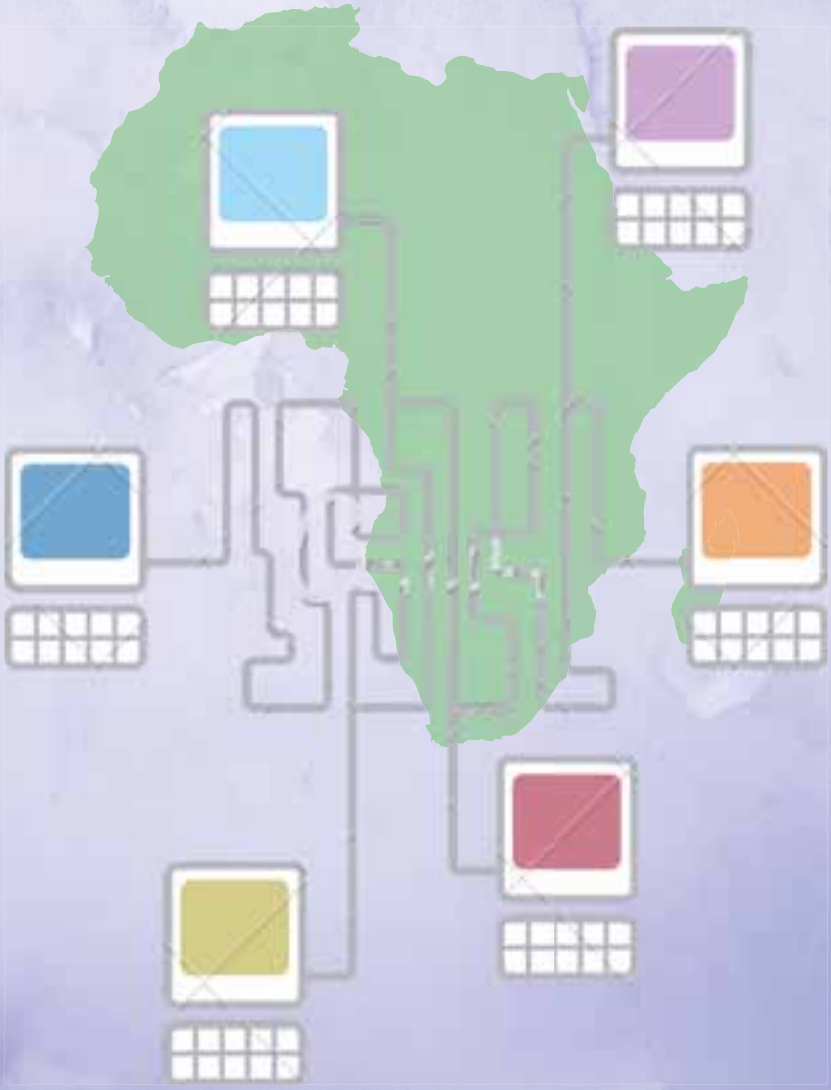
THE AFRICAN CAPACITY BUILDING FOUNDATION | FONDATION POUR LE RENFORCEMENT DES CAPACITÉS EN AFRIQUE

Africa Capacity Report 2017

Building Capacity in Science, Technology and Innovation for Africa's Transformation



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FOREWORD

African countries have shown their interest and willingness to strive for science, technology, and innovation (STI)-led development in the coming years. African heads of state and decisionmakers, through Agenda 2063 and the Common African Position in Agenda 2030, have highlighted STI as a key enabler promoting the ability of African countries to achieve their economic transformation and development goals. This commitment was clearly expressed by the adoption of a 10-year Science, Technology, and Innovation Strategy for Africa (STISA-2024) in June 2014 at the 23rd Ordinary Session of African Union Heads of State and Government Summit. The strategy links science, technology, and innovation to Africa's sustainable economic transformation.

This Report shows that capacity in its various dimensions, though improving, remains a problem for African economies generally, not just for STI. But a more important message emerges: even though two-thirds of African countries have STI policies and strategies, their capacity to implement them remains very low.

Most African countries have underdeveloped STI institutions and fail to effectively generate and deploy knowledge and technological innovations for socioeconomic growth. This challenge largely reflects how STI institutions are not adequately staffed with skills and expertise expertise, financial resources, infrastructural capabilities, and equipment. Encouragingly, the Report shows that it is possible to build STI institutions and use them for socioeconomic transformation, with a good number of African countries providing practical success stories based on strategies and initiatives that can easily be adapted to other countries.

Notably, despite the growing emphasis on the importance of STI for Africa's development, significant capacity bottlenecks still hinder countries from using STI in national development. Evidence suggests that African countries lack specific human and institutional capacities, critical technical skills, and resources to promote STI. To some extent, the capacity lag in STI is linked to the investment priorities of African countries, which have yet to convert their political commitments into practical programs for STI-based development. The current average of African spending on research and development (R&D) stands at about 0.5 percent—below the one percent of GDP pledged in 1980 and again in 2005. Unless countries build STI capacities to innovate and promote STI for development, Africa risks being left behind in the race toward inclusive globalization.

Among the key findings, the Report shows that 91 percent of the 44 surveyed African

countries consider training a High or Very High priority in STI. Other areas also rated as High or Very High priorities were information and communications technology (ICT) infrastructure (80 percent), patent rights and trademarks (80 percent), investment (75 percent), production/publication of scientific papers (72 percent), policy/strategy (70 percent), and regulation/laws (65 percent).

The Report recommends that to address these capacity gaps, the following must be done:

- African governments and the African Union must vigorously pursue new and innovative funding alliances involving bilateral and multilateral donors, governments, as well as nonstate actors like private foundations and businesses. A dedicated percentage of all development loans and grants from development partners should go into developing STI capacity programs.

- In pursuing STI-driven development, African governments must make serious commitments to develop human and institutional capacities by investing substantially in high-quality universities, state-of-the-art equipped and maintained laboratories, ICT infrastructure, and research funding mechanisms.

- Regional bodies—such as the East Africa Community, Economic Community of West African states West African States, and Southern Africa Development Community—must develop and implement coherent strategies for establishing regional STI systems as nested networks of national STI systems with differentiated capabilities and competencies. Such strategies should promote regional R&D infrastructure and the harmonization of technical standards and research regulations across Africa. They should also design mobility programs for scientists and engineers, foster regional university collaborations, encourage public–private partnerships across national borders, and facilitate the adoption of regional intellectual property rights protection frameworks.

- Concerted effort by all stakeholders is a critical step for enhancing STI capacity building. For instance, the role of government is to foster the right environment by formulating good policies, creating efficient institutions of implementation and follow-up, offering financial resources, and improving investment in human resources. The role of the private sector and development partners is to complement government efforts by, for example, offering financial resources, improving investment in human resources, promoting exchange programs, sharing good practices (including funding their scaling up), and encouraging innovation in private firms.

The African Capacity Building Foundation remains committed to coordinating STI capacity development on the continent. It will build strategic partnerships as part of its 2017–2021 Strategy in support of the African Union Commission's (AUC) work in ensuring that STI becomes the enabler in implementing Agenda 2063. This will build on the Foundation's capacity needs assessment for the AUC around Agenda 2063. I thus call on all development partners to support African countries in forming their STI capacity to accelerate the continent's economic transformation.

Let me take the opportunity to sincerely thank the World Bank, the United Nations Development Programme, the