African Development Community would be severely food insecure in the next six months, following abnormally low rainfall in four of the previous five growing seasons.[171] Persistent drought, back-to-back cyclones, and flooding wreaked havoc on harvests.

Although agriculture is negatively affected by climate change, agriculture and changes in land use are major contributors to greenhouse gas emissions. Africa contributes about 15% of global agricultural greenhouse gas emissions, compared with 13% for Europe and 25% for the Americas.[172] Although Africa's total annual per capita greenhouse gas emissions remain the world's lowest—3.9 metric tons of carbon dioxide equivalent—its emissions growth will be rapid when nonagricultural land uses are also included. For example, between 2000 and 2010, agricultural expansion, primarily of smallholder farms, accounted for about 70% of the forest loss in Africa.[173]

Despite high returns for African agricultural investments,[174] countries have underinvested. Public spending on agriculture in Africa has lagged behind that of other developing regions. In the 2014 Malabo Declaration, African leaders reaffirmed their commitment to earmark at least 10% of their annual budgets to agriculture. To date, only a handful of countries have kept that promise, resulting in weak national agricultural research systems.

Climate and land use changes threaten Africa's ecosystems, with adverse implications for the benefits they provide, including the oxygen they supply, the climate they regulate, and the flood protection they provide.

Ecosystems under threat

Climate change, already damaging terrestrial ecosystems, has considerably reduced biodiversity, constraining the livelihoods of forest-dependent communities.[175] Ocean acidification and warming are damaging ocean ecosystems, particularly coral reefs. Other climate-related stresses affecting coastal systems include flooded river deltas and increasing human migration from the interior to coastal cities due to the increased frequency of drought.[176]

Climate and land use changes threaten Africa's ecosystems, with adverse implications for the benefits they provide, including the oxygen they supply, the climate they regulate, and the flood protection they provide. Three primary trends in Africa's terrestrial ecosystems have been observed.[177] The desert area has expanded, and the vegetation area has contracted.[178] Natural vegetation has shrunk.[179] And woody vegetation has decreased in West Africa[180] and increased in Central, East, and Southern Africa.[181] The primary driver has been human changes in land use, particularly the expansion of agriculture, livestock grazing, and fuelwood harvesting.

The continuing changes in precipitation, temperature, and carbon dioxide associated with climate change are very likely to drive major changes in terrestrial ecosystems throughout Africa. Africa's freshwater ecosystems are also at risk from land use changes, overextractions of water, diversions from rivers and lakes, and increased pollution and sedimentation in water bodies.[182] And elevated water temperatures are reported in the surface waters of lakes Kariba, Kivu, Malawi, Tanganyika, and Victoria.[183]

Coastal and ocean systems, which contribute to the economies and livelihoods of coastal communities, are also under pressure from pollution, migration, salinization, coastal erosion, habitat degradation, biodiversity loss of, and resource overexploitation.[184] Climate change will harm coastal systems through sea level rise, combined with storm swells generated by cyclones. Extreme events that used to hit coastal areas once a century will strike every year on many coasts by 2050.[185] Coastal systems will also be affected by flooding river deltas.[186]

Rising levels of carbon dioxide in the atmosphere are increasing the acidity of seawater. Ocean acidification, combined with higher temperatures, is projected to lower coral reef productivity and resilience,[187] which will reduce reef biodiversity, ecology, and ecosystem benefits. The changes will also harm coastal fisheries, leading to the loss of livelihoods.

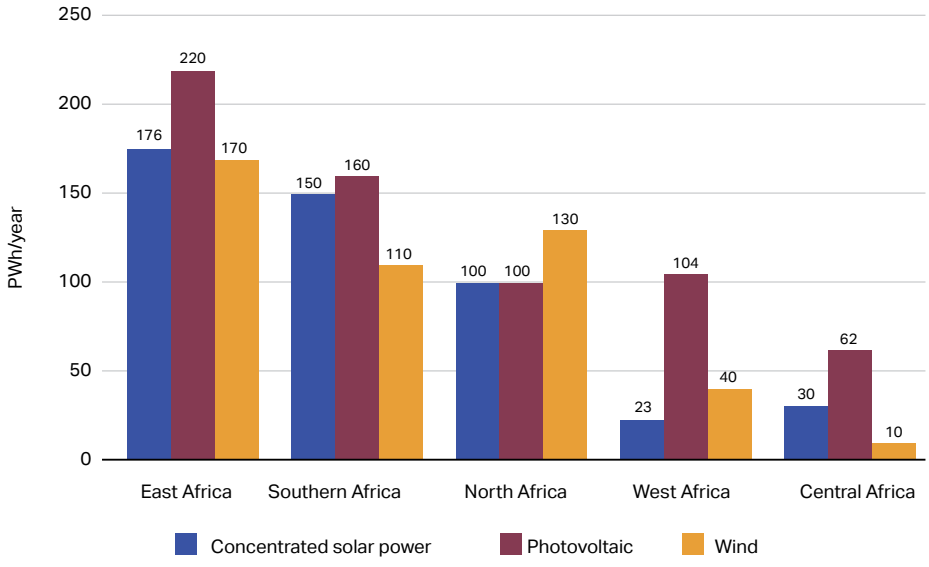
Potential for renewable energy

Africa's energy sector is particularly vulnerable to climate change because of an overdependence on traditional biomass fuels (firewood and charcoal) for household thermal energy. Nearly 80% of Sub-Saharan Africans rely on biomass for their household needs, including cooking.[188] About 600,000 people in the region die each year from the adverse health impacts of household air pollution, nearly half of them children under age five.[189] The use of traditional biomass also drives deforestation. But the climate threat can turn into an opportunity if Africa's considerable renewable energy resources can be tapped to power economic transformation and mitigate carbon emissions.

Sub-Saharan Africa has the lowest electricity coverage in the world at just 42%, about half the global access rate of 87%. Fourteen countries have electricity access rates of 20% or less, and as many as 600 million people have no access.[190] Access to modern cooking facilities, crucial for reducing the high death toll from household air pollution, is even more restricted than access to electricity. Around 846 million people in Africa lack access to clean cooking facilities, and 783 million people rely on biomass for cooking.[191]

Africa has abundant renewable energy resources in concentrated solar power (CSP) and photovoltaics (PV), wind, hydroelectric, geothermal, and bioenergy. According to the International Renewable Energy Agency, Africa's total energy potential for CSP, PV, and wind energy is about 1,585 petawatt hours (PWh) per year, broken down as follows: CSP, 479 PWh; PV, 640 PWh; and wind, 460 PWh (figure 3.1). For both CSP and PV, East Africa has the highest potential (176 PWh for CSP and 220 PWh for PV), followed by Southern Africa (150 PWh for CSP and 160 PWh for PV). North Africa has potential of about 100 PWh for both CSP and PV. West Africa is endowed with good PV potential (104 PWh) but limited CSP potential (23 PWh) because of less direct irradiation and higher "solar fluctuations."[192] Central Africa has relatively low potential for either CSP or PV compared with the other regions.

FIGURE 3.1 AFRICA HAS GOOD POTENTIAL FOR RENEWABLE ENERGY



Source: International Renewable Energy Association 2014.

The lack of modern energy has severely constrained Africa's socioeconomic development. Energy access affects poverty and other aspects of human development, such as health and education.[193] Indeed, universal access to clean cooking facilities could prevent around 300,000 children from dying each year from acute respiratory tract infections.[194] Reliable access to energy would accelerate progress in child health. Around 60% of refrigerators used to store vaccines in Africa lack access to reliable energy supplies, resulting in high levels of waste and increased delivery costs.[195] Developments in solar refrigerators will enable more children to be vaccinated and save lives. Improved access to modern energy can increase school attendance and lower dropout risk, particularly for girls, who could spend less time collecting firewood.

Providing basic lighting through low-cost renewable energy technologies could generate energy savings of 80%–90%. Clean cooking stoves could save $5 billion for poor people living on less than $2.50 a day. Reducing energy costs could lift 16–26 million people out of poverty.[196] And replacing household biomass sources (firewood and charcoal) with modern energy sources (solar and gas) would reduce deforestation, land degradation, and ecosystem damage. Using biomass to meet household energy demand in Sub-Saharan Africa consumes more than 300 million metric tons of wood annually.[197] Cutting biomass use by half would save 60–190 million metric tons of carbon dioxide equivalent emissions.

Given Africa's very low contribution of 2–3% of global CO_2 emissions, it would be inequitable to insist on tight emission constraints, even more so when more than half the population in Sub-Saharan Africa lacks access to electricity. Although this Report focuses on climate risk rather than energy, note that Africa can address its energy constraints in the short to medium term by exploiting its natural gas resources until a time when renewables can plug the energy gap at competitive prices.

Broad policy agenda to manage climate risks

African countries need to respond to climate change with policy actions on several fronts—agriculture, ecosystems, and energy—to address the threats of climate change to Africa's economic transformation. Africa's leaders can leverage climate-smart agriculture to increase agricultural productivity and build farmers' resilience They can adopt innovative natural resource management practices to improve ecosystem resilience and promote inclusive growth. And they can harness Africa's considerable renewable energy resources to speed economic transformation while mitigating carbon emissions.

These three fronts are consistent with the positions of the Pan-African Negotiations Group in the Conference of Parties negotiations under the UN Framework Convention on Climate Change: to increase food security and protect food systems, to protect ecosystems, and to scale up renewable energy solutions (box 3.1). The Group's fourth position is to design large infrastructure projects to withstand the impacts of climate change.

Box 3.1 African positions in global climate negotiations

Africa's negotiating positions at the Conference of Parties (COP) to the United Nations Framework Convention on Climate Change are articulated by the African Group of Negotiators with guidance and inputs from the African Union Assembly, the Committee of African Heads of State on Climate Change, and the African Ministerial Conference on the Environment and Natural Resources. Africa's goal in the climate negotiations is to achieve sustainable climate-resilient economic growth.

The African Group, established at the Berlin COP in 1995, enables Africa to speak with one voice in the global climate change negotiations. In the early years, the Group faced challenges of inadequate resources, limited access to high-quality information and weak negotiating skills. But in recent years, with support from the UN Economic Commission for Africa, New Partnership for Africa's Development, and African Development Bank, as well as multilateral and bilateral donors, the Group has participated more actively and had a greater impact on outcomes.

For instance, the Group was instrumental in getting the COP to accept Africa's position that adaptation should be a priority over mitigation given the severe harm it will face and its negligible carbon footprint in relation to the rest of the world. At COP15 in Copenhagen, the Group influenced the wording of the final accord that pledged additional climate finance of $30 billion for developing countries by 2020. It also played a key role in shaping the negotiations that led to the transition from REDD (Reducing Emissions from Deforestation and Forest Degradation) to REDD+, which goes beyond simply deforestation and forest degradation to include incentive payments for conservation, sustainable forest management and enhancement of carbon sinks. It now covers blue carbon projects that provide results-based payments to coastal communities to conserve mangroves.

Leveraging climate-smart agriculture

Climate-smart agriculture[198] is an approach to farming that targets three goals simultaneously, what the Food and Agriculture Organization calls a "triple win:"[199]

- Sustainably increasing agricultural productivity and incomes.
- Adapting and building resilience to climate change.
- Reducing greenhouse gas emissions.

Climate-smart agriculture builds on the earlier model of sustainable intensification, introduced to address the shortage of arable land, by increasing agricultural yields without harming the environment or converting additional nonagricultural land to farming. It leverages technological innovations to increase farm productivity and profitability. Examples include the use of new crop varieties that tolerate heat and soil salinity and resist floods and drought. It promotes management techniques such as conservation agriculture, crop diversification, and integrated pest management that improve soil and water quality. Innovations such as precision agriculture

To adopt and benefit from climate-smart agriculture, smallholder farmers need information on weather, markets, and best bet climate-smart agricultural practices backed by technical know-how.

and push–pull technology help optimize the use of farm inputs, improving farm productivity and lowering costs. For example, in Pune, India, the Nano Ganesh irrigation system uses digital applications to allow remote control of irrigation pumps by mobile phone, saving farmers time, water, and energy.[200] In Peru, the use of text messaging to send market price information on local crops increased farmers' sales by 13%–14% over farmers without such information.[201]

Climate-smart agriculture also boosts farm income through upstream and downstream measures. By reducing postharvest losses, it raises farm income, increases food and raw material supply, and reduces the pressure to increase production by bringing additional land into production or using chemical fertilizer to increase yields. Another innovation is the use of e-Extension services, which provide cost-effective contact with more farmers and thus help to increase their profits. In South Asia, Latin America, and parts of Sub-Saharan Africa, Digital Green has produced and disseminated more than 5,000 locally relevant videos in more than 50 local languages, enabling farmers to share knowledge on agricultural production practices.[202]

Diversity among farming communities raises the costs of experimentation and adaptation to identify the practices that suit a given farm type and generate the triple win. Socioeconomic and biophysical diversity are common in many parts of Africa, even at the district level, with gender a main dimension. The gender gap in technologies, key resources, and access to formal and informal institutions reduce the adoption and impact of climate-smart agriculture. In contrast, deploying modern information and communication technology could increase the adoption of climate-smart agriculture.

To adopt and benefit from climate-smart agriculture, smallholder farmers need information on weather, markets, and best-bet climate-smart agricultural practices backed by technical know-how. Despite some improvements, smallholder farmers still find it difficult to gather timely, localized, and usable climate information. To get the triple win, they need to deploy an optimal mix of agricultural practices appropriate for their socioeconomic and agroecological contexts. Climate-smart agriculture is a knowledge-intensive practice, but public extension systems in Sub-Saharan Africa have too few resources to serve highly scattered and heterogeneous smallholder farmers who have little formal education.

The African Continental Free Trade Area (AfCFTA) could help in adapting climate-smart agriculture to different agro-ecologies. Tailoring climate-smart agriculture to each of Africa's multitude of agro-ecologies might not be economically viable. But because countries in the region share several common agro-ecologies, the AfCFTA enables them to act collectively to achieve scale in their investments in research and development on climate-smart agricultural practices. It could also spread climate-smart agriculture by improving farmers' access to bigger input and output markets and by raising the returns to farming.

Many climate-smart agriculture interventions require upfront infrastructure or technical investments, such as fencing material and irrigation equipment. But commercial banks are generally unwilling to lend to smallholders, who generally lack acceptable collateral, and

insurance for smallholder farmers is virtually nonexistent. So, smallholder farmers have been reluctant to adopt improved technologies that are perceived as risky.[203] The near-absence of viable insurance products entrenches risk-induced poverty as smallholder farmers choose low-risk and low-productivity technologies, which further reduce their access to credit.

Across Africa, the supply of credit for smallholder agriculture falls far short of demand. The main challenge for commercial banks has been the high transaction cost of financing smallholder farmers by mobilizing savings from numerous microinvestors. With recent financial innovations such as crowdfunding, mobile-based finance, and internet and mobile technology, funds could be mobilized from a wider creditor base. And financial services could be provided at cheaper prices to the large numbers of geographically dispersed smallholder farmers. A good example is M-Pesa, the Kenyan mobile phone-based money transfer, financing, and microfinancing service used by 96% of Kenyans.[204]

Recent advances in remote sensing and data analysis are enabling the design of viable insurance products for smallholder farmers, supporting the diffusion of new technologies perceived as risky. Insurance products have recently been developed that are based on an index that is closely related to agricultural loss, such as rainfall or vegetation. By avoiding the need for field visits after weather disasters, these products reduce the transaction cost of providing insurance services. And constraints on adoption by smallholder farmers can be overcome by revising contract designs, using advanced technology for better measurement (such as satellite imagery and data analysis), improving marketing, and providing better policy support.[205]

Disruptive agricultural technologies (also known as digital agricultural solutions) can boost climate-smart agriculture by providing real-time market and climate data, including cost-effective agricultural advisory services for smallholder farmers.[206] Digital solutions can facilitate how farmers and other agricultural value chain actors access finance, pay for goods and services, connect and transact business as buyers and sellers, manage operations and logistics, and make decisions about the future (box 3.2). Digital solutions can also be deployed for early detection of diseases and insect pests.

The African Continental Free Trade Area (AfCFTA) could help in adapting climate-smart agriculture to different agro-ecologies.

Box 3.2 Disruptive agricultural technologies in Ghana

Ghana has 1.6 million users of disruptive agricultural technology (DAT) solutions, 30% of them women. DATs involve the use of digital technologies, innovations, and data to transform business models and practices across the agricultural value chain and address bottlenecks in productivity, postharvest handling, market access, finance, and supply chain management. The goal is to achieve greater income for smallholder farmers, improve food and nutrition security, build climate resilience, and expand inclusion of youth and women.

The most common uses of DAT solutions are data services, market links, advisory services, and supply chain management. As regulatory reforms in 2013–15 expanded the use of mobile money, people began to use other digital products as well. For real impact, however, products need to reach the large underserved populations who live mostly in rural areas. The illiteracy of many farmers impedes the diffusion of DATs. Providers are trying to address this challenge by offering interactive voice response services in local languages.

Ghana's experience with DATs offers three important lessons. First, mobile money is key to DAT services because it helps farmers and the broader population understand and trust digital products and services. Second, DATs can increase farmers' access to credit—for example, by digitizing their land titles for use as collateral. Third, many parts of the country (especially rural areas) remain too unproductive for DAT providers to enter, due mainly to the poor transportation infrastructure and lack of basic services. Massive public and private investments are needed to create an environment that would allow DATs to thrive.

Source: CTA and Dalberg Advisors 2019. According to the *Digitalisation of African Agriculture Report 2018–19.*

Carbon markets and impact investing also present opportunities to accelerate the diffusion of climate-smart agriculture. Carbon markets, introduced through the Kyoto Protocol, allow participants in cap-and-trade schemes to trade emissions for credits that pay for reductions in greenhouse gas emissions or offset emissions.[207] Such markets manage climate change more efficiently than taxes and subsidies. A company in Europe can buy carbon credits from African smallholder farmers practicing climate-smart agriculture if buying the credits is cheaper than reducing its own carbon emissions. Access to carbon market finance could further encourage smallholder farmers to take on climate-smart agriculture.

Impact investing—a business approach for meeting social and environmental objectives—could also promote climate-smart agriculture.[208] In recent years, nongovernmental organizations, funded by a growing number of philanthropists, have emerged as key players addressing societal problems beyond the reach of government or the private sector. Since climate mitigation is a public good, it offers impact investors an opportunity to support the adoption of climate-smart agriculture with philanthropic funds.

The sharing economy, enabled by technology, can also relieve capital constraints and resolve scale issues. Africa's agriculture is perhaps the world's least mechanized, with smallholder farmers depending largely on animal and human power for plowing and harvesting. Access to shared tractor services, by reducing the dependence on animals, could lessen the overstocking of animals, one of the main drivers of climate change and environmental degradation. It could also ease the rising rural labor shortages driven mainly by rural–urban migration. Hello Tractor, a Nigeria-based startup, has provided mechanization services to smallholder farmers in Nigeria since 2015 and is expanding to other African countries (box 3.3).

Box 3.3 Hello Tractor provides shared mechanization services

Hello Tractor, an agritech company, connects tractor owners and smallholder farmers through a farm equipment sharing application. Founded in 2014 in Abuja, Nigeria, it is now active in Kenya, Mozambique, Senegal, and Tanzania as well. Farmers can request tractor services through an app or through a booking agent. The tractor owner matches the request with an available tractor. The farmer pays a commitment fee and receives confirmation. The tractor service on the farm can be monitored in real time on the web or through the app. On completion, the farmer makes final payment using a platform such as M-Pesa and receives a receipt. Hello Tractor reduces risk, improves service delivery, benefits the tractor owner and the tractor service user, and gives smallholder farmers access to shared mechanization services.

In 2018, Hello Tractor joined a public–private partnership to expand services in Nigeria. Under the agreement, John Deere, in partnership with the Nigerian government, will deploy 10,000 tractors over five years, with Hello Tractor as the implementing partner. The project includes a pay-as-you-go model that allows tractors to be leased to new owners for a defined time and then sold to them at a discount. The tractors will bring an estimated 9 million hectares of land into production, producing 37 million metric tons of additional food and creating more than 2 million direct and indirect jobs.

Source: Hello Tractor 2019.

To promote the diffusion of climate-smart agriculture, governments need to strengthen research and extension systems, build infrastructure and ecosystems, address gender disparities, and encourage the formation of farmers' production and marketing groups to achieve scale and reduce transaction costs.

Governments should also build the requisite infrastructure and ecosystems to support technology and new business models, making the business case for investing in climate-smart agriculture even more persuasive. The institutional, policy, and legal frameworks need overhauling to keep pace with recent developments. And governments should partner with the private sector in different parts of the value chain—production, postharvest handling, processing, and marketing—where the business case for climate-smart agriculture practices might initially be weak but where there is potential to create farm-level incentives. Such partnerships could also be leveraged to create job opportunities for youth while building resilient and green economies.

Governments need to address supply-side and demand-side barriers to digital technology access. Measures to ease supply-side barriers include improving the low rural network coverage and increasing farmers' access to digital applications. The demand-side measures include improving farmers' skills and knowledge. For farmers to adopt a technological innovation, they need to know about it, believe that it can help them, and learn how to use it. Because farmers also have to believe that they can afford the innovation, measures are needed to make climate-smart agriculture technologies more affordable.

Governments should also take measures to end the gender disparity in agriculture, since women constitute a major portion of the African farming community. Yet, female-managed plots are less likely than male-managed plots to adopt improved agricultural practices, mainly because female farmers have limited access to resources, technology, and institutions. Addressing these gaps should expand the adoption of climate-smart agriculture practices and increase the returns.

Finally, governments should facilitate the formation of farmers' production and marketing groups to achieve scale and reduce transaction costs in both production and marketing. Due to land fragmentation and land tenure obstacles, African farmers struggle to achieve scale, leading to high transaction costs. Bringing farmers together in cluster farming and marketing could lower transaction costs and encourage participation in input and output markets. It would also help farmers connect with the global community and benefit from finance for climate change adaptation and mitigation, thereby stimulating the diffusion of climate-smart agriculture diffusion.

To promote the diffusion of climate-smart agriculture, governments need to strengthen research and extension systems, build infrastructure and ecosystems, address gender disparities, and encourage the formation of farmers' production and marketing groups to achieve scale and reduce transaction costs.

Managing Africa's ecosystems

Innovative natural resource management practices can improve the resilience of Africa's vulnerable ecosystems while contributing to economic transformation.

Nature-based solutions

Nature-based solutions combine natural alternatives with technology-based infrastructure to solve land use problems. For example, catchment engineering can reduce flood risk by attenuating runoff within a catchment, providing other benefits such as reducing pollution caused by substances that are not easily traced to a single source.[209]

Nature-based solutions can integrate government regulations and customary laws in the sustainable management of natural resources. They can also provide incentives for public–private partnerships and local communities to address societal challenges of climate change, deforestation, and ecosystem degradation.

In the Ruvu watershed of eastern Tanzania, sediment loading in the Ruvu River had severely degraded hydrological services, reducing water quality and storage capacity. The solution involved payments for ecosystem services that engaged downstream buyers (industry, sewerage plants) and upstream farmers.[210] The farmers received payments for intercropping with tree crops, reforestation and planting grass strips to control runoff and soil erosion while improving crop production. Stakeholders from different disciplines participated fully, from project design through implementation. It rewarded farmers through payments and ensured achievement of the objective of controlling runoff and erosion. And its social and ecological objectives reinforced one another.[211]

Another nature-based solution addressed food security and environmental degradation in the Kagera River basin shared by Burundi, Rwanda, Tanzania, and Uganda. The flow of the Kagera River is important for preserving Lake Victoria's water level and outflow to the Nile River. Its wetland areas play a major role in depositing eroded sediments and nutrients, thereby maintaining water quality. Its diverse ecosystems provide habitats for animal and plant species of high global importance. But the rich biodiverse resources, along with the livelihoods and food security of the people who depend on them, are threatened by deforestation, land degradation, encroachment of agriculture into wetlands, and declining productive capacity of croplands and rangelands. Climate change has made rainfall patterns unreliable and prolonged periods of drought while increasing exposure to extreme temperatures.

An integrated ecosystems approach for land and water resource management was adopted in the basin through a horticulture program promoting cultivation of vegetables that require little space, have a short growth cycle, and are easily marketable. Measures to address climate change effects include mulching and use of organic fertilizer, small-scale irrigation, and high-yielding and drought-tolerant crop varieties.

Forests

Nature-based solutions can integrate government regulations and customary laws in the sustainable management of natural resources.

Since Africa has the world's largest share of forest-dependent subsistence households,[212] and applying nature-based solutions in the forest sector can reduce the high rate of forest depletion while providing sustainable livelihoods for large and rapidly growing populations.[213] The United Nations' Reducing Emissions from Deforestation and Forest Degradation (REDD+) initiative offers good prospects for African countries.[214] REDD+ provides performance-based financial incentives for developing countries to reduce greenhouse gas emissions and address socioeconomic development challenges, such as poverty and poor governance.

But financial transfers through REDD+ to Sub-Saharan Africa have so far been limited, and disbursements are well behind commitments.[215] Participating countries face financing challenges, including the need for financing in advance of performance-based payments.[216] And REDD+ requires a credible system for measuring, reporting, and verifying emissions, but many African countries have been unable to accurately measure and report the carbon sequestered in their forests.

Forest governance and land tenure also face challenges. In general, forest governance in Africa suffers from poor institutional capacity and performance and insecure or weak land and forest tenure by local communities. Less than 2% of Africa's forests are estimated to be legally owned or designated for use by local communities.[217] Land tenure reforms are urgently needed to enable indigenous and local communities to claim property rights in forest land in order to benefit from REDD+ payments.

Coastal and ocean ecosystems

The blue economy includes all activities derived from aquatic and marine spaces—oceans, seas, coasts, lakes, rivers, and underground water. The blue economy underpins such ecosystem services as aquatic resources, coastal systems and marine ecosystems, and commerce and trade around oceans and rivers. Blue economy services include fisheries, aquaculture, tourism, transport, minerals, hydrocarbons, and renewable energy. The oceans and rivers are also a locus of knowledge and a store of cultural and religious values.

Africa's blue economy is extensive. Of the 55 African countries, 39 have coastlines and 16 are landlocked. The maritime zones total about 13 million square kilometers for territorial seas and exclusive economic zones and approximately 6.5 million square kilometers for the continental shelf, where countries have jurisdiction over only the seabed. Lakes in Africa cover about 240,000 square kilometers.[218] More than 12 million people are employed in fisheries alone, the largest blue economy sector, providing food security and nutrition for more than 200 million Africans and generating value added estimated at more than $24 billion, or 1.26% of African GDP.[219] Illegal, unregulated, and unreported fishing from West Africa represents $1.3 billion a year of $10–$23 billion worldwide.[220]

The concept of the blue economy promotes the sustainable use and management of aquatic and marine ecosystems following principles of equity, low carbon development, resource efficiency, and social inclusion. The blue economy is at the center of the African Union's Agenda 2063, which recognizes it as a lever for Africa's structural transformation, integrated development, and regional collaboration and coordination. The United Nations also recognizes the blue economy in the Sustainable Development Goals (SDGs), with SDG 14 calling on countries to "conserve and sustainably use the oceans, seas, and marine resources for sustainable development." Most SDGs are interlinked with the blue economy, with aquatic and marine resources supporting various economic sectors that provide livelihoods and employment opportunities to end poverty—SDG 1.

Prospects for maximizing the benefits of the blue economy could be substantially diminished by climate change, poor waste management, and maritime insecurity. Rising temperatures reduce fish stocks, while rising sea levels harm fish production. Plastic pollution is another major threat to aquatic and marine systems, with increasing volumes of waste dumped in the oceans harming fish production and other marine organisms. And piracy, armed robbery, and illegal, unregulated, and unreported fishing threaten the sustainable use of blue economy resources.

To manage the risks, African countries can:

- Advance toward their nationally determined contributions under the Paris Agreement by using blue carbon markets (the carbon captured by ocean and coastal ecosystems) through the REDD+ initiative to access financing for mitigation measures (box 3.4).[221]
- Increase the blue economy's contribution to their economic transformation through a clear delineation of maritime boundaries and resolution of any maritime boundary disputes.
- Ratify and enforce international and regional instruments related to maritime safety, security, and illegal practices and harmonize national legislation with international laws.
- Foster deeper collaboration by sharing information and best practices on the blue economy through the AfCFTA.

The concept of the blue economy promotes the sustainable use and management of aquatic and marine ecosystems following principles of equity, low carbon development, resource efficiency, and social inclusion.

Box 3.4 Blue carbon projects in Kenya and Madagascar

Kenya's blue carbon project aims to rehabilitate, protect, and sustainably use the mangroves in the southern part of Gazi Bay, generating an estimated 3,000 metric tons of carbon dioxide equivalent credits to be sold on the voluntary carbon market. The project will generate about $12,000 a year for the local community. Coastal communities throughout Kenya are expected to benefit from the sustainable management of mangroves, supported by revenue from carbon credits.

Madagascar's blue carbon project aims to empower coastal communities to equitably participate in a mangrove REDD+ initiative. Since 2013, the project has worked through the widely used Verified Carbon Standard (developed for terrestrial forests) to foster blue carbon projects through mangrove REDD+ in Madagascar and elsewhere.

Opportunities for African countries to unlock the value of coastal carbon and ecosystem services and convert it into improved ecosystem management revenue have been diminished by the failure to fully integrate blue carbon benefits into policy discussions about financial mechanisms for climate mitigation. Blue carbon projects offer good prospects for African countries to implement climate change mitigation strategies while pursuing sustainable and inclusive use of their coastal and marine resources. Seizing these opportunities requires recognizing the importance of blue forests and blue carbon to climate change adaptation and then mobilizing African governments and development partners to act.

Source: UN Economic Commission for Africa 2016b.

Harnessing renewable energy technologies

To attract the investment required to exploit Africa's renewable energy resources, African governments should develop a stable regulatory and policy environment, establish competitive pricing to promote mini-grid solutions and standalone systems, adopt other measures to attract domestic and foreign investors and deepen regional collaboration.

Although prices of renewable energy technologies continue to fall, high setup costs discourage adoption by businesses and households. Local commercial banks and financial intermediaries generally lack expertise in appraising renewable energy projects, limiting their support. Even businesses and households with access to credit face high interest rates. The steep upfront costs of renewable energy technologies make incentives for adoption necessary, such as tax rebates and import duty reductions. Incentive schemes are particularly important to enhance the competitiveness of home-grown renewable energy enterprises. Adoption of renewable energy technologies is also constrained by market barriers, particularly the small size of renewable energy markets in Africa. In general, the larger the market, the higher a technology's chance of being acquired, adapted, and disseminated. Weak supply chains, which make it difficult to obtain equipment and spare parts, are another barrier.

Digital technology and innovative business models can reduce the costs of acquiring renewable energy technologies, especially for poor households. In a scheme operated by M–Kopa Solar in Kenya, customers pay a small deposit for a solar home system and repay the balance in small installments on a pay-as-you-go basis using M–Pesa. The scheme has enabled low-income households to own their systems outright after several months. SolarNow, a Ugandan company with a customized business model, allows 80% of the cost of a solar home system to be spread over 24 monthly installments. This arrangement lowers upfront capital costs that might otherwise exclude poor households. The company claims to have reached over 25,000 clients directly, with around 90,000 people benefiting from its services.[222]

Since renewable energy investments are long term and have high upfront costs, private investors need to be assured that their investment is secure. That requires robust legal and regulatory frameworks and independent regulatory bodies. Many power utilities in Africa are inefficient and riddled with corruption, so utility reform needs to be accelerated and governance systems strengthened. The reforms should include separating transmission and distribution functions, which is under way in several African countries. And innovative off-take arrangements (for the energy that can be sold) are needed to attract private investors.

Regulatory policies and fiscal incentives can encourage investing in grid-connected and off-grid renewable energy systems. Regulatory polices include feed-in tariffs, renewable purchase options, and auctions.[223] Fiscal incentives include capital subsidies, grants, reductions in value added taxes, and import duty exemptions. Algeria, Ghana, Kenya, Mauritius, Rwanda, Tanzania, and Uganda now operate feed-in tariff schemes, while Burkina Faso, Egypt, Morocco, and South Africa run auctions. A handful of countries, including Algeria, Kenya, and Mauritius, run both systems. Although regulatory policy instruments have the capacity to incentivize private investors, the considerable administrative resources required make them more suited to middle-income countries. For low-income countries, fiscal instruments such as tax reductions and exemptions from value added taxes and import duties may be more effective.

African governments need to promote renewable energy investments by both domestic and foreign investors estimated at $32 billion a year between 2015 and 2030.[224] Current investments are far below those levels and are concentrated mainly in Algeria, Egypt, Kenya, Mauritius, and South Africa. Financing for renewable energy projects is available from development finance institutions but has been underused because local financial institutions lack experience with renewable energy projects. Public–private partnerships for cost and risk sharing in renewable energy investments can reduce perceived risks and increase the prospects of funding renewable energy projects.

Finally, deepening regional collaboration on energy resource sharing and investment will boost regional energy security. Increasing regional collaboration and integration is critical for achieving efficiencies and economies of scale to reduce the cost of achieving SDG 7, which aims to close the energy access gap and "ensure access to affordable, reliable, sustainable and modern energy for all."

Regional integration could save an estimated $63 billion, or 14% of the total, of investments needed to quadruple electricity use by 2040.[225] A regional approach in financing renewable energy investments will also address the challenge of small and widely dispersed markets.

Furthermore, a harmonized regional approach to tariffs, technical standards, power purchase agreements, and project approval guidelines can reduce transaction costs and accelerate project development.[226]

Although the REDD+ initiative has particular relevance to Africa's economic transformation, progress has been slow, and the anticipated socioeconomic and environmental benefits are yet to be fully realized. Governments can help drive their countries towards REDD+ readiness by building the capacities of their technical, governance, and financial institutions. In the short term, many African countries would need to rely on international financial support to address technical and financial constraints, and blue carbon markets offer opportunities for accessing finance through the REDD+. Going forward, governance policy reforms should be fast-tracked to attract domestic and foreign finance.

Africa, richly endowed with natural resources, can become a world leader in renewable energy use. But to attract much-needed finance, governments should create a stable regulatory and policy environment. They can also establish competitive pricing for off-grid, mini-grid, and standalone systems. And they can adopt other measures to attract domestic and foreign investors and deepen regional collaboration. Clearly, strong leadership and commitment are required at all levels to improve the participation of women in the renewable energy value chain through education, skills training, and improved access to finance.

Africa, richly endowed with natural resources, can become a world leader in renewable energy use. But to attract much-needed finance, governments should create a stable regulatory and policy environment.

Priorities for action

Challenges with moving materials across closed borders and the slowdown in port operations, as a result of the COVID-19 response, have severely interrupted supply chains, affecting agricultural production in some countries. Small-scale food producers are already vulnerable due to a combination of factors such as weak resilience and limited access to resources and services.Any further spread of the pandemic and related disruptions to transportation systems and agricultural supply chains could lead to a decline in food production and availability.

In parts of Africa, the battle to contain COVID-19 was compounded by an unfolding locust crisis. East Africa is the epicenter of a locust outbreak considered to be the worst in a generation, hitting Ethiopia, Kenya, Somalia, and Uganda. Without broad-scale control measures, damages and losses could have reached $8.5 billion by the end of 2020.[227]

COVID-19 recovery plans should aim to keep supply chains functioning well. Farmers need to be assisted to have continuing access to markets, and small-scale food producers should be included in government assistance programs and any social protection programs addressing the crisis. Economic stimulus packages should prioritize investments in rural agricultural programs to ensure more sustainable food systems and food security and to enhance resilience. And stimulus packages designed for infrastructure and jobs should include renewable energy investments, smart buildings, and green industries without smokestacks.

Above all, countries should begin to formulate policies now that will not only help them recover from the COVID-19 downturns but, once resources are available, also set them on the path to sustained economic transformation out of agriculture and into 21st century manufacturing and services.

Any further spread of the pandemic and related disruptions to transportation systems and agricultural supply chains could lead to a decline in food production and availability.

Promoting climate-smart agriculture

Adopting climate-smart agriculture will help African farmers to increase their productivity, improve resilience, and mitigate climate change. Modern farm inputs (such as heat-tolerant crop varieties), improved management techniques (such as crop diversification), and innovations (such as precision agriculture) help optimize the use of farm inputs, increase farm productivity, and lower costs.

Key priority actions:

- *Increase farmers' technical skills and knowledge of technological innovations by boosting the capacity of national agricultural research and extension systems.* This can be done by increasing investments in research and development and in extension services. Kenya is strengthening the capacity of the local agricultural research and extension system to deliver training, knowledge, and advisory services to farmers.[228] The activities include upscaling climate-smart agriculture practices by financing interventions to promote and facilitate adoption of climate-smart agriculture practices, as well as supporting market, climate, advisory, and agrometeorological services.

- *Adopt, develop, and adapt technological innovations to local conditions.* Climate-smart agriculture solutions developed in advanced countries may not directly be applicable to conditions in Africa. So, it is essential to adapt them to the local conditions. In Kenya, the Ministry of Agriculture, Livestock, and Fisheries is also supporting the development, validation, and adoption of context-specific climate-smart agricultural practices. In Ghana, the Rain Forest Alliance is producing tailor-made online training materials, to help cocoa farmers build resilience and end deforestation in the cocoa supply chain.

- *Improve rural coverage of digital applications and ensure that farmers have access to them.* Improve telecommunications coverage particularly in the rural areas to enable farmers access digital applications. To increase farmers' access to these applications, the service providers also need to come up with products that are affordable. This can be achieved through public-private partnerships, with government providing incentives to private sector operators. In Tunisia, Plantix Tunisia is a mobile-based crop advisory application for farmers and extension workers.[229] It can diagnose pest damage, plant diseases, and nutritional deficiencies affecting crops and offer treatment measures. To improve coverage and access, the project is training young agriculture graduates to be deployed across the country.

- *Promote regional collaboration in agricultural research.* To share knowledge and experiences in the production of climate-smart agricultural practices tailored to specific agroclimatic zones and subzones requires regional collaboration among national agricultural systems. Agricultural research in Africa is highly fragmented given the large number of countries and the wide variety of agroecological zones and farming systems. Much of Africa's agricultural research and development investment has come from donors, with limited private sector involvement. Regional collaboration is therefore required to develop an African funding base to support supranational research and reduce the current dependency on donors. In the absence of such a funding structure, existing models of supranational research—such as the West Africa Agricultural Productivity Program and the East Africa Agricultural Productivity Program can be leveraged to promote regional spillovers.

Sustaining green and blue ecosystems

A key policy priority for Africa is to sustain its green and blue ecosystems. Sustainable use of the green ecosystem can be achieved by devising and applying nature-based solutions to address land use problems, while blue ecosystems can be sustainably managed by using innovative coastal zone management approaches such as blue carbon projects. Sustainable management of both the green and blue ecosystems can be enhanced by deepening regional collaboration.

Key priority actions:

- *Devise and apply nature-based solutions to address land use problems.* To sustainably manage Africa's green ecosystems, countries can apply nature-based solutions, which involve using natural alternatives to solve land use problems such as deforestation and water scarcity. Examples include afforestation, agroforestry, and integrated watershed and catchment management. Co-designed by government agencies, civil society, and local communities, they provide incentives for public-private partnerships to address climate change and ecosystem degradation. Payments from NBS-related initiatives such as REDD+ or the Clean Development Mechanism provide financial incentives to forest-dwelling communities to plant trees and reduce deforestation.

  For afforestation, the Humbo community project in southeastern Ethiopia involves the restoration of indigenous tree species. A collaboration under the Clean Development Mechanism, it involves local and regional governments, local communities, the Ethiopian Environmental Protection Agency, and development partners. It was the first in Africa to sell temporary Certified Emissions Reductions, which were purchased by the World Bank BioCarbon Fund. Revenue from the carbon credits is managed by the community-owned forest management cooperatives and is being used to improve the livelihoods of the people through investments in micro businesses and agroprocessing.[230]

  For agroforestry, integrating trees on farms and rangelands, a view to reduce farmer dependence on a single staple crop and thus to diversify their livelihoods, is a nature-based solution in the Lushoto District in northeastern Tanzania, where more than 60% of the land is eroded. An integrated watershed and catchment management approach controls runoff and reduces soil erosion. In the Uluguru mountain range in eastern Tanzania, a hydrological assessment in the catchment had revealed an overall decrease in water quality due to a dramatic increase in sediment loading in the Ruvu River, the main water source in the area. To address the problem, upstream farmers received payments from downstream buyers (industry, sewage plants) for adopting agricultural practices to control runoff and soil erosion while improving crop production. The approach included construction of bench terraces, reforestation, intercropping crops with fruit trees, mulching, and fertilizing with animal manure.

- *Sustain blue ecosystems by promoting blue carbon projects in coastal areas.* Africa's blue economy plays a key role in providing employment, food security and nutrition. More than 12 million people are employed in fisheries, the largest blue economy sector, providing food security and nutrition for more than 200 million Africans and generating value added estimated at more than $24 billion, or 1.3% of African GDP.[231]

Sustainable management of both the green and blue ecosystems can be enhanced by deepening regional collaboration.

Blue carbon projects involve the rehabilitation, protection, and sustainable use of mangroves in coastal areas. Seagrasses, salt marshes, and mangroves sequester and store carbon dioxide, referred to as "blue carbon." Blue carbon projects can generate carbon credits that can be sold on carbon markets under the mangrove REDD+ or Clean Development Mechanism. For the Mikoko Pamoja projects, currently implemented in Gazi Bay, Kenya, the local community depends on the mangroves for their livelihoods, with 80% of the people making their living from fishing-related activities.[232] Revenues from selling the credits go for mangrove planting and conservation and community development.

- *Deepen regional collaboration for Africa's green and blue economies.* To optimize the benefits of Africa's green and blue economies, a regional approach to addressing forest governance would make it easier for countries to access climate finance initiatives such as REDD+ to help achieve their nationally determined contributions under the Paris Agreement on climate. Regional collaboration is also required to resolve maritime boundary disputes and to address piracy, illegal fishing, and plastic pollution. The Economic Community of Central African States has integrated maritime security for its member states, including joint patrols, harmonized actions at sea, a regional maritime tax regime, and information sharing and management.

Developing and scaling up renewable energy

Africa has the lowest electricity access in the world but is endowed with abundant reserves of renewable energy resources that remain underexploited. Two key barriers to developing them are lack of investment and steep upfront costs of renewable energy technologies.

Key priority actions:

- *Increasing investment by strengthening the policy and regulatory frameworks.* Developing robust legal and regulatory frameworks and independent regulatory bodies will provide a sense of security and certainty to potential investors, both domestic and foreign. Nigeria established a new entity, the Nigerian Bulk Electricity Trading Company, to buy electricity from independent power producers and provide capital and market guarantees.

  Innovative policy instruments can provide price incentives for investing in grid-connected and off-grid renewable energy systems. Feed-in tariffs in South Africa require the state-owned utility, Eskom, to purchase renewable energy from independent power producers at predetermined prices,[233] which reduce financial risk and increase market certainty for renewable energy developers and private investors.

- *Broaden access to renewable energy technologies by reducing the steep up-front costs.* Access to renewable energy can be improved by promoting digital technology and innovative business models that can help to reduce the costs, especially for poor households. In a scheme operated by M–KOPA Solar in Kenya, customers pay a small deposit for a solar home system and repay the balance in small installments on a pay-as-you-go basis using M–PESA.

In Rwanda, the Infrastructure Gender Mainstreaming Strategy 2017–2022 has special provisions to address gaps in women's involvement in the energy value chain, such as access to finance. And in many parts of Africa, wireless carrier MTN Group addresses the lack of access to banking facilities and credit by allowing its mobile money service subscribers to make single or bulk payments without having a bank account.

- *Deepen regional collaboration to reduce electricity costs and increase access.* Deeper regional collaboration on energy resource-sharing will help maximize the benefits from Africa's renewable energy resources and increase regional energy security. This can be done by integrating regional energy markets to facilitate cross-border energy trade. Increasing cross-border energy trade can drive down costs, create economies of scale, and stimulate investment, and thus boost electricity access across the region. Regional energy integration could save an estimated $63 billion of the $450 billion in investments needed to quadruple electricity use by 2040.[234] And the returns on cross-border transmission investment could be 20–30% across much of the region, rising to 120% for southern Africa.[235]

  The decision by African Union Commission to launch the African Single Electricity Market in 2021 is a step in the right direction. When fully operational in 2040, it will be the world's largest single electricity market, covering 55 member states and serving 1.5 billion consumers.

Committed political leadership is required at the national and regional levels to manage the threats of a changing climate. National leaders should support climate-smart agriculture by building the capacity of national agricultural research and extension systems to help farmers optimize the use of farm inputs, increase farm productivity, and lower costs. They should implement innovative natural resource management practices to improve the resilience of Africa's vulnerable terrestrial and marine ecosystems. To offset the steep upfront costs that consumers face in switching to renewable energy technologies, political leaders should provide incentives such as tax rebates. And to attract sustainable, green-minded private investment, governments should introduce robust, independent, national climate change legislation. They should also implement strong environmental regulatory frameworks to align with changing international norms.

Committed political leadership is required at the national and regional levels to manage the threats of a changing climate.

References

AfDB (African Development Bank). 2019. ***Adaptation Benefits Mechanism: Giving Resilience a Value***. Pilot phase information note. Abidjan, Côte d'Ivoire: AfDB. Available at: https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/adaptation-benefit-mechanism-abm.

Africa Progress Panel. 2015. ***Power, People, Planet: Africa Progress Report 2015.*** Available at: https://www.seforall.org/news/power-people-planet-africa-progress-report-2015.

African Risk Capacity. 2019. "How the African Risk Capacity Works." Available at: https://www.africanriskcapacity.org/about/how-arc-works/.

Aggarwal, P. K., A. Jarvis, B. M. Campbell, R. B. Zougmoré, A. Khatri-Chhetri, S. J. Vermeulen, A. M. Loboguerrero Rodriguez, L. S. Leocadio, J. Kinyagi, O. Bonilla Findji, M. A. O. Radeny, J. W. M. Recha, D. Martínez Barón, J. Ramírez Villegas, S. Huyer, P. K. Thornton, E. K. Wollenberg, J. Hansen, P. Álvarez Toro, A. Aguilar-Ariza, D. Arango-Londoño, V. Patiño-Bravo, O. Rivera, M. Ouédraogo, and B. T. Yen. 2018. "The Climate-Smart Village Approach: Framework of an Integrative Strategy for Scaling up Adaptation Options in Agriculture." ***Ecological Society*** 23 (1): 14.

Allen, D. W. 2011. "Legalising Land Rights Local Practices, State Responses, and Tenure Security in Africa, Asia and Latin America." ***Agricultural History*** 85 (1): 119–120.

Angelsen, A. 2013. ***REDD+ as Performance-Based Aid: General Lessons and Bilateral Agreements of Norway***. Helsinki: UNU-WIDER.

Anthony, K. R. N., J. A. Maynard, G. Diaz-Pulido, P. J. Mumby, P. A. Marshall, L. Cao, and O. Hoegh-Guldberg. 2011. "Ocean Acidification and Warming Will Lower Coral Reef Resilience." ***Global Change Biology*** 17 (5): 1798–1808.

Asafu-Adjaye, J. 2014. "Climate Change and Agriculture in Africa." ***Journal of African Economies*** 23: ii17–ii49.

Azongo, D. K., T. Awine, G. Wak, F. N. Binka, and A. R. Oduro. 2012. "A Time Series Analysis of Weather Variability and All-cause Mortality in the Kasena-Nankana Districts of Northern Ghana, 1995–2010." ***Global Health Action*** 5 (Suppl.): 14–22.

Biasutti, M. 2013. "Forced Sahel Rainfall Trends in the CMIP5 Archive." ***Journal of Geophysical Research D: Atmospheres*** 118 (4): 1613–1623.

Boko, M., I. Niang, A. Nyong, C. Vogel, A. Githeko, R. Tabo, and P. Yanda. 2007. "Climate Change 2007: Impacts, Adaptation and Vulnerability." In M. L. Parry, O. F. Canziani, J. P. Palutokof, P. J. van der Linden and C. E. Hansen, Eds., ***Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change***, pp. 433–467. Cambridge, UK: Cambridge University Press.

Boon, E., and A. Ahenkan. 2012. "Assessing Climate Change Impacts on Ecosystem Services and Livelihoods in Ghana: Case Study of Communities around Sui Forest Reserve." ***Journal of Ecosystem & Ecography*** S3 (1): 1–8.

Brink, A. B., and H. D. Eva. 2009. "Monitoring 25 Years of Land Cover Change Dynamics in Africa: A Sample-Based Remote Sensing Approach. *Applied Geography* 29 (4): 501–512.

Brown, M., B. Hintermann, and N. Giggins. 2009. "Markets, Climate Change, and Food Security in West Africa." *Environmental Science and Technology* 43: 8016–8020.

Caine, M., T. Moss, J. Lloyd, and M. Luke. 2014. "Our High Energy Planet: A Climate Pragmatism Project." Available at: https://sites.tufts.edu/cierp/files/2018/02/Our-High-Energy-Planet_DOC.pdf.

Carter, M., A. de Janvry, E. Sadoulet, and A. Sarris. 2017. "Index Insurance for Developing Country Agriculture: A Reassessment." *Annual Review of Resource Economics* 9: 421–438.

Cheng, L., Abraham, J., Trenberth, K.E. *et al.* 2021. "Upper ocean temperatures hit record high in 2020". *Advances in Atmospheric Sciences*. https://doi.org/10.1007/s00376-021-0447-x.

CTA (Technical Centre for Agricultural and Rural Cooperation) and Dalberg Advisors. 2019. *The Digitalization of African Agriculture Report 2018–2019*. 1st ed. Wageningen, Netherlands: CTA and Dalberg Advisors.

Darwall, W., K. Smith, D. Allen, R. Holland, I. Harrison, and E. Brooks (Eds.). 2011. *The Diversity of Life in African Freshwaters: Under Water, Under Threat. An Analysis of the Status and Distribution of Freshwater Species throughout Mainland Africa*. Cambridge, UK and Gland, Switzerland: International Union for Conservation of Nature and Natural Resources (IUCN).

Dawson, S. 2017. "Why Does M-PESA Lift Kenyans out of Poverty?" CGAP Blog, January. Available at: https://www.cgap.org/blog/why-does-m-pesa-lift-kenyans-out-poverty.

Digital Green. 2017. *Annual Report 2017*. Available at: https://www.digitalgreen.org/wp-content/uploads/2017/08/Digital-Green_Annual-Report_2017.pdf.

Diop, S., R. Arthurton, P. Scheren, J. Kitheka, K. Koranteng, and R. Payet. 2011. "The Coastal and Marine Environment of Western and Eastern Africa: Challenges to Sustainable Management and Socioeconomic Development." In D. McLusky and E. Wolanski, eds., *Treatise on Estuarine and Coastal Science.* Vol. 11: *Management of Estuaries and Coasts,* 315–335. Amsterdam, Netherlands: Academic Press.

Eberhard, A., O. Rosnes, M. Shkaratan, and H. Vennemo. 2011. *Africa's Power Infrastructure: Investment, Integration, Efficiency.* Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/2290.

EC (European Commission). 2015. *Towards an EU Research and Innovation Policy Agenda for Nature-based Solutions and Renaturing Cities*. Final Report of the Horizon 2020 Expert Group. European Commission, Directorate-General for Research and Innovation, Brussels.

EDF (Environmental Defense Fund). 2019. *How Cap and Trade Works*. Available at: https://www.edf.org/climate/how-cap-and-trade-works.

Energypedia. 2021. "South African Renewable Energy Feed-in Tariff." Wiesbaden, Germany https://energypedia.info/wiki/South_African_Renewable_Energy_Feed-in_Tariff.

FAO (Food and Agriculture Organization of the United Nations). 2006. *Food Security*. Policy brief, Issue 2, June. Rome: FAO.

———.2011. *Payments for Ecosystem Services and Food Security.* Rome: FAO. Available at: http://www.fao.org/docrep/014/i2100e/i2100e00.htm.

———. 2013. *Climate-Smart Agriculture: Managing Ecosystems for Sustainable Livelihoods*. Rome: FAO. Available at: http://www.fao.org/3/a-an177e.pdf.

———. 2018a. *The Future of Food and Agriculture: Trends and Challenges.* Rome: FAO. Available at: http://www.fao.org/3/a-i6583e.pdf.

———. 2018b. *Nature-Based Solutions for Agricultural Water Management and Food Security.* Land and Water Discussion Paper 12. Rome: FAO.

———. 2019. "As Climate Shocks Intensify, UN Food Agencies Urge More Support for Southern Africa's Hungry People." Rome: FAO. Available at: http://www.fao.org/news/story/en/item/1242784/icode/.

GAVI. 2012. "National Ownership of Innovative Supply Chain Technologies." Geneva: GAVI, the Vaccine Alliance. Available at: https://www.gavi.org/partnersforum2012/session-summaries/11-%E2%80%93-national-ownership-of-innovative-supply-chain-technologies/.

Gboney, W. 2011. "Policy and Regulatory Framework for Renewable Energy and Energy Efficiency Development in Ghana." Climate Policy 9 (5): 508–516.

Goyal, A., and J. Nash. 2017. Reaping Richer Returns. Washington, DC: Agence Française de Developpement and World Bank.

Hello Tractor. 2019. Breaking Ground, Drive Change. Impact Whitepaper, Hello Tractor.

Hsiang, S. M., M. Burke and E. Miguel. 2013. "Quantifying the Influence of Climate on Human Conflict." *Science* 341 (6151).

ICIPE (International Centre of Insect Physiology and Ecology). 2019. "PUSH-PULL: A Novel Farming System for Ending Hunger and Poverty in Sub-Saharan Africa." Available at: http://www.push-pull.net/icipe.shtml.

IFC (International Finance Corporation). 2019. "What Is Impact Investing?" Washington, DC: World Bank. Available at: https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Impact-investing/Overview/.

IFPRI (International Food Policy Research Institute). 2019. "Global Food Security under Climate Change: Outlook and Adaptive Responses." GCA Background Paper. Washington, DC: IFPRI.

IEA (International Energy Agency). 2014. *World Energy Outlook 2014*. Paris: IEA.

———. 2017. *World Energy Outlook 2017*. Paris: IEA.

IPCC (Intergovernmental Panel on Climate Change). 2007. ***AR4 Climate Change 2007: The Physical Science Basis.*** Geneva: IPCC. Available at: https://www.ipcc.ch/assessment-report/ar4/.

———. 2018. ***Special Report on Global Warming of 1.5.*** Available at: http://www.ipcc.ch/report/sr15/.

———. 2019. ***Special Report on the Ocean and Cryosphere in a Changing Climate***. Geneva: IPCC. Available at https://www.ipcc.ch/report/srocc/.

IRENA (International Renewable Energy Agency). 2014. ***Estimating the Renewable Energy Potential in Africa: A GIS-based Approach***. Abu Dhabi: IRENA. http://www.irena.org/DocumentDownloads/Publications/IRENA_Africa_Resource_Potential_Aug2014.pdf.

———. 2015. ***Off-Grid Renewable Energy Systems: Status and Methodological Issues***. Abu Dhabi: IRENA.

IUCN (International Union for Conservation of Nature). 2012. ***The IUCN Programme 2013–2016***. Gland, Switzerland: IUCN.

James, R. and R. Washington. 2013. "Changes in African Temperature and Precipitation Associated with Degrees of Global Warming." ***Climatic Change*** 117 (4): 859–872.

Kray, H. and S.Shetty. 2020. "The locust plaque: Fighting a crisis within a crisis."' World Bank Blogs.

Lambe, F., M. Jürisoo, H. Wanjiru, and J. Senyagwa. 2015. "Thermal Energy for Cooking." New Climate Economy and Stockholm Environment Institute background paper for the Africa Progress Report 2015.

Lobell, D. B., M. B. Burke, C. Tebaldi, M. D. Mastrandrea, W. P. Falcon, and R. L. Naylor. 2008. "Prioritizing Climate Change Adaptation Needs for Food Security in 2030." ***Science*** 319 (5863): 607–610.

Lotsch, A. 2007. "Sensitivity of Cropping Patterns in Africa to Transient Climate Change." World Bank Policy Research Working Paper 4289, World Bank, Washington, DC.

Lou, Y. and X.-Q. Zhao. 2010. "A Climate-based Malaria Transmission Model with Structured Vector Population." ***SIAM Journal on Applied Mathematics*** 70 (6): 2023–2044.

McCartney, M. P. and M. M. Girma. 2012. "Evaluating the Downstream Implications of Planned Water Resource Development in the Ethiopian Portion of the Blue Nile River." ***Water International*** 37 (4): 362–379.

McKinsey. 2015. ***Brighter Africa: The Growth Potential of the Sub-Saharan Electricity Sector***. New York: McKinsey & Company. Available at: http://www.mckinsey.com/insights/energy_resources_materials/powering_africa.

Mayaux, P., J.-F. Pekel, B. Desclée, F. Donnay, A. Lupi, F. Achard, M. Clerici, C. Bodart, A. Brink, R. Nasi, and A. Belward. 2013. "State and Evolution of the African Rainforests between 1990 and 2010." ***Philosophical Transactions of the Royal Society B*** 368 (1625).

MININFRA (Ministry of Infrastructure), Government of Rwanda. 2017. *Infrastructure Gender Mainstreaming Strategy (2017/18–2021/22).* Kigali: MININFRA.

Mitchard, E. T. A., and C. M. Flintrop. 2013. "Woody Encroachment and Forest Degradation in Sub-Saharan Africa's Woodlands and Savannas 1982–2006." *Philosophical Transactions of the Royal Society B* 368 (1625).

Nakasone, E. 2013. "The Role of Price Information in Agricultural Markets: Experimental Evidence from Rural Peru." Paper presented at the Agricultural and Applied Economics Association (AAEA) and Canadian Agricultural Economics Association (CAES) Joint Annual Meeting, August 4–6, Washington, DC.

NOAA (National Oceanic and Atmospheric Administration). 2019a. *Assessing the Global Climate in October 2019*. Washington, DC: NOAA, National Centers for Environmental Information. Available at: https://www.washingtonpost.com/weather/2019/11/19/were-living-through-earths-second-hottest-year-noaa-finds/.

———. 2019b. *Is Sea Level Rising?* Washington, DC: NOAA, National Centers for Environmental Information. Available at: https://oceanservice.noaa.gov/facts/sealevel.html.

Niang, I., O. C. Ruppel, M. A. Abdrabo, A. Essel, C. Lennard, J. Padgham, and P. Urquhart. 2014. "Africa." In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, UK and New York: Cambridge University Press.

Osborne, P. L. 2012. *Tropical Ecosystems and Ecological Concepts.* 2nd ed. Cambridge, UK: Cambridge University Press.

Patricola, C. M., and K. H. Cook. 2011. "Sub-Saharan Northern African Climate at the End of the Twenty-first Century: Forcing Factors and Climate Change Processes." *Climate Dynamics* 37 (5–6): 1165–1188.

Parshotam, A., and H. van der Westhuizen. 2018. *Women and the Energy Value Chain*. Discussion Paper, October, Global Economic Governance (GEG) Africa.

Porter, J. R., L. Xie, A. J. Challinor, K. Cochrane, S. M. Howden, M. M. Iqbal, D. B. Lobell, and M. I. Travasso. 2014. "Food Security and Food Production Systems. In C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, M. Chatterjee, K. L. Ebi, Y. O. Estrada, R. C. Genova, B. Girma, E. S. Kissel, A. N. Levy, S. MacCracken, P. R. Mastrandrea and L. L. White, eds. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, 485–533. Cambridge, UK and New York, NY: Cambridge University Press.

Rain, D., R. Engstrom, C. Ludlow, and S. Antos. 2011. *Accra, Ghana: A City Vulnerable to Flooding and Drought-Induced Migration.* Case study prepared for Cities and Climate Change: Global Report on Human Settlements 2011, United Nations Human Settlements Programme (UN-HABITAT), Nairobi, Kenya.

Rigaud, K., A. de Sherbinin, B. Jones, J. Bergmann, V. Clement, K. Ober, J. Schewe, S. Adamo, B. McCusker, S. Heuser, and A. Midgley. 2018. ***Groundswell: Preparing for Internal Climate Migration***, Washington, DC: World Bank. Available at https://openknowledge.worldbank.org/handle/10986/29461.

Schlenker, W., and D. B. Lobell. 2010. "Robust Negative Impacts of Climate Change on African Agriculture." ***Environmental Research Letters*** 5 (1).

Schramski, J. R., C. B. Woodson, G. Steck, D. Munn, and J. H. Brown. 2019. *"Declining Country-Level Food Self-Sufficiency Suggests Future Food Insecurities*." Biophysical Economics and Resource Quality 4 (12).

Searchinger, T., R. Waite, C. Hanson, J. Ranganathan, P. Dumas, and E. Matthews. 2019. ***Creating a Sustainable Food Future***. World Resources Institute. Available at: https://wriorg.s3.amazonaws.com/s3fs-public/creating-sustainable-food-future_2.pdf.

Shah, M. M., G. Fischer, and H. van Velthuizen. 2008. ***Food Security and Sustainable Agriculture: The Challenges of Climate Change in Sub-Saharan Africa***. Laxenburg, Austria: International Institute for Applied Systems Analysis.

Shongwe, M. E., G. J. van Oldenborgh, B. van den Hurk, and M. van Aalst. 2011. "Projected Changes in Mean and Extreme Precipitation in Africa Under Global Warming. Part II: East Africa." ***Journal of Climate*** 24 (14): 3718–3733.

SolarNow Uganda. 2019. ***Grow with Us!*** Available at: https://www.solarnow.eu/.

Somorin, O. A. 2010. "Climate Impacts, Forest-Dependent Rural Livelihoods and Adaptation Strategies in Africa: A Review." ***African Journal of Environmental Science and Technology*** 4 (13): 903–912.

Steffen, W., J. Rockström, K. Richardson, T. M. Lenton, C. Folke, D. Liverman, C. P. Summerhayes, A. D. Barnosky, S. E. Cornell, M. Crucifix, J. F. Donges, I. Fetzer, S. J. Lade, M. Scheffer, R. Winkelmann, and H. J. Schellnhuber. 2018. "Trajectories of the Earth System in the Anthropocene." ***Proceedings of the National Academy of Sciences of the United States of America*** 115 (33): 8252–8259.

Thornton, P. K., P. G. Jones, G. Alagarswamy, and J. Andresen. 2009. "Spatial Variation of Crop Yield Response to Climate Change in East Africa." ***Global Environmental Change*** 19 (1): 54–65.

Tulsian, M., and N. Saini. 2014. "Market–Driven Innovations in Rural Marketing in India." ***International Journal of Scientific and Engineering Research*** 5 (5): 1439–45.

Tunisia-GIZ. 2017. "Plantix a smartphone application serving the agricultural sector." Tunis, Tunisia. https://www.webmanagercenter.com/2017/06/21/407967/tunisie-giz-plantix-une-application-smartphone-au-service-du-secteur-agricole/.

UNECA (UN Economic Commission for Africa). 2016a. *Africa's Blue Economy: Opportunities and Challenges to Bolster Sustainable Development and Economic Transformation*. Issues Paper. Addis Ababa, Ethiopia: UNECA.

———. 2016b. *Africa's Blue Economy: A Policy Handbook*. Addis Ababa, Ethiopia: UNECA.

UNFCCC (United Nations Framework Convention on Climate Change). 2003. *Ghana's Climate Change Technology Needs Assessment Report*. Available at: http://www.un-gsp.org/sites/default/files/documents/ghana_tna.pdf.

———. 2010. Cancun Agreements. Decision 1/CP.16. United Nations Framework Convention on Climate Change, Bonn. Available at: http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf.

———. 2015. Adoption of the Paris Agreement. Draft decision −/CP.21, Conference of the Parties Twenty-First Session, Paris, November 30–December 11. Available at: http://unfccc.int/resource/docs/2015/cop21/eng/l09.pdf.

UN Security Council. 2017. "Security Council resolution 2349 (2017) [on the situation in the Lake Chad Basin region]", 31 March, S/RES/2349.

WHO (World Health Organization). 2003. *Climate change and human health – risks and responses. Summary.* Geneva: WHO.

———. 2012. *Burden of Disease from Household Air Pollution for 2012: Summary of Results*. Geneva: World Health Organization. Available at: http://www.who.int/phe/health_topics/outdoorair/databases/HAP_BoD_results_March2014.pdf.

———. 2013. *Global Health Observatory (GHO): The Data Repository.* Geneva: WHO. Available at www.who.int/gho/database/en/.

Vincke, C., I. Diédhiou, and M. Grouzis. 2010. "Long Term Dynamics and Structure of Woody Vegetation in the Ferlo (Senegal)." *Journal of Arid Environments* 74 (2): 268–276.

Waylen, K., E. Hastings, E. Banks, K. Holstead, R. Irvine, and K. Blackstock. 2014. "The Need to Disentangle Key Concepts from Ecosystem-Approach Jargon." *Conservation Biology* 28: 1215–1224.

Wilkinson, M., P. Quinn, N. Barber, and J. Jonczyk. 2014. "A Framework for Managing Runoff and Pollution in the Rural Landscape Using a Catchment System Engineering Approach." *Science of the Total Environment* 468: 1245–1254.

Woltering, L., A. Ibrahim, D. Pasternak, and J. Ndjeunga 2011. "The Economics of Low-Pressure Drip Irrigation and Hand Watering for Vegetable Production in the Sahel." *Agricultural Water Management* 99 (1): 67–73.

World Bank. 2007. *World Development Report 2008: Agriculture for Development*. Washington, DC: World Bank.

———. 2018. *Ethiopia: Beyond Connections*, Washington, DC: World Bank.

———. 2019. *World Development Indicators*. Washington, DC: World Bank.

———. 2021. Kenya Climate Smart Project. Washington, DC. https://projects.worldbank.org/en/projects-operations/project-detail/P154784.

World Vision. 2021. "Humble Humbo's carbon trade upgrade." Melbourne, Australia. https://www.worldvision.com.au/global-issues/work-we-do/climate-change/humble-humbo-carbon-trade-upgrade.

Wylie, L., A. E. Sutton-Grier, and A. Moore. 2016. "Keys to successful blue carbon projects: Lessons learned from global case studies." Marine Policy 65: 76–84.

Zhu, C., K. Kobayashi, I. Loladze, J. Zhu, Q. Jiang, X. Xu, G. Liu, S. Seneweera, K. L. Ebi, A. Drewnowski, N. K. Fukagawa, and L. H. Ziska. 2018. "Carbon Dioxide (CO_2) Levels This Century Will Alter the Protein, Micronutrients, and Vitamin Content of Rice Gains with Potential Health Consequences for the Poorest Rice-Dependent Countries." *Science Advances* 4 (5).

Zinyengere, N., O. Crespo, and S. Hachigonta. 2013. "Crop Response to Climate Change in Southern Africa: A Comprehensive Review." *Global and Planetary Change* 111: 118–126.

End notes

155 IPCC 2018.

156 Steffen et al. 2018.

157 NOAA 2019a.

158 Cheng et al. 2021.

159 McCartney and Girma 2012.

160 World Bank 2019.

161 Just about 4% of the total area in production in Sub-Saharan Africa is under irrigation, compared with 39% in South Asia and 29% in East Asia (World Bank 2007).

162 IFPRI 2019.

163 Boko et al. 2007. An exception is in eastern Africa where maize production could benefit from warming at high elevation locations (Thornton et al. 2009).

164 Lobell et al. 2008.

165 Zinyengere, Crespo, and Hachigonta 2013.

166 Schlenker and Lobell 2010.

167 Zhu et al. 2018.

168 Asafu-Adjaye 2014.

169 FAO 2018a.

170 Brown, Hintermann, and Giggins 2009.

171 FAO 2019.

172 FAO 2013.

173 Africa Progress Panel 2015.

174 Returns to national agricultural R&D spending range from 17% for small countries such as Botswana, Burundi, and Gabon to 43% for large countries such as Ghana, Kenya, and Nigeria (Goyal and Nash 2017).

175 Boon and Ahenkan 2012.

176 Rain et al. 2011.

177 The terrestrial ecosystems comprise deserts, grasslands, shrublands, savannas, woodlands, and forests.

178 Brink and Eva 2009.

179 Mayaux et al. 2013.

180 Vincke, Diedhiou, and Grouzis 2010.

181 Mitchard and Flintrop 2013.

182 Darwall et al. 2011.

183 See Woltering et al. (2011) and Osborne (2012).

184 Diop et al. 2011.

185 IPCC 2019. A recent example is Tropical Cyclone Idai which struck in February 2019, causing deadly flooding in Malawi, Mozambique, and Zimbabwe. According to the World Bank, it will cost the southern African nations more than $2 billion to repair the damage.

186 Rain et al. 2011.

187 Anthony et al. 2011.

188 IEA 2014.

189 Africa Progress Panel 2015.

190 IEA 2017.

191 Ibid.

192 IRENA 2014.

193 Caine et al. 2014.

194 WHO 2012.

195 GAVI 2012.

196 Africa Progress Panel 2015.

197 Lambe et al. 2012

198 FAO 2013; Aggarwal et al. 2018.

199 FAO 2011.

200 Tulsian and Saini 2014.

201 Nakasone 2013.

202 Digital Green 2017.

203 For example, in northern Ghana smallholder farmers are often unwilling to use improved seed varieties due to the risk of economic losses if rain is delayed or the level is inadequate.

204 Dawson 2017.

205 Carter et al. 2017.

206 CTA and Dalberg Advisors 2019.

207 EDF 2019.

208 IFC 2019.

209 Wilkinson et al. 2014.

210 Payment for ecosystem services occurs when beneficiaries or users of an ecosystem service make payments to the providers of that service.

211 FAO 2018b.

212 Somorin 2010.

213 According to the FAO, forests cover 675 million hectares in Africa, which is about 23% of the total land area. The highest rate of deforestation in the world is in Africa, with an annual loss of 0.49% of forested area.

214 UNFCCC 2010, 2015.

215 Africa Progress Panel 2015.

216 Angelsen 2013.

217 Allen 2011.

218 UNECA 2016a.

219 UNECA 2016a.

220 Africa Progress Panel 2015.

221 Blue carbon refers to the carbon captured by ocean and coastal ecosystems. Examples include mangroves, sea grasses, and tidal marshes along the coast, which can capture and hold carbon, resulting in a carbon sink.

222 SolarNow Uganda 2019.

223 A feed-in tariff is a scheme in which the power producer pays the firm or household for excess electricity generated by a solar photovoltaic system, which is then fed into the central grid; renewable purchase options refer to obligations imposed by law on some entities to buy either green electricity or renewable energy certificates; auctions refer to a process where renewable energy is sold through competitive bidding.

224 IRENA 2015.

225 McKinsey 2015.

226 IRENA 2015.

227 Kray and Shetty 2020.

228 World Bank 2021.

229 Tunisia-GIZ 2017.

230 World Vision 2021.

231 UNECA 2016a.

232 Wylie et al. 2016.

233 Energypedia 2021.

234 McKinsey 2015.

235 Eberhard et al. 2011.

04

Pursuing regional collaboration as the route to integration

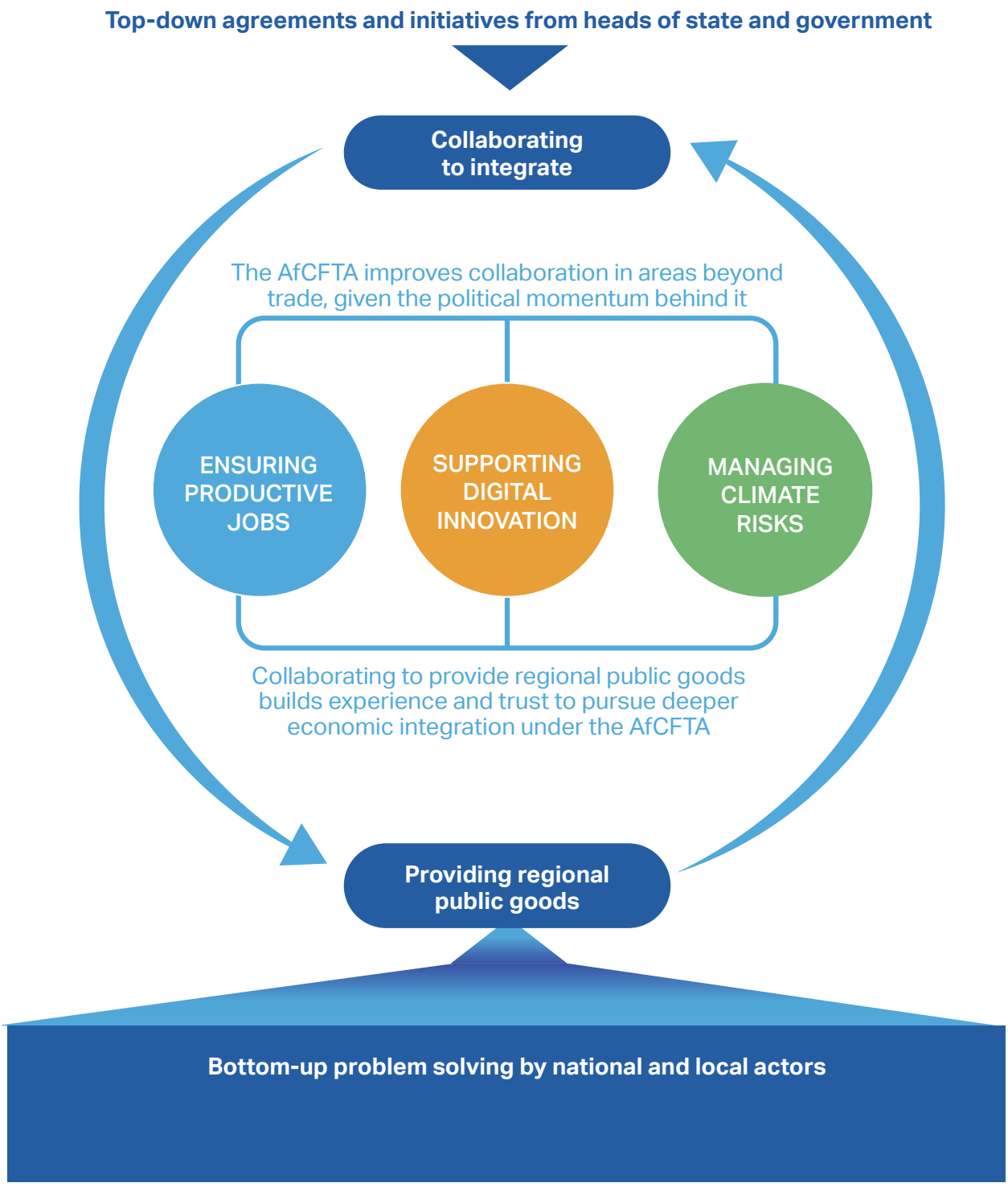
Regional collaboration and integration are about more than reducing commercial and regulatory barriers to trade—they are about providing interdependent regional public goods that bind countries together socially, economically, and politically.

Regional integration and collaboration have long been high on the agenda in Africa—with initial phases before independence and numerous waves since then, including the Abuja Road Map to create the African Economic Community and most recently the African Continental Free Trade Area (AfCFTA) agreement. But implementing these regional frameworks has for the most part been slower than planned. The AfCFTA gives fresh impetus to the integration project. In signing the agreement, countries affirmed the importance of accelerating intra-African trade and boosting Africa's competitiveness in global markets. In broad terms, the agreement envisages free trade areas that progressively eliminate tariff and nontariff barriers to trade among the member states. That would help countries boost growth, diversify their exports beyond unprocessed commodities, and attract more foreign and domestic investment. The agreement also envisages freer movement of labor and capital, likely making both more productive.

These encouraging developments are necessary for Africa's integration, but they are not sufficient. Deepening regional integration requires shifting the integration narrative from pursuing not just regional market integration but also broader regional collaboration. One underexploited area of regional collaboration is the provision of regional public goods and services whose benefits cross borders—benefits such as increasing the efficiency of transport corridors, reducing the spread of disease, increasing the dissemination of knowledge about climate-smart agricultural techniques, reducing the pollution in river basins and oceans, and reducing the regulatory obstacles to regional communications networks and financial markets.

Regional collaboration and integration are thus about more than reducing commercial and regulatory barriers to trade—they are about providing interdependent regional public goods that bind countries together socially, economically, and politically.[236] Trade is often the starting point for thinking about regional integration. But market integration has generally been slow. And given the interdependence of trade integration with other areas, providing regional public goods more broadly and effectively is likely to increase trust, collaboration, and shared decisionmaking (infographic 4.1).

INFOGRAPHIC 4.1 INTEGRATING TO TRANSFORM



Regional collaboration can thus be a route to faster and deeper regional integration. The regional economic community secretariats and commissions are but one set of actors effectively engaging on regional cooperation and delivering regional public goods. They may be multipurpose organizations. But improving the delivery of regional public goods requires looking beyond them to understand the full diversity of regional, national, and local actors that influence and shape regional cooperation in practice—and thus shape what and how regional public goods are provided in Africa.

Regional collaboration to provide regional public goods may sound sensible, but it is extremely difficult—because the parties have to resolve three issues. First is understanding the type of regional public good that is to be provided and devising the best arrangement to deliver it. Second is making sure that the jurisdiction of the regional authority to deliver the public good matches the geography of the problem to be solved. Third is delegating national sovereignty to a regional authority to finance and oversee its implementation.

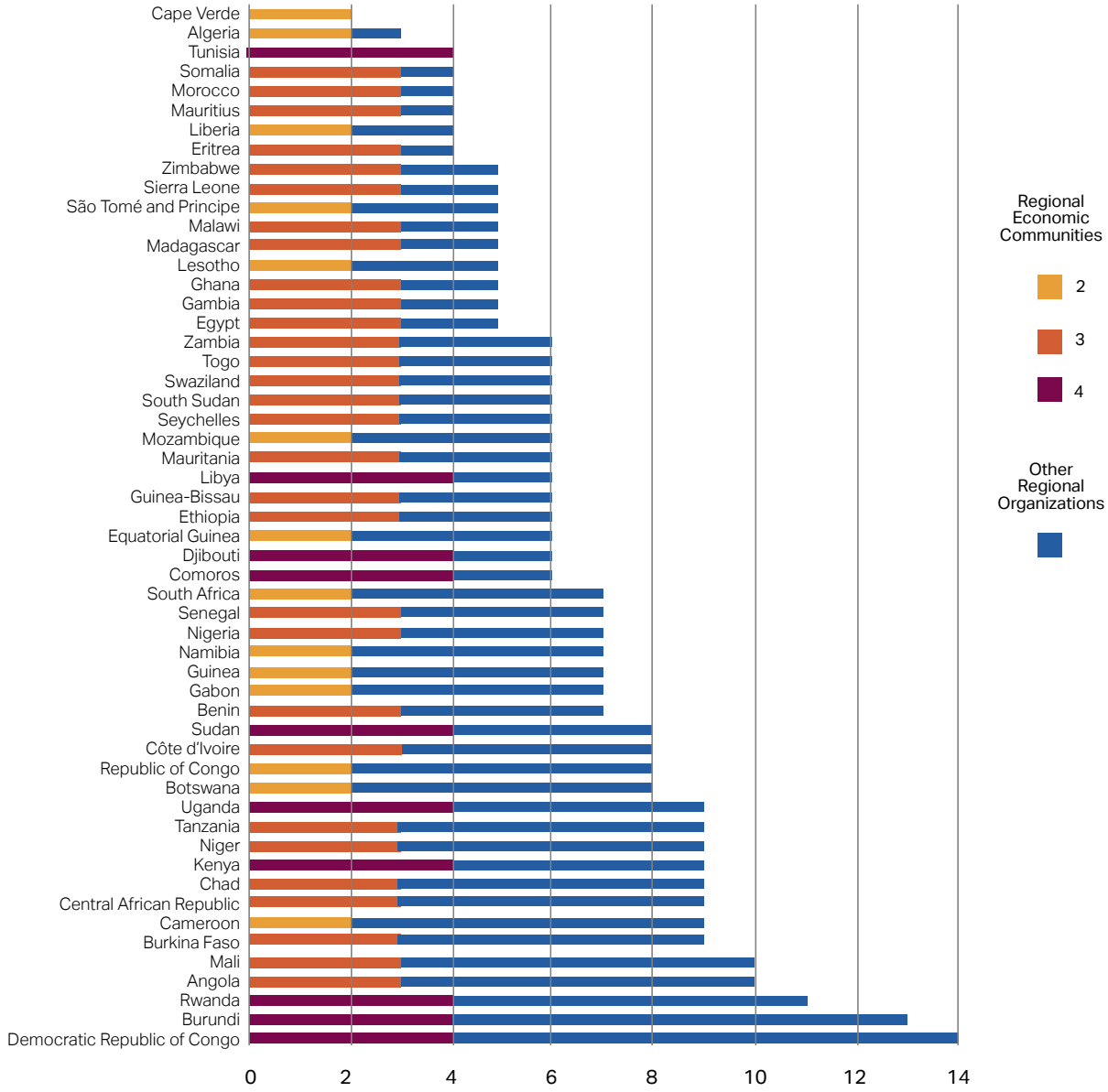
Africa's regional agreements and structures

Regional collaboration and integration are more necessary than ever before in Africa, with cross-border spillovers proliferating and requiring multicounty collective action. The spillovers result from Africa's complex natural and political geography among its 54 countries, 16 of them landlocked, nearly all connected through informal trade, and most of them sharing watersheds and other ecological features with their neighbors. The spillovers also arise from climate change, increasing water stress, insecurity in many parts of the continent, the movement of people across borders—and now COVID-19, threatening all of the continent.

African countries are well endowed with institutional structures for regional cooperation and integration. All countries except Cabo Verde are members of more than one of the eight African Union–recognized regional economic communities (RECs). All except Tunisia also belong to regional bodies for energy, peace, and security, and river basin and natural resource management. This complex landscape of memberships in regional organizations implies overlaps in memberships and domains of activity (figure 4.1). Regional organizations rarely die (although some are all but defunct) since countries seeking different benefits from multiple memberships keep them alive and, arguably, relevant as serving some interests of their member states.[237]

The AfCFTA gives fresh impetus to integration. In signing the agreement, countries affirmed the importance of accelerating intra-African trade and boosting Africa's competitiveness in global markets.

FIGURE 4.1 MEMBERSHIPS INTERSECT ACROSS REGIONAL ORGANIZATIONS AND REGIONAL ECONOMIC COMMUNITIES



Note: Organizations include 8 African Union–recognized regional economic communities and 7 other economic organizations plus the AU itself, and 25 other regional organizations (5 energy-based, 15 river and lake management, 4 peace and security, and 1 environmental). Countries average memberships in three RECs and four other regional organizations.

Most regional organizations rely heavily on external finance. In 2002, 12 donor projects, worth $3 million, funded the African Union and the RECs, but by 2015 there were more than 140 such projects worth $150 million. Such external finance can come with a cost when external partners steer their agendas.[238] The 2017 Kagame Report found that African Union programs were 97% funded by donors.[239] The AU levy of 0.2% on all African imports seeks to address this by raising member state contributions, but reduces efficiency, risks a challenge at the World Trade Organization, and would still be insufficient to finance all proposed AU programs.[240]

The implementation gap in Africa, though often framed in terms of finance and public sector capacity, is largely political.

Integration across Africa through the RECs has made progress, but less than was expected when the Abuja Treaty launched the process in 1994. The timetable then aimed for a free trade agreement status with a common external trade policy by 2017. Only the East African Community has reached the free trade goalpost for intra-REC trade and created a customs union.[241] The assumption that regional collaboration and integration proceed linearly from continental and regional agreements to ratification, to implementation, to impact and benefits for all fails to stand up in practice. Most RECs are behind on their market integration commitments, and efforts to share river basins and create regional electricity networks struggle. And although the AfCFTA has entered into force, discussions around the details of its content continue.

Even when regional and continental agreements are agreed and ratified, implementation and impact are often limited. For example, to benefit from the Economic Community of West African States (ECOWAS) Trade Liberalization Scheme, traders must obtain a certificate of origin or formal recognition of eligibility, and partner country customs officials must accept these credentials. None of these steps can be taken for granted, as persistently high levels of estimated informal trade attest, even for the East Africa Community (EAC), which has eliminated intraregional tariffs. The East African Common Market Scorecard reported that the leading barrier to intra-EAC integration is when border officials do not recognize simplified certificates of origin.[242]

The implementation gap in Africa, though often framed in terms of finance and public sector capacity, is largely political, as illustrated by progress along the Northern Corridor in East and Central Africa when the interests of leaders aligned. There is also a wide gap between the regional politics that shape the agreements that heads of state sign and the domestic politics that shape what and how governments implement them. In countries with weak administration and uncertain rule of law and accountability (particularly in the application of credible sanctions for noncompliance), implementation takes place only when the incentives align to support it.

The 2011 launch of the Tripartite Free Trade Area and the more recently agreed AfCFTA, while aiming to resolve overlapping memberships, are effectively additional agreements on top of the existing REC agreements because of the negotiating principle of building on existing levels of integration. Countries thus face two challenges: ensuring consistency between their multiple memberships and securing resources to follow up on and implement multiple regional commitments.

The AfCFTA envisages the full integration of all African countries, with the eight regional economic communities as building blocks, by resolving their multiple overlapping memberships (box 4.1). The integration process envisages free trade areas with tariffs eliminated among the member states—leading to customs unions with common external tariffs, then to a common market with the free movement of workers, goods, and capital, followed by an economic and monetary union, with common fiscal and monetary policies. Initial negotiations set protocols for trade in goods, trade in services, and dispute settlement. Concluded in December 2020, negotiators set schedules for tariff concessions on trade in goods and commitments for trade in services, starting with business, communication, finance, transport, and tourism.

Box 4.1 The African Continental Free Trade Area

The AfCFTA, one of the flagship programs under the African Union's Agenda 2063, aims to boost economic growth and development and rapidly transform the continent's economies into a global powerhouse. The African market has a growing middle class expected to rise to 600 million by 2030, when the AfCFTA is expected to halve Africa's trade deficit and double the share of intra-African trade to 26% of Africa's exports. Achieving the full potential depends on putting in place significant policy reforms and trade facilitation measures.

Transition costs in the form of falling tariff revenues, temporarily rising unemployment, and declining economic activities are likely in some subsectors due to reallocations of resources. Given that income gains may take time to materialize, the corresponding revenue increases may not compensate for tariff revenue losses in the short term. In addition, higher revenues will also be needed to finance infrastructure improvements and upgrade social safety nets to mitigate transitional costs from lowering trade barriers.

Road and rail connections to neighboring countries need to be facilitated to enhance regional trade and mutual economic benefits. Newer models for funding and managing cross-border infrastructure need to be considered such as public-private partnerships and build, operate, and transfer arrangements, including at the regional level. And a more fully developed regional financial infrastructure can facilitate further intraregional trade—such as harmonizing regional payment systems to facilitate cross-border payments and creating a multicurrency clearing center to reduce risks from trading in different national currencies.

Upholding the provisions of the agreement will be crucial for the AfCFTA's success. The AfCFTA secretariat should have the legal authority to conduct negotiations, monitoring, and oversight on behalf of member states, along with the capacity to provide technical assistance and practical guidance. An institutionally strong secretariat, with the authority and capacity to implement trade rules in line with the text of the agreement, will build credibility and reduce trade policy uncertainty and strengthen Africa's position in trade negotiations.

All very promising, but stepping up the pace of the AfCFTA's implementation requires shifting the way countries think about regional integration. It requires shifting the narrative about what integration really entails if it is to transform African economies by supporting Growth with DEPTH. It also requires shifting to pursue not just regional market integration but also broader regional collaboration. And it requires shifting from relying only on the traditional top-down approach with regional organizations taking the lead in trying to convert regional commitments to national actions—to also pursuing a bottom-up approach that starts with identifying local or national problems with a regional reach and formulates the policy responses. This requires linking national development plans and programs with regional plans and programs.

Regional public goods come in two primary types: pure public goods and quasi public goods. The majority of the RPGs key to driving Growth with DEPTH in Africa are quasi public goods. Understanding the type of regional public good is critical to designing appropriate policy and institutional response (box 4.2).

Box 4.2 Types of regional public goods and their joint provision

There are two primary types of public goods: pure public goods and quasi public goods. Pure public goods are nonexcludable, meaning that nonproviders cannot be excluded from their benefits at a reasonable cost. So the incentive to provide them is weak, but excluding nonproviders reduces social benefits.1 They are also nonrival (or non-diminishable), since consumption by one user does not prevent consumption by others—the marginal cost of extending consumption to another user is zero. Examples include knowledge, airwaves, streetlights, lighthouses, national defense, and clean air and other environmental goods.

Quasi public goods, sometimes called impure or near-public goods, are semiexcludable or semirival. Examples include road and parks: they are semi-excludable because of the costs of building a tollbooth on a road or a fence around a park, and semi-rival because of the effects of congestion on a transport corridor or a park. Most public goods are quasi public goods, which have three subcategories:

- *Club goods* are excludable at a nominal cost but nonrival. A properly designed benefit system with a toll or pricing scheme requires users to reveal a preference, in which case they will be charged accordingly. Examples are regional roads and rails, air control networks, and power grids.
- *Common pool resources* are usually nonexcludable but rival. Their benefits are delivered in flows, they are subject to congestion, and their overuse leads to their depletion and eventual disappearance if each individual pursues his or her own self-interest. Examples are communal grasslands and stocks such as fisheries, forests, and irrigation systems.
- *Joint-product quasi public goods* provide multiple outputs. If one of the outputs is a private good, it is more likely that the public good will be provided. Examples are a regional electricity grid such as the Southern African Power Pool and the rain forest in Central Africa.

Improving the design of institutions to increase the supply of regional public goods requires looking beyond the regional economic commissions to the full diversity of regional, national, and local actors that shape the extent of the regional spillovers. Among them are regional organizations not recognized by the African Union, such as the monetary and customs unions in West, Central, and Southern Africa and the river basin organizations on the Nile, Niger, and Senegal rivers, each well placed to deliver regional public goods.

Regional collaboration to provide regional public goods may sound sensible, but it is extremely difficult—because the parties have to resolve three issues. First is understanding the type of regional public good that is to be provided and devising the best arrangement to deliver it. Second is making sure that the jurisdiction of the regional authority to deliver the public good matches the geography of the problem to be solved. Third is delegating national sovereignty to a regional authority to finance and oversee its implementation.

Broad policy agenda for regional collaboration

Growing economic interdependence and integration through cross-border flows of people and agricultural commodities raise the need to manage spillovers between countries on a common basis and address potential risks and tensions. If successful, the development of transboundary road networks, information transmission, and energy power pools promises productivity increases, but if financing and maintenance are not coordinated, such development threatens disruption.

Spillovers

Spillovers—also known as externalities[243]—include conflicts, floods, droughts, and other calamities that cross national boundaries. They take many forms. Some are a consequence of geography, depending on the nature of the border or the need to share lake waters or river basins. Others, such as pollution, are a result of economic activity. Externalities are common when property rights are ill-defined or uncertain and markets cannot signal to efficiently allocate resources or, at the extreme, are entirely missing, as in the case of a pure public good.

Correcting such cross-border spillovers calls for providing regional public goods, since the benefits (or costs) accrue to more than one country.[244] Regional boundaries across Africa are not well defined, affecting the evaluation of costs and benefits.[245] Regions such as those encompassed by the African Union–recognized RECs are determined through intergovernmental decisions, and the REC boundaries reflect historical heritage more than cultural, climatic, geographic, political, or geological dimensions or degree of interconnectedness, all of which shape cross-border spillovers.

Benefits

In Africa's fragmented geography, the benefits of regional public goods cross national jurisdictions and often extend beyond REC boundaries.[246] Decisions on providing benefits according to REC membership would overlook some recipients—this explains the persistence of the many regional organizations found across Africa. Decisions made by having the jurisdiction coincide with the benefit range of the public good it provides would call for an institutional arrangement—here an REC or regional organization—that approximates the range of spillover benefits for the regional public good, which is often difficult to determine.

And for providing some types of public goods, the configuration would theoretically go beyond intergovernmental collaboration to delegating some authority to a supranational level. This has proven difficult to achieve even in the European Union, the most successful case of deep integration, as shown by difficulties in reaching a banking union. Political dynamics within countries further complicate the institutional design for providing regional public goods.

Because water is strategically important, African states have set up intergovernmental river basin organizations and agreed on countless commitments and frameworks to regulate and sustainably manage transboundary watersheds.

Financing

Supplying a regional public good requires financing. But at what level should that take place? Some countries may not participate in funding or may participate only partially because they know they will get some of the benefits whether they participate or not. Some countries may decide not to participate because of scarce financial resources that are already earmarked for other priority activities with more limited cross-border spillovers.

One problem with the RECs overseeing the financing of RPG provision is the small size of African markets, which means that countries suffer from fairly high fixed costs and limited economies of scale in providing RPGs. A related problem with REC financing of regional public goods is the great disparity in per capita incomes within RECs. This can lead to undersupply, especially if providing the good depends on substantial contributions of all members, as, for example, in a transport corridor crossing multiple countries. In addition, there is great disparity in economic size between the hegemons in each group—such as Egypt in the Common Market for Eastern and Southern Africa (COMESA), Nigeria in Economic Community of West African States (ECOWAS), and South Africa in the Southern African Development Community (SADC)—and the other members. This could be good for financing if these hegemons play a leading role. But why would they, if their benefits were small or uncertain, as could arguably be the case for Egypt in the Grand Ethiopian Renaissance Dam project?

The optimal provision of regional public goods may also depend on the degree of regional integration. Conversely, the provision of RPGs may promote greater regional integration as the greater familiarity of countries with each other reduces transaction costs and increases trust.

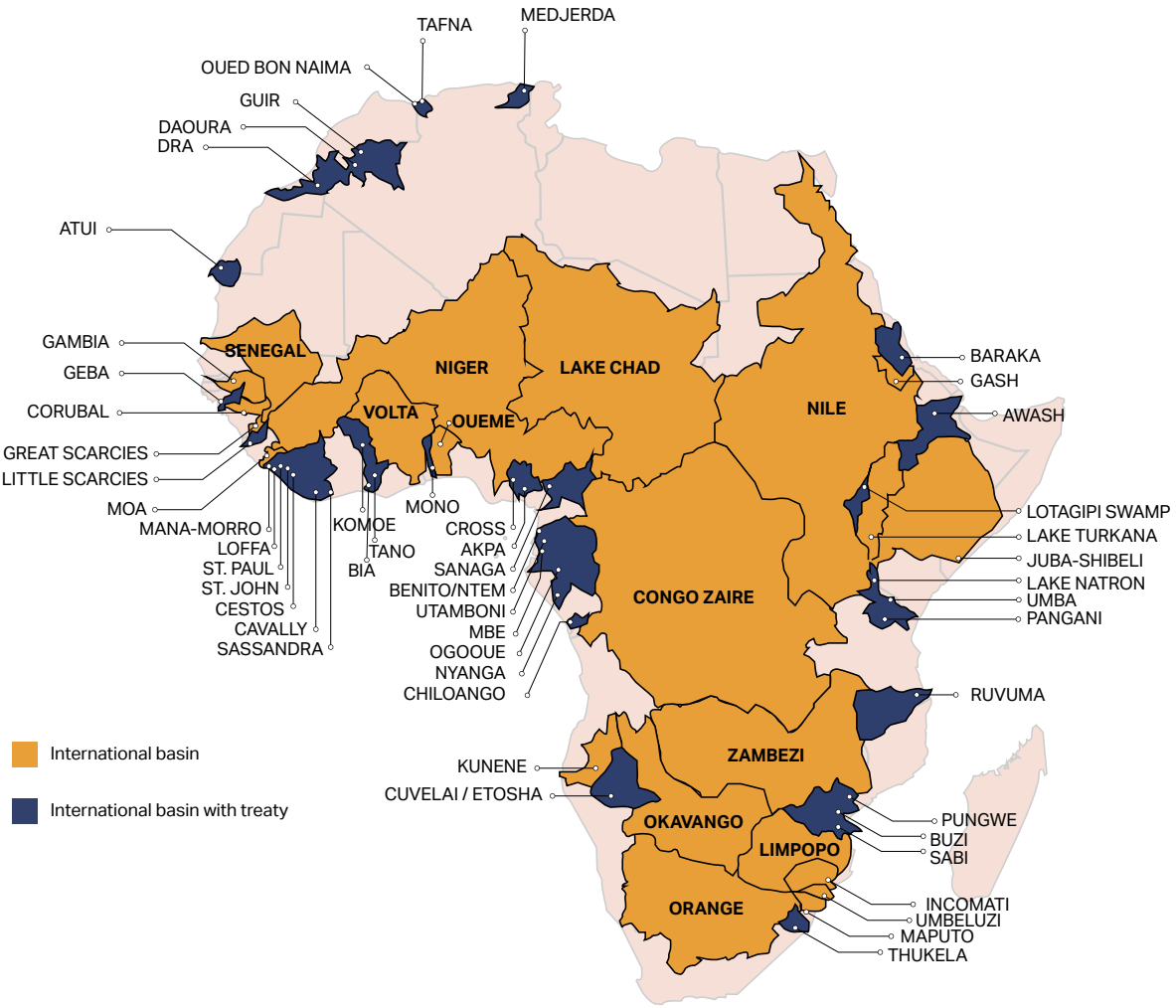
Hydropower and regional water collaboration

Only 11% of Africa's technically feasible hydropower potential is used, implying major opportunities for expansion.[247] African leaders seek to increase the use of Africa's hydropower potential to close the electrification gap that leaves around 55% of Sub-Saharan Africa's population without access to electricity.[248] Water infrastructure also features prominently in the AU's vision for the continent's development, with the Grand Inga Dam project in the Democratic Republic of Congo as one of the flagship projects of Agenda 2063. But river basins cross several countries, and water is a common pool resource, calling for joint management of its extraction by all riparian countries in a basin.

Most African countries are part of at least one transboundary river or lake basin (figure 4.2). The large number of riparian countries in many river basins complicates management of transboundary water resources. Securing freshwater, ensuring water quality, and avoiding

environmental disasters depend on the riparian countries. Because water is strategically important, African states have set up intergovernmental river basin organizations and agreed on countless commitments and frameworks to regulate and sustainably manage transboundary watersheds. In recent years, with the technical and financial support of multilateral and bilateral donor agencies, the river basin organizations have evolved into fairly uniform specialized regional organizations with a mandate covering all aspects of sustainable water resource management.[249]

FIGURE 4.2 AFRICA'S INTERNATIONAL RIVER BASINS AND FRESHWATER AGREEMENTS



Note: Borders beween international basins with treaty are not illustrated.

Source: Redrawn from UN Watercourse Convention

In practice, however, implementing river basin agendas has been slow. What is often assumed to be an issue of capacity and resource constraints is actually a set of problems that require balancing water conservation for fisheries and irrigation with hydropower development, as the Niger River basin illustrates (box 4.3).

Box 4.3 Managing river waters in high water stress areas in the Niger River basin

The Niger River basin exemplifies the difficulties of managing river waters in the water-stressed Sahel environment. Mali supports dam construction both upstream (the Fomi project in Guinea) and downstream (the Taoussa project in Mali), but for different reasons. Upstream, Mali hopes to use the Fomi dam to feed its large state-run irrigation schemes. But the dam risks reducing the seasonal flooding of the Niger River's inner delta, the world's third-largest internationally recognized and protected wetland and home to about 2 million Malians. In light of the potential benefits from upstream development, the Malian government views damage to the protected wetland as an acceptable and manageable externality internal to Mali.

Downstream, Mali has long sought to realize the Taoussa project between Timbuktu and Gao, to encourage economic activity and reduce the isolation of an area under constant threat from violent extremism. For Western donors, the low projected returns of the project due to high rates of evaporation are a major concern, while Niger and Nigeria are concerned about the impact on their downstream flows.

Since water is a common pool resource, and thus subject to overuse, managing multiple transboundary water services is difficult. Interests and incentives (as well as self-sufficiency) are often at odds, resulting in competition between countries and tradeoffs within countries between short-term gains and long-term benefits. Flow management and flood control are critical services in the seasonal basins of Africa, but excessive water storage during the dry season or discharge during the wet season in one country threatens water security for all downstream countries. And adequate flood control may mean different things for upstream and downstream stakeholders, as shown by water service management along the Niger River basin.

Regional power markets

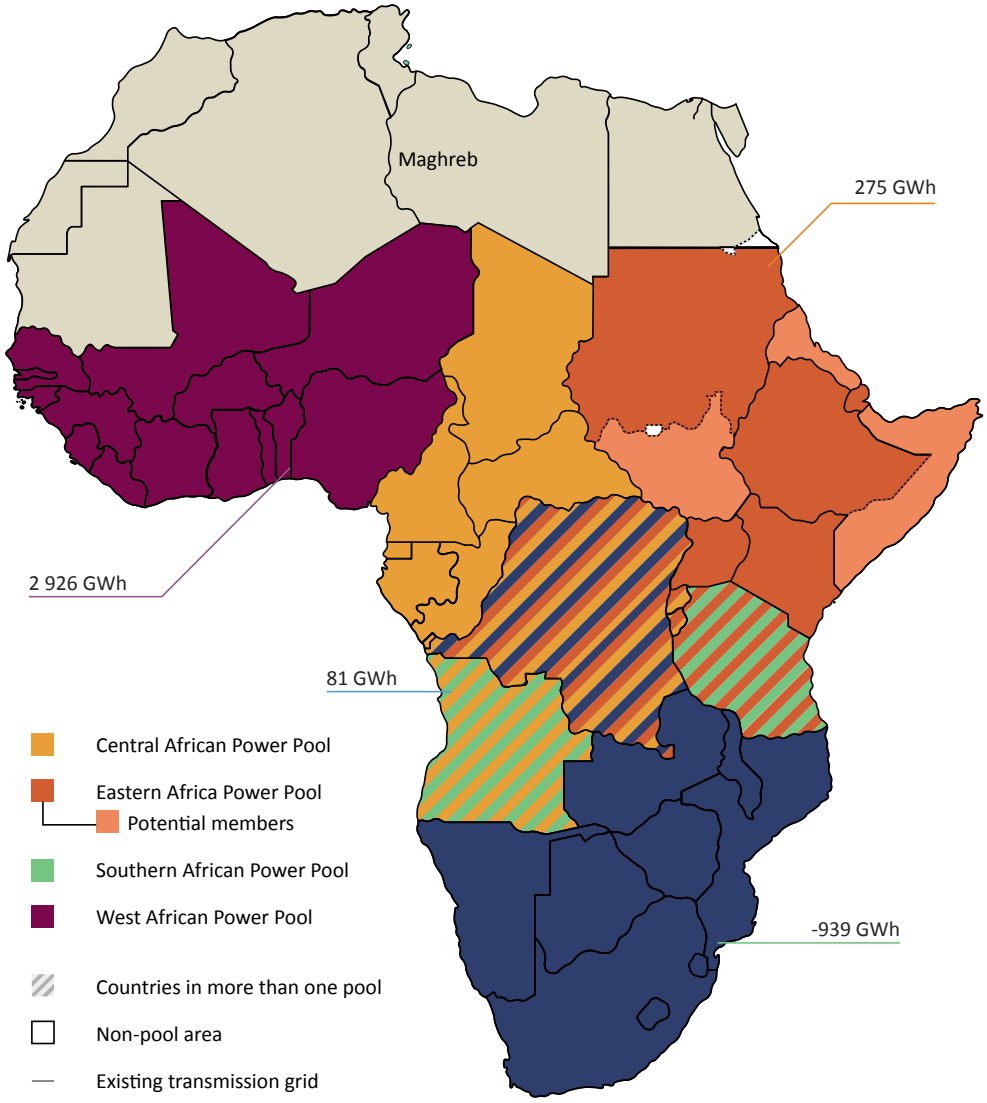
Regional power markets highlight the political difficulties of seeking regional electricity markets. Electricity is transported across national grids that connect producers with consumers, serviced by one or more utilities that facilitate the transaction. Consumers usually pay for access according to the amount of energy they take from the grid. National grids are generally self-contained, but power can be transferred from one national grid to another through dedicated infrastructure for cross-border power sharing.

Regional electricity sharing ranges from deep integration to unplanned and even temporary arrangements. Collaboration through bilateral agreements offers stability but generally fixes the price. For example, the 500-kilovolt high-voltage direct current line between Ethiopia and Kenya is nearing completion, which should enable a 400-megawatt power purchase agreement

between the two countries.[250] Joint ownership, another model, enables sharing electricity on a fixed basis among more than two countries. In the Senegal River Basin Development Organization (Guinea, Mali, Mauritania, and Senegal) membership involves joint investment and ownership of hydropower and transmission infrastructure, with each country allocated a fixed percentage of the power at a fixed price. Both these models have dealt with cross-country energy coordination through fixed contracts that reduce flexibility and ignore fluctuating demand in different places.

Another possibility is a regional market mechanism as part of a power pool. Five African power pools are at varying stages of implementation, with overlapping memberships (figure 4.3). Though the West African, East African, and Southern African power pools all have energy transmission interconnections, so far only the Southern African Power Pool has a functioning regional market mechanism for channeling a small part of regional electricity trade.[251]

FIGURE 4.3 SUB-SAHARAN REGIONAL POWER POOLS



Source: International Energy Agency 2019.

The case for developing energy markets across Africa is compelling. Energy-producing countries get access to larger markets, grid losses are reduced by selling power to nearby customers, countries and areas with energy deficits or limited generation potential have access to reliable power imports, and grid development at scale allows countries to save resources by reducing their dependence on portable energy and often outdated solutions.[252] Power pooling and cross-border trade can accelerate electrification on the continent and create an incentive to invest in large-scale renewable projects. a realistic integration scenario would save $860 billion over 2014–40 (17% of the cost of electricity), representing an annual gain of $33 billion.[253]

The critical conditions that must be met for regional power sharing, in addition to the regional framework for it, include:

1. Sufficient excess installed capacity in net producing countries. Because of periods of peak demand, a regional market can perform as designed only if installed capacity exceeds both national and regional demand.

2. Reliable interconnections for transfer energy from one grid to another.

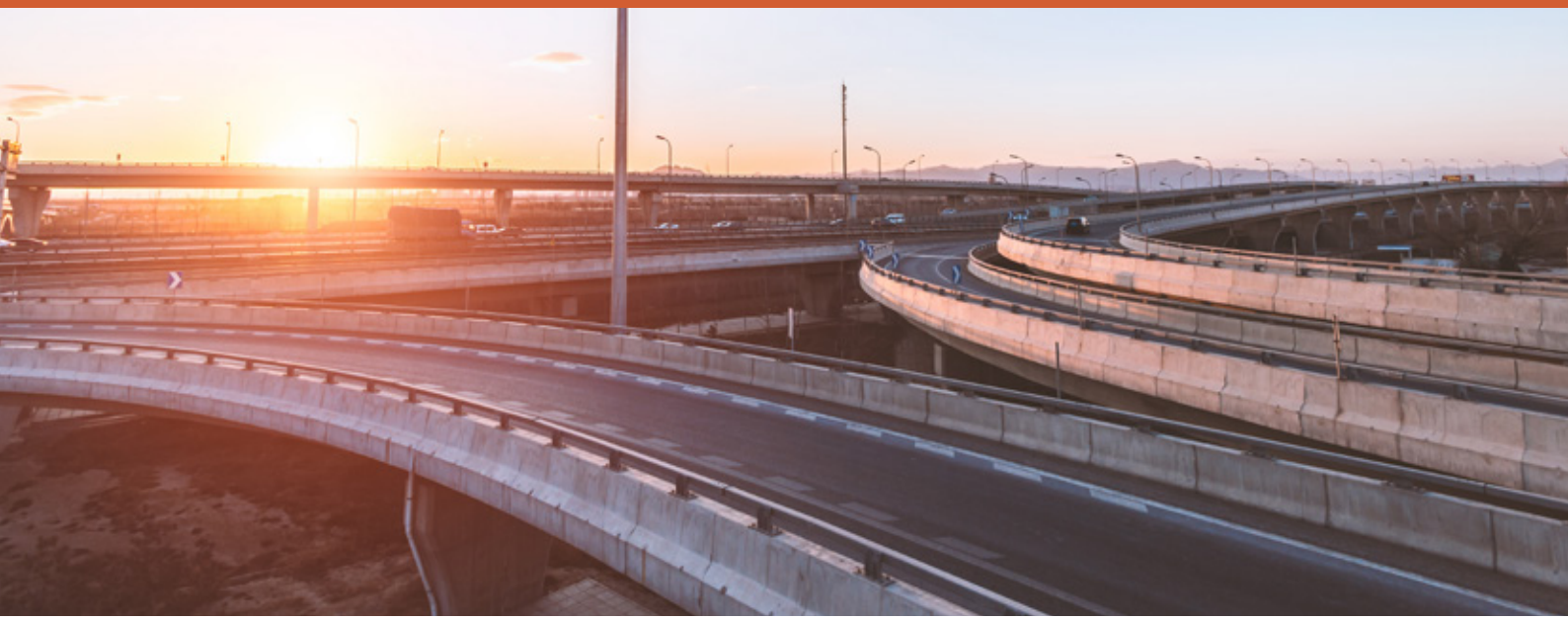
3. Independent utility companies that are free of political pressure and able to engage in short-term electricity trade on a regional market.

4. Regionalization of regulatory policy (to reduce the vulnerability to national regulatory systems).

These conditions are not yet in place in most of Africa's regional power pools. Conditions 1 and 2 relate to hard infrastructure. If there is not enough tradable supply to meet demand, countries will not entrust their energy security to their neighbors. In East Africa, for example, having one future major producer and several energy-deficient consumers does not present a strong case for dynamic trading—instead, countries favor the security of bilateral power purchase agreements.

Conditions 3 and 4 concern soft infrastructure for regional energy markets. If members have enough trust to set up an independent regulatory institution, perhaps with external support, regulatory reform might succeed. Trust is always difficult to build, especially among heterogeneous groups. Internationalizing regulatory policy should stabilize regulatory reform by reducing the problem of regulatory capture. [254]

The case for developing energy markets across Africa is compelling. Energy-producing countries get access to larger markets and grid losses are reduced by selling power to nearby customers.



Road networks

Africa's road density of 3.4 kilometers per 1,000 people is less than half the global average, while its paved road density of 0.7 kilometers per 1,000 people is less than a fifth of the global average.[255] Compared with costs in the United States, the cost of transporting goods is estimated at 3.5 times higher in Ethiopia and 5.3 times higher in Nigeria.[256] In landlocked Ethiopia, a drop in tariffs on inputs was associated with increased productivity for firms with access to quality roads, but not usually for other firms.[257]

Africa's combination of low urbanization and poor connectivity keeps a large part of Africa's population from having access to regional and global markets. Africa is the least urbanized region in the world, with just 43% of the population living in urban areas compared with more than half in other regions.[258] In Europe, doubling city size has been estimated to boost productivity by 3%–8%.[259] In Africa, increased urbanization would presumably also raise productivity, and increasing market access is a priority for urbanization.

More urbanized and faster urbanizing countries have built more roads.[260] Centralization was consistently correlated with more paved road construction. A study of 39 African countries estimated that increased market access from improved roads contributed an extra 5%–10% to urbanization over 1960–2010.[261] For the proposed Trans African Highway project (to expand the 1,490-kilometer network in 2010 to 42,000 kilometers by 2040), the increased market access enabled by the expanded network would increase urbanization by 0.7%–6%. Since urban labor productivity is higher than rural labor productivity, these analyses support Africa's emphasis on hard infrastructure to boost productivity and promote economic growth.

Logistics services—the soft infrastructure needed to operate transport corridors—complement the hard infrastructure of roads and railways and influence prices. Trade costs due to poorly functioning logistics markets may be a greater obstacle to trade than tariffs and nontariff barriers.[262]

Good logistics—such as trucking services, terminal operation, and freight forwarding and handling—mean efficient services. The higher costs, despite lower wages in Ethiopia and Nigeria, presumably reflect such factors as high maintenance costs, excessive regulation, and

long waiting times and heavy duties at international borders.[263] Logistics markets operate more efficiently when terminal operations and freight forwarding, and handling services can improve how goods are cleared through customs.

Widespread cross-border spillovers—both physical (environment) and policy (air transport, transport corridors)—promise high benefits to common regional policies. As trade barriers fall, inefficient infrastructure for the transit of goods becomes a greater hindrance. Because trade liberalization has internationalized communication infrastructure, the associated networks operate more efficiently when they are organized internationally. And regulation that is coordinated regionally can counter local forces that aim to suppress international competition.[264]

However, while hard regional transport infrastructure is improving in Africa, logistics markets are not. One reason is that all African infrastructure straddles jurisdictions. Regionwide infrastructure reform would help at several levels. Standards harmonization or mutual recognition agreements would reduce trade costs and weaken the power of domestic providers.[265] But because this would require delegating authority to a supranational level, the prognosis for supply is cloudy.

Differences among member countries can also create high costs for implementing common regional policies.[266] Common decisionmaking can diverge from preferred national policies, eroding national sovereignty. Coordinated policies and harmonized regulations and legal institutions face resistance from those who benefit from the status quo. Like a trade agreement, a common regulatory framework is a "club good" (excludable through entry fees), and members not applying it essentially opt out of the club, thus reducing the overall benefits to all members. This situation is at the root of the coordination failure of infrastructure harmonization.

Digital connectivity

The digital economy is expected to be the fastest growing sector in the world economy.[267] Regional and global digital connectivity are particularly important. In the East African Community, regional digital connectivity can operate as a hub-and-spoke network, as in Kenya, where the hub and the spokes communicate almost without cost once the physical infrastructure is in place. With digital connectivity, the high fixed costs of building the network contrast with the low cost of operating it. Digital hub-and-spoke networks are also subject to a holdup problem, because the spokes may be reluctant to cooperate with the hub for fear of increasing the hub's bargaining power. The overall level of service depends most on the hub, giving it greater importance. The holdup problem requires a minimum of participation to reap economies of scale but also a small number of participants because of the need for trust.

The East Africa One Network Area (ONA) reveals the benefits and challenges of network connectivity. In 2015, the EAC set up ONA to harmonize mobile phone markets across the EAC. The first phase aimed to harmonize markets in Kenya, Rwanda, South Sudan, and Uganda under an agreement to reduce and ultimately eliminate roaming charges for calls across member country borders. ONA also stipulated waivers of excise taxes and surcharges on incoming ONA voice traffic and wholesale and retail price caps on outbound ONA traffic. The rollout of this initiative was well received by consumers and the private sector. In mid-2015, ONA was extended to data and mobile money transactions, both key to developing cross-border trade and regional value chains, an objective of the AfCFTA.

Africa's combination of low urbanization and poor connectivity keeps a large part of Africa's population from having access to regional and global markets.

After ONA implementation, inbound roaming calls to Kenya from Rwanda increased by more than 950%, and retail roaming rates in Uganda dropped eightfold to around US$0.10 a minute.[268] Cross-border traffic tripled in both Kenya and Uganda and increased nearly fivefold in Rwanda and thirtyfold in South Sudan.[269]

ONA is part of the East Africa Single Digital Market Initiative, focused on a single connectivity market, a single data market, and seamless digital content access. Major gains are expected in the next 10 years that would add 0.6–1.6 percentage points to GDP growth and create 1.6–4.5 million new jobs. Existing internet users would capture $1.2–$4 billion in consumer surplus due to falling broadband prices.[270]

To succeed fully, ONA must keep improving its regulatory framework to eliminate charges for receiving voice calls while roaming, waive excise taxes and surcharges on incoming ONA voice calls, and establish wholesale and retail price caps on outbound ONA traffic. These steps require mobile network operators to renegotiate with their roaming partners to reduce wholesale tariffs on cross-border calls.[271] Unlike transport networks, ONA is a private sector initiative, sparked by competition among firms, which may have seen ONA as a way to reduce or eliminate government taxes and surcharges on incoming international calls."[272]

Despite this progress, challenges remain, primarily around financing telecommunication infrastructure to provide low-cost and accessible roaming services for faster connectivity. ONA also falls short in managing and monitoring full implementation, particularly eliminating taxes on roaming transactions, which create substantial government revenues.

Applying a problem-driven approach to providing regional public goods

Providing regional public goods requires a series of public policies and services. Even if countries agree to a customs union, for example, facilitating trade depends on instructing, empowering, and motivating customs officers at the border to change the way they work. Similarly, the functioning of power pools depends on national utility companies, whose efficiency depends on internal management and its authorization by the political jurisdiction to operate, innovate, and collect and invest resources. A problem-driven approach can determine the interests of countries, the incentives of domestic players, and the type of policies that are appropriate and thus help overcome implementation gaps in RPG provision (box 4.4).

Box 4.4 Five broad policy types

Some policy problems are easier to address than others, depending on how far they deviate from business as usual. The effort required for change and the persistence of change depend on the level at which decisions are made, the degree of local discretion required for successful implementation, the demand for change, and the degree of innovation required to address a problem. These considerations produce five broad policy types:[273]

- *Fairly easy:* Decisions depend on a limited group, and implementation also requires action from a fairly limited group. Examples include shaping monetary policy (given its centralized control), adopting a regional strategy, and establishing specific regional units or agencies.
- *A bit harder:* Designing policies generally requires more intensive negotiations, but implementation does not require a high degree of local discretion. Examples are setting up payment systems, building electricity interconnections, setting up electronic customs systems, and building transport and one-stop border-post infrastructure.
- *Harder still:* This category of policies requires agreement by many agents, and implementation requires a degree of local discretion and buy-in. Yet the service responds to a broadly recognized demand. One regional example is a simplified trading regime for small-scale traders that exempts them from import duties.
- *Even harder:* These policies are more difficult than the previous category, because they require compliance or a behavioral change but do not stem from local demand. An example is managing a border post on a transport corridor.
- *The hardest:* In addition to requiring agreement by many and decisionmaking at the local level, the problem to be addressed has no known solution and thus requires an experimental approach to policy change. Construction of upstream water infrastructure is an example. Although construction of a dam, such as Ethiopia's Grand Ethiopian Renaissance Dam, is fairly straightforward, it requires agreement by a wide range of stakeholders in downstream countries when it comes to operating it. A change in a river's flow affects the way countries have to handle indirectly related goods such as energy, irrigation, and flood management, for which solutions need to be developed locally, rather than developed centrally and applied locally.

Each policy problem calls for a different approach to implementation. Factors such as the level of decisionmaking, the degree of local discretion, and the demand for change define how much the political and organizational environments support change. If some of these factors are misjudged or ignored, policies become difficult or even impossible to implement, regardless of the government's motivation. Superficial or temporary change often follows and ultimately undermines the provision of an RPG.

The regional public goods framework can help avoid many pitfalls of regional collaboration.

Providing regional public goods implies coordinating the actions and incentives of multiple groups at the regional and national levels, posing significant (domestic and regional) political challenges. Collaboration, perhaps with some delegation of authority to supranational entities, is essential to any regional public goods approach and can focus on matching traditional policy supply with the demand for better defined regional benefits through regional public goods. Regional organizations are the vehicles to provide regional public goods. They should be adapted so that the institution's jurisdiction matches the geographic range of the public good (and not just the boundaries of REC membership). Adherence to this match should boost efficiency, promote institutional evolution, and make it easier to manage the political economy factors that complicate the design and evaluation of the regional organizations supporting regional public goods.[274]

The regional public goods framework can help avoid many pitfalls of regional collaboration. While regional collaboration and integration are inherently messy and gradual, this framework can support an iterative, bottom-up approach for planning the policies and initiatives to deliver RPGs and thus to promote regional collaboration and integration (see infographic 4.1 and annex table A4.1).

The RPG framework starts by asking what domestic issue or problem needs addressing through the provision of an RPG. Regional collaboration is not an objective—it is a process. Building the capabilities of countries and organizations to address the identified problems is ideally iterative. The experience of regional collaboration through repeated cycles of problem definition, program implementation, and adaptation increases the feasibility of further collaboration and provides greater interconnectivity.

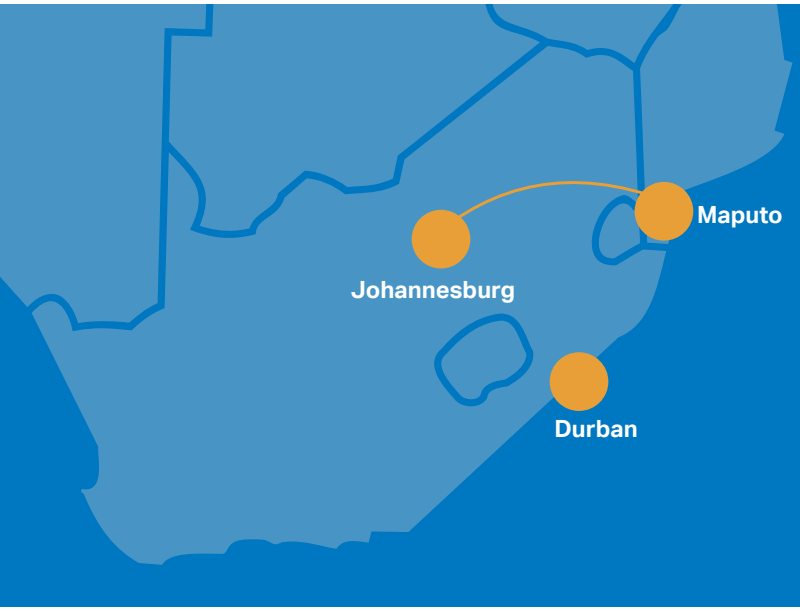
A problem-driven approach is not in itself a solution to past regional integration frustrations. Yet, focusing on feasible solutions can advance regional collaboration in the long run. The Senegal River Development Organization, for example, was launched in the 1970s to respond to the urgent problem of decreasing rainfall in the Sahel region. Rather than take an open-ended aspirational approach as many other African river basin organizations have done, the member states set out from the start to develop jointly owned hydropower infrastructure in the Senegal basin. This required support and agreement at various levels. To this day, the Senegal River Development Organization is seen as a guiding example for water cooperation across the continent.[275] The joint infrastructure has underpinned the basin countries' diplomatic relations for some time, making further cooperation and investment much easier. Widespread confidence in the approach, due to their commitments, putting the regional organization in a much stronger and even authoritative position toward its member states.

A more recent example is the Nile Basin Initiative.[276] In a tense environment among protagonists Egypt, Ethiopia, South Sudan, and Sudan, the initiative has focused on technical, more apolitical projects, using training and knowledge sharing to establish formal and informal working relationships and trust among the people in riparian countries who are working on water issues. The initiative also championed sub-basin arrangements to foster collaboration closer to the rivers and lakes themselves, partially bypassing the longstanding conflict between Egypt and its upstream neighbors. Even though these solutions are far from perfect, they have had a positive impact on regional collaboration, notwithstanding continuing regional politics around the dam.[277]

Finally, the Maputo Transport Corridor between South Africa and Mozambique offers an example of problem solving between two economies with very different incomes. After the end of South Africa's apartheid and of Mozambique's civil war, the countries' leaders discovered a joint interest in an additional, closer outlet to the sea for South Africa's industrial heartland via Maputo, which would reduce congestion in the port of Durban. The transport corridor was completed in the late 1990s. As a club good, the program needed each country to pay by investing in the corridor and pursuing trade and investment benefits. This prevented free riding. To avoid coordination failure, the effort required close political dialogue (bolstered by the context of post-apartheid and post-civil war reconciliations).

Poor connections on either side of the border would lower the corridor's overall benefits to both countries. That feature encouraged both sides to ensure that the project was well-financed and harmonized in operation, with a cross-border public–private partnership agreement for road construction and maintenance. In implementation, road building and maintenance are politically simple, but day-to-day operation at the border is an implementation-intensive imposition of obligations that today create a bottleneck constricting the flow of the full benefits of the corridor. This suggests a need to identify areas of collaboration, such as digitalization of border procedures, that also lower the transaction intensity, a need for local decisionmaking, and a need to analyze the causes of resistance and ways to incentivize change, whether within the system or by changing it.

The problem-driven RPG approach also extends to other ongoing cross-border challenges across Africa. The characteristics of a particular RPG help explain blockages and thus the elements that policy should concentrate on. Adopting a problem-driven approach to regional collaboration can liberate RPG provision from the capability traps that impair regional cooperation frameworks worldwide. Persistent implementation failure, which erodes the legitimacy of regional cooperation, cannot be resolved by rushed, overambitious policy statements that are unlikely to be realized. Building capabilities at the source by promoting implementable cross-border solutions for regional problems offers a new dynamic for regional actors in Africa. RPGs offer a conceptual framework for regional collaboration needs and problems and can provide operational guidance for regional integration and collaboration through workable solutions independent of existing diplomatic frameworks.



The Maputo Transport Corridor between South Africa and Mozambique offers an example of problem solving between two economies with very different incomes.

COVID-19 as an opportunity to jump-start regional collaboration

The COVID-19 pandemic and country responses could be a tipping point for jump-starting regional collaboration in Africa, just as the 2004 tsunami triggered cooperation among the Association of Southeast Asian Nations in setting up an early warning system. But so far, countries have closed their air and land borders rather than engage each other in collaboration. But greater collaboration is gaining ground.

The African Union's Centers for Disease Control and Prevention, set up in the wake of the West African Ebola crisis, have managed to provide continent-wide leadership on providing information to governments, liaising with the WHO, and making initial steps to pooled purchases of medical equipment and negotiating debt relief for African countries. The regional economic communities have taken varying approaches to the pandemic—ranging from regional-scale pooled procurement mechanisms in ECOWAS and EAC, regional attempts to raise finance across the RECs, and information sharing on the different border and lockdown measures in COMESA.

Though some collective action has taken place, as with many regional efforts at cooperation, incentives within and between countries do not always align. The RECs often lack the authority to instruct member states what to do. So, alongside calls to coordinate border measures to ensure safe trade facilitation, the EAC secretariat was quick to propose testing for truck drivers at borders and prioritizing necessary goods such as medical equipment and food. But in practice, this is carried out by different government services at specific border posts, where regional harmonization has proven hard to achieve, while failures to arrive at joint solutions risks creating food shortages.

Some actors, such as TradeMark East Africa, are working with authorities to put in place specific measures to address social distancing for drivers, while the EAC secretariat is trying to boost testing capacity. They depend on actual agreement between heads of state, where some states are taking a less stringent approach to the virus, notably Tanzania. And with overlapping REC membership, harmonization essentially requires, say, COMESA, EAC, and SADC to all agree on the measures to be put in place, thus requiring further coordination. Even with the current urgency, this is a challenge.

Going forward, it will be important to ensure that practice at the local level can be harmonized—for example, on both sides of a single border between Kenya and Uganda, while attempting over the longer term to ensure wider harmonization. The REC secretariats continue to have a role in coordinating joint actions, and in continuing to provide information and a forum for regional leaders. But the immediate cross-border problems may need addressing through more locally grounded coalitions.

Such coalitions can do more than speed recovering from the pandemic. They can lay the groundwork for fostering regional collaboration in ways that promote regional integration and set countries onto trajectories for sustainable economic transformation.

The COVID-19 pandemic and country responses could be a tipping point for jump-starting regional collaboration in Africa.

Priorities for action

Collaborating to provide regional public goods requires shifting from relying only on the traditional top-down approach with regional organizations taking the lead in trying to convert regional commitments to national actions—to a bottom-up approach that starts with identifying local or national problems with a regional reach and formulates the policy responses. This requires linking national development plans and programs with regional plans and programs (figure 4.4).

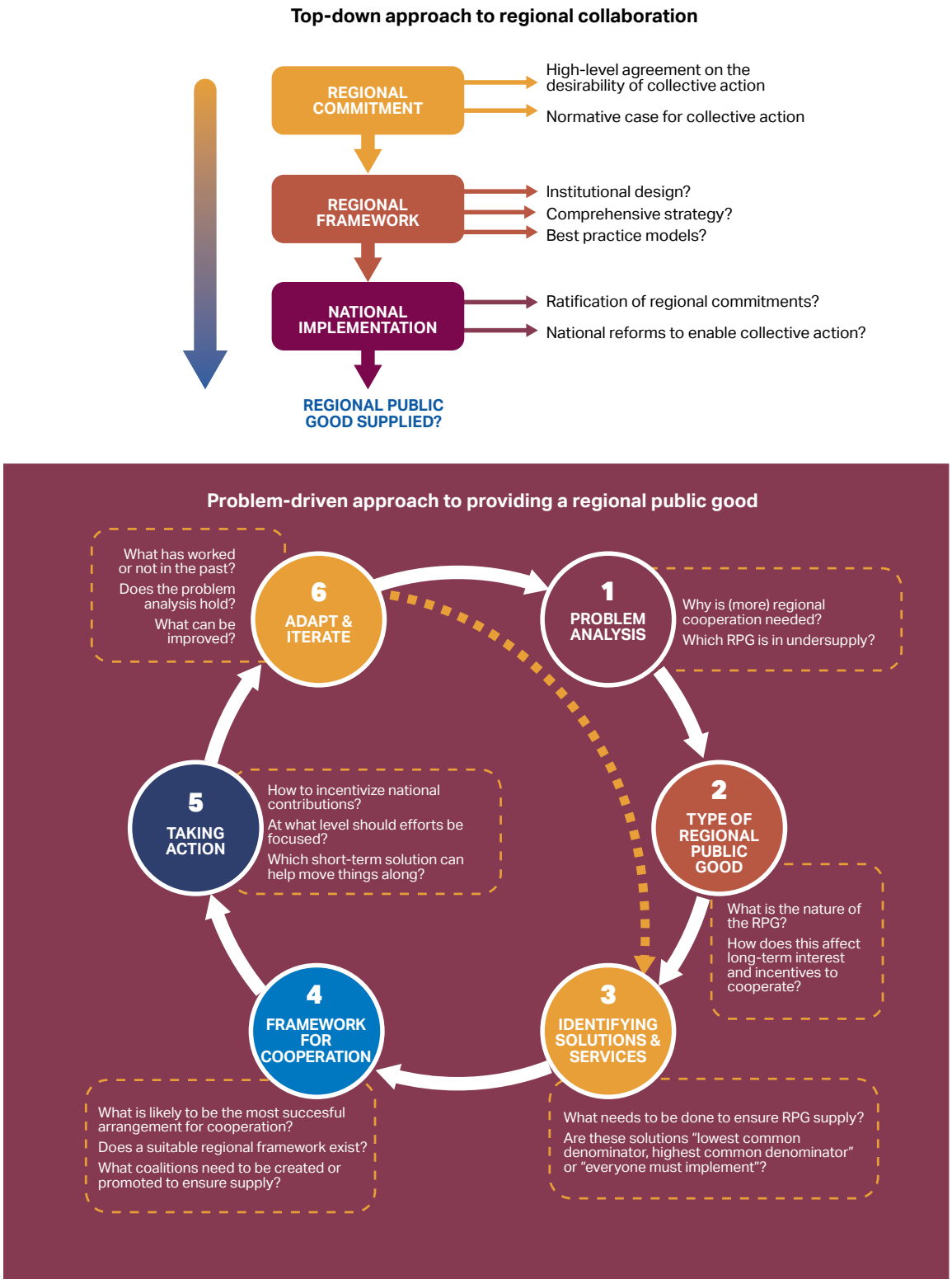
The bottom-up problem-solving approach to providing regional public goods determines the interests of countries, the incentives of domestic players, and the type of policies that are appropriate, thus helping to overcome implementation gaps. It starts by asking what domestic problem needs the provision of a regional public good. To address the problem, it builds the capabilities of countries and organizations through repeated cycles of program implementation and adaptation, increasing the feasibility of further collaboration.

Reframing regional collaboration as addressing national problems

One way to address this is to reframe these top-down processes as entry points for addressing the problems at the local or national level. That requires understanding some of the needs or ambitions of stakeholders that could be advanced by collective, regional approaches. It also requires understanding how the high-level trade or other regional collaboration agreements might help provide a useful framework to address those needs.

The AfCFTA can arguably help firms find new markets or source inputs from beyond their regional trade bloc—which are those firms, and how to ensure their current difficulties are addressed? For example, regional collaboration around dam construction and water levels can help address issues of energy access and irrigation, and can facilitate financing national priority projects. And framing problems in this way can help generate momentum for implementing agreements.

FIGURE 4.4 COMPLEMENTING THE TRADITIONAL TOP-DOWN APPROACH WITH A BOTTOM-UP APPROACH TO COLLABORATING FOR THE PROVISION OF REGIONAL PUBLIC GOODS



Source: Annex A – Table 4.1

Also needed is understanding the types of regional public goods. Does part of implementation require collective action across multiple countries for the benefits to be realized, as in creating a free trade area or a communications network, where all participants must be mobilized (a summation regional public good)? Is it a weakest link issue, where the focus has to be on key bottlenecks, as in managing epidemics or transport corridor blockages due to nontariff barriers (border officials demanding side payments)? Or is it something where a best shot from any participant will ensure benefits for all, as with a vaccine? Identifying the type of regional public goods can help identify the services and solutions essential for implementation. For example, TradeMark East Africa model of flexible donor support to reduce regional trade costs in East Africa reflects this way of matching top-down initiatives and agreements with bottom-up problem-solving around different types of regional public goods, adapting support to the type and needs.

Assembling coalitions for change

Identifying the problem should be followed by understanding which actors, within and across affected countries, can champion and help undertake implementation and at what level. Is the issue more likely to be successfully addressed through national, bilateral, or a larger regional group of countries? Does everyone need to be equally involved, or just a few, for the regional public goods to be provided? Does a suitable collaboration framework already exist? Is it flexible enough?

A common assumption is that regional collaboration and integration must take place through regional organizations. Experience shows that this is not always the case. Regional secretariats and commissions are important actors, but they are not always well-placed or indeed mandated to lead or promote implementation of the agreements they have helped foster.

Sometimes reform coalitions can stem from high-level political initiatives, but they often require a combination of different regional, national, and perhaps even local actors to be on board—thus providing 'demand' for the regional good. The Maputo Development Corridor fits this approach, mixing high-level engagement with private sector engagement and wider initiatives for those less directly involved.

Resolving problems is about working with and for specific constituencies, as with private firms seeking to trade more easily, in civil society seeking to protect citizens engaged in cross-border movement of livestock, or public agencies seeking to apply formal rules in complex and fragile circumstances. Of course, some stakeholders may stand to lose from certain aspects of regional collaboration, requiring that solutions be sought by engaging with these groups, and potentially offset their losses.

A common assumption is that regional collaboration and integration must take place through regional organizations, but experience shows that this is not always the case.

Work to help roll out the COMESA Simplified Trade Regime sought to build such coalitions around key border posts where the regime will be implemented. Civil society organizations that seek to train, inform, and support informal traders in West Africa can also help ECOWAS implement its customs union.

Using the AfCFTA's political momentum for wider regional public good implementation

The AfCFTA currently enjoys a lot of political momentum and attention. But for the main benefits to flow, other regional public goods have to be in place—not just existing regional trade liberalization agendas on which the AfCFTA builds, or hard and soft trade and transport infrastructures, or better aligned quality and standards frameworks. It will also require cross-border energy connections and markets to ensure viable energy distribution and wider access to it; regional arrangements for reliable and appropriately priced mobile telephony roaming and internet connections; more flexible movements of people and labor, recognizing qualifications; and coordinated responses to insecurity and climate change. All are forms of regional public good provision—addressing different problems, with different regional public good characteristics, requiring different coalitions of reform. At the same time, existing regional collaboration frameworks and agreements have often struggled with implementation.

Each of these additional regional agendas is an important facilitator for delivering AfCFTA benefits, but in a circular way they can also benefit from the political momentum behind the AfCFTA. The AfCFTA can thus be an impetus for why more regional collaboration and integration are necessary. It can also promote dialogue on how best to pursue regional collaboration, and how to prepare different actors to contribute to delivering the greatest benefits.

Collaborating to tackle the three frontline challenges covered in this report

Ensuring productive employment

The free movement of workers and business people is a big issue for Africa's labor market. Though the AfCFTA has much of the attention, the closely connected Protocol on the Free Movement of People has far less, with only four countries having ratified it.

Consider this political matter in terms of the bottom-up problem-solving approach proposed here:

Creating a common market with the free movement of people requires all countries to implement one. But it may be possible to address movement at a narrower, sectoral level, addressing specific markets. In a regional framework, different actors could agree to allow increased movement in agreed sectors. A coalition of interested private and public parties from two or more countries could then coordinate their efforts to increase political traction, all framed as making the AfCFTA a reality given the need for cross-border services to support trade in goods.

In the East African Community, the private sector identified the lack of mutual recognition of professional qualifications across borders as hindering the regional market. Without the lead of a regional body, groups from sectors such as accounting found ways to ensure mutual recognition of qualifications among professional associations to allow better cross-border integration of professional services. For accountancy services, an agreement was signed by all the professional institutes without substantial preparatory work. For engineering services, an agreement initiated by the registrars in Kenya, Tanzania, and Uganda was signed only by the engineering boards, which saw their underlying qualifications and forms of regulation as sufficiently similar to allow for mutual recognition. For architectural services, and agreement was initiated by the East Africa Institute for Architects, a regionwide umbrella organization for the bodies representing architects in each country.

Other examples include regional training centers. The COMESA African Leather and Leather Products Institute training centers—though not "regional" as such—take place in one country with wider regional benefits (best shot approach). They also address the problem of how to add value to the large livestock population in several COMESA countries, again working with a coalition of interested parties, including the Zambia government, to increase buy-in for the approach.

Supporting digital innovation

For innovation to fully benefit Africa requires well integrated digital infrastructure across the continent. While regional agreements to harmonize standards are necessary, they often are not enough. Some technologies call for agreement on leadership, which suggests a transfer of decisionmaking to a frontrunner that can provide a public good to the benefit of multiple consumers. The East Africa One Network Area roaming initiative lowers the cost of roaming and communications among Kenya, Rwanda, South Sudan, and Uganda through regulatory intervention and coordination—and Tanzania joined in January 2021. Again, the case for connecting digital infrastructure to benefit from the AfCFTA is quite clear.

Aligning national innovation systems may offer another opportunity, but it needs to be clear for whom and for what. Similarly, aligning national digital innovation strategies with the AU digital transformation strategy may seem attainable (best shot), but the challenge is in the implementation. Technological and regional solutions can be helpful, and organizations and capacities exist to provide them, but only if responding to demand and need: What is the issue they seek to address?

Having identified the problem that innovation systems seek to address, the question is to see what kind of regional public good is envisaged—is it about a framework, or about eliminating weakest links and therefore which actors need to be involved? While the AfCFTA will lead to negotiations on the digital economy, broader innovation systems will complement the AfCFTA with new business models and technology applications that will produce more jobs.

Managing climate risks

Preserving blue and green ecosystems requires regional collaboration on multiple issues and in multiple forms, so a more problem-focused approach can help get beyond broad climate-related policies to implementation. Even if regional organizations exist for this, enforcing and implementing agreements remains a country responsibility. Focusing on specific bottom-up problems within these broader issues can help identify where to zoom in on specific aspects of water conservation, or energy generation and how to address the tradeoffs between and within countries.

Renewable energy, particularly through hydropower, is a good example, where upstream energy generating capacity in one country can affect downstream water availability for irrigation in another. Gathering technical data from across the river basin—helped by new tools to simplify data-sharing—can then identify key bottlenecks and tensions, specify the key actors that will be affected, and seek to address specific problems, all while addressing the broader problem of energy distribution for broader economic transformation.

Regional power pools have the potential to bring down unsustainably high energy costs for both producing and consuming countries, and accelerate the transition to renewable energy by increasing the potential market, and ensuring that infrastructure can run at full capacity (even if domestic consumption is low). While a sophisticated regional market mechanism can be set up as in Southern and East Africa, it requires sufficient installed capacity and good interconnections, and it must be driven by some key actors. The initial success of the Southern African Power Pool came from solving the problem of changing domestic and regional energy capacities and meeting South Africa's growing energy needs.

While the AfCFTA will lead to negotiations on the digital economy, broader innovation systems will complement the AfCFTA with new business models and technology applications that will produce more jobs.

The core premise of this report is the great potential for regional integration to accelerate economic transformation in Africa. Strong political leadership and commitment are required to jumpstart implementation of the AfCFTA and create coalitions of interest around corridor plans where progress is slow. More important, African leaders must drive regional collaboration and see it as the route to regional integration. This requires leaders to tackle national problems that require cross-border solutions through the provision of regional public goods using existing cross-border and subregional frameworks.

For this approach to succeed, national leaders should be willing to cede some of their authority to specialist regional bodies, when necessary, to negotiate and provide regional public goods on their behalf. They thus need to look beyond the regional economic communities to integrate regional markets, infrastructure, and societies by identifying and promoting approaches that link local dynamics with wider national and regional needs and ambitions. By aligning national and regional incentives and investing in regional public goods, African leaders are more likely to realize the efficiency gains needed to broaden and deepen the recovery and get on a trajectory for sustainable economic transformation.

References

Adams, O. 2011. "River Blindness." Chapter 4 in *Regional Public Goods: Financial Frameworks and Institutional Arrangements*. Centurion, South Africa: Collaborative Africa Budget Reform Initiative (CABRI).

ADB (Asian Development Bank). 2018. Asian Economic Integration Report 2018, Toward Optimal Provision of Regional Public Goods in Asia and the Pacific. Mandaluyong City, Philippines: ADB.

AfDB (African Development Bank). 2017.

———. 2019. A*frican Economic Outlook 2019*. Abidjan, Côte d'Ivoire: AfDB.

AU (African Union). 2012. *The Programme for Infrastructure Development in Africa (PIDA): Transforming Africa through Modern Infrastructure, The PIDA Energy Vision*.

———. 2017. *Report on the Proposed Recommendations for the Institutional Reform of the African Union*. By Paul E. Kagame. Addis Ababa, Ethiopia. Available at: https://au.int/sites/default/files/documents/33273-doc-report-_institutional_reform_of_the_au.pdf.

Andrews, M., L. Pritchett, and M. Woolcock. 2017. *Building State Capability: Evidence, Analysis, Action*. Oxford, UK: Oxford University Press.

Apiko, P., and L. Miyandazi, 2019. "Self-financing the African Union: One Levy, Multiple Reforms." Discussion Paper 258, European Centre for Development Policy Management, Maastricht, Netherlands.

Atkin, D., and D. Donaldson. 2015. "Who's Getting Globalized? The Size and Implications of Intra-national Trade Costs." Working Paper 21439, National Bureau of Economic Research, Cambridge, MA.

Barasa, F. 2019. "Why the Kenya–Ethiopia Power Highway is a Game Changer." *Business Insider*, 17 June.

Barrett, S. 2014. "Why Climate Negotiations Proved So Disappointing?" Sustainable Humanity, Sustainable Nature: Our Responsibility. Extra Series 41, Pontifical Academy of Sciences, Vatican City.

Barrett, S. 2018. "Regional Public Goods: Conceptual Foundations." Mimeo, Asian Development Bank, Mandaluyong City, Philippines.

Barrett, S., C. Carraro, and J. de Melo (eds.). 2015. *Towards a Workable and Effective Climate Regime*. VoxEU e-book.

Byiers, B. 2017. "Is the Nile Basin Initiative a 'Regional Sailboat' in Choppy Geopolitical Waters?" ECDPM Talking Points Blog, March 2017.

CABRI (Collaborative Africa Budget Reform Initiative). 2011. *Regional Public Goods: Financial Frameworks and Institutional Arrangements*. Centurion, South Africa: CABRI.

Collier, P., and A. Venables. 2008. "Illusory Revenues: Tariffs in Resource-Rich and Aid-Rich Economies." OxCarre Working Papers 004, Oxford Centre for the Analysis of Resource Rich Economies, University of Oxford.

Dadush, U. 2017. "Regional Public Goods: The Case of Migration." In Estevadeordal, A., and L. Goodman (eds.). (2017) ***21st Century Collaboration, Regional Public Goods, and Sustainable Development.*** London: Routledge.

Estevadeordal, A., and L. Goodman (eds.). (2017) ***21st Century Cooperation, Regional Public Goods, and Sustainable Development.*** London: Routledge.

Gray, J. 2018. "Life, Death, or Zombie? The Vitality of International Organizations." ***International Studies Quarterly*** 62 (1): 1–13.

Gwilliam, K. 2011. ***Africa's Transport Infrastructure: Mainstreaming Maintenance and Management***. Directions in Development; Infrastructure. Washington, DC: World Bank.

IEA (International Energy Agency). 2019. ***World Energy Outlook 2019***. Paris: IEA.

ITU (International Telecommunication Union). 2016. ***A Case Study of ONA: East Africa One Network Area Roaming Initiative***. Geneva: ITU. Available at: https://www.itu.int/dms_pub/itu-d/opb/pref/D-PREF-EF.ONA-2016-PDF-E.pdf.

Jedwab, R. 2018. "The Average and Heterogeneous Effects of Transportation Investments: Evidence from Sub-Saharan Africa 1960–2010." Working Papers *2019-8, George Washington University, Institute for International Economic Policy.*

Jedwab, R., and A. Storeygard. 2017. "Economic and Political Factors in Infrastructure Investment: Evidence from Railroads and Roads in Africa 1960–2015." Working Papers 2017-3, *George Washington University, Institute for International Economic Policy*.

Kessides, I., R. Noll, and N. Benjamin, 2011. "Regional Infrastructure Reform in Developing Countries." ***World Economics*** 11 (3): 79–108.

Mysiak et al. 2010.

Medinilla, A. 2018. "African River Basin Organisations: From the Best Practice to Best Fit." Discussion Paper 236, European Centre for Development Policy Management, Maastricht, Netherlands.

Medinilla, A., B. Byiers, and K. Karaki, 2019. "African Power Pools: Regional Energy, National Power. Discussion Paper 244, European Centre for Development Policy Management, Maastricht, Netherlands.

Medinilla, A., and M. Ronceray. 2019. "Entre cooperation et contestations: Les intérêts maliens dans la gestion des fleuves transfrontaliers du Sahel." Discussion Paper 247, European Centre for Development Policy Management, Maastricht, Netherlands.

Sanfilippo, M., A. Sundaram, and F. Z. Mulugeta. 2018. "Trade Liberalisation, Infrastructure, and Firm Performance: Evidence from Ethiopia." Policy Brief 32403, International Growth Centre, London.

Stapel, S., and F. Söderbaum, 2017. "Mapping and Problematizing External Funding to the AU and the RECs." In *The Political Economy of Regional Security Organizations in Africa, Asia and Latin America: Follow the Money*. London: Routledge.

Teravaninthorn, S., and G. Raballand. 2009. "Transport Prices and Costs in Africa: A Review of the International Corridors." *Directions in Development: Infrastructure*. Washington, DC: World Bank.

UNDESA (United Nations Department of Economic and Social Affairs). 2019. *World Urbanization Prospects: The 2018 Revision*. New York: UNDESA.

World Bank. 2016. "One Network Area in East Africa." Background note prepared for the *World Development Report 2016: Digital Dividends.* Washington, DC: World Bank. Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/23651/WDR16-BP-One-Network-Area-in-East-Africa-Kelly-Kemei.pdf?sequence=1&isAllowed=y.

World Bank. 2018. "A Single Digital Market for East Africa: Presenting a Vision, Strategic Framework, Implementation Road Map, and Impact Assessment." Washington, DC: World Bank. Available at: http://documents.worldbank.org/curated/en/809911557382027900/A-Single-Digital-Market-for-East-Africa-Presenting-Vision-Strategic-Framework-Implementation-Roadmap-and-Impact-Assessment.

World Bank and EAC Secretariat. 2016. *EAC Common Market Scorecard 2016. Tracking EAC Compliance in the Movement of Capital, Goods and Services*. Washington, DC: World Bank.

End notes

236 "Public goods—activities which most people can enjoy at little or no additional cost and from which few can be excluded—are a natural province of governments. Examples of pure public goods include investments in national defense and regulations that assure clean air, and examples of partial public goods include roads and the electricity grid. These public goods can be provided at many levels, by a city, a nation, or through a regional or global arrangement involving many countries." (Dadush in Goodman and Estevadeordal 2017).

237 Julia Gray (2018) categorizes international organizations as alive, dead, or zombies, rating organizations by predicted trade levels and meetings held. She categorizes the Community of Sahel-Saharan States (CEN-SAD) and the Arab Maghreb Union (AMU) as zombies ("their offices stay open and some minimal activity persists, but they make few meaningful advances in collaboration"), though AMU showed some signs of life in 2013 after the Arab Spring. Regional organizations rarely die, since countries seeking different benefits from multiple memberships keep them alive and, arguably, relevant as serving some interest of their member states.

238 Stapel and Soderbaum 2017. Nonetheless, most donors focus on state-led regional organizations, particularly the African Union and RECs (Soderbaum and Brolin 2016).

239 AU 2017.

240 Apiko and Miyandazi 2019.

241 According to tariff data at the HS6 level for 2014, average applied bilateral tariffs are close to corresponding average most favored nation tariffs. For example, for COMESA these tariffs are 5% and 12%, respectively, and for ECOWAS they are 11% and 12% (AfDB 2019, table 3.1).

242 World Bank and East African Community Secretariat 2016, p.85.

243 A negative externality is a cost suffered by a third party (to a transaction between two parties) that has no choice and whose interests were not taken into account. Examples are waste spilled down a river, pollution in the air, and desertification. A positive externality is a benefit to a third party resulting from a transaction. For example, the more education a person receives, the greater the social benefit, since more educated people tend to be more enterprising and so bring greater economic value to their community.

244 For symmetry, this covers regional public "bads" (RPGs with negative benefits) such as desertification and polluted rivers in downstream riparian countries in a river basin.

245 The African Development Bank defines RPGs as "goods orservices whose benefits are shared by a group of countries in the same region in a nonrival and nonexcludable way" (ADB 2018, table 7.3).

246 River blindness (onchocerciasis) transmitted by the black fly affects 30 countries in Africa. It has been the object of the successful African Programme for Onchocerciasis Control (Adams 2011).

247 International Hydropower Association 2020: 32.

248 IEA 2019: 362.

249 Medinilla 2018.

250 Barasa 2019.The interconnection will eventually be extended to Tanzania, creating a link with the Southern African Power Pool.

251 In 2015, around 6% of regional electricity trade in the Southern African Power Pool was channeled through the pool's market mechanism (Medinilla et al 2019).

252 Medinilla et al 2019.

253 See https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/PIDA%20brief%20Energy.pdf.

254 Drawing on the positive political theory of regulation, Kessides, Noll, and Benjamin (2011) present the case for regionalizing regulatory reform by constructing a regulatory agency protected from undue political intervention.

255 Gwillliam 2011.

256 Atkin and Donaldson 2015.

257 Sanfilippo et al. 2018.

258 UNDESA 2019.

259 Collier and Venables 2009.

260 Jebwab and Storeygard 2017.

261 Jebwab and Storeygard 2018.

262 Teravaninthorn and Raballand (2009) were the first to show systematically that in logistics markets, prohibition of cabotage (the transport of goods or passengers between two places in the same country by a transport operator from another country), rather than road conditions and road controls, contributed most to vehicle operating costs. They showed that the operating costs (the costs of "producing" transport) of trucking fleets were similar to those in Europe but that transport prices (the prices paid by users) were much higher.

263 Atkin and Donaldson.

264 See Kessides, Noll, and Benjamin (2011) for further discussion and a discussion of the West African Telecommunications Regulatory Association.

265 Kessides, Noll, and Benjamin 2011.

266 For example, a coastal country wants to control the flow of goods with a neighboring landlocked country while the landlocked country wants to have access to the ports.

267 The share of the digital economy is predicted to increase from the current 15% of global GDP to 25% in less than a decade (World Bank 2018, 14).

268 World Bank 2018.

269 ITU 2016.

270 World Bank 2018, 14.

271 ITU 2016. Before the ONA, even companies with networks on both sides of a common border had to build and operate those networks as separate entities, with interconnections possible only through state monopoly gateways. The move to create a common mobile telephone network, like other regional public goods, therefore faced national-level interests and potential blockages. In this case, efforts were initially stimulated by private sector moves to connect networks (though that is not a prerequisite), with heads of state follow-up to ensure that the requisite legislation was in place (ITU 2016).

272 ITU 2016, 10.

273 Andrews et al. 2017.

274 Pollution along a river is an externality - that is, its presence arises from the fact that people do not take it into account in their decisions. If the river crosses, say, three countries, the boundary is those three counties, which may not correspond to REC membership. Cleaning up the river is a regional public good. See Mysiak et al. (2010).

275 Medinilla and Ronceray 2019.

276 Byiers 2017.

Annex

ANNEX A – TABLE 4.1 SIX STEPS OF AN ITERATIVE REGIONAL PUBLIC GOOD APPROACH FOR POLICYMAKERS

Step	Purpose	Key questions
1. Analyze the problem	Identifying the need or ambition that requires regional collective action	• Why is greater regional collaboration needed, and for whom? • Which regional public good (RPG) is underprovided?
2. Understand the type of RPG	Understanding the structural factors that shape country interests in an RPG	• What type of RPG is underprovided? • How does this shape the long-term interests of countries in providing or not providing the RPG? • What other factors—geographic, historic, economic, political—define interests and incentives around providing the RPG?
3. Identify necessary services and policies	Identifying solutions or services that are needed to provide an RPG and how the specific RPG characteristics inform countries' interests and incentives for contributing	• What services or solutions are needed for the RPG to be provided? • What are the RPG characteristics of those services or solutions? For example, is one a weakest link solution, where the eventual provision is determined by the smallest effort or by no effort? Or is it a weighted sum solution, where all members must be mobilized to do their part? • What minimum combination of services and solutions is needed for the RPG to be provided?
4. Choose a suitable coalition and framework for collaboration	Choosing a workable and feasible cross-border or regional framework and set of actors for the provision of an RPG	• Is the issue more likely to be successfully addressed through bilateral collaboration, through a (sub-) regional group of countries, or through a combination? • Does everyone need to be equally on board, or just a few, for the RPG to be provided? • Does a suitable regional framework already exist? Is it flexible enough? • What coalitions or alliances need to be created or promoted for the RPG to be provided?

5. Act	Building the capabilities to ensure RPG provision in an adaptive way	• What type of policy implementation is it—policy/elite services, logistical, other? • How can national contributions be incentivized? • At what level should most efforts be focused to ensure real organizational change—for example, the regional level for best shot and policymaking/elite services, or the local level for weakest link and implementation-intensive service delivery? • What short-term or partial solutions can change the environment and increase traction for regional collaboration? • How can negative forces and disincentives be lessened to muster support for implementation?
6. Adapt and repeat	Adapting solutions to lessons learned	• What has not worked in the past, and why? • Does the initial problem analysis (step 1) hold? • What can be improved, and how? • Do previous actions open new doors for advancing RPG provision?

Source: African Transformation Report team, building on the problem-driven iterative adaptation methodology of Harvard University's Center for International Development among others (https://bsc.cid.harvard.edu/about).

ACET African Center for Economic Transformation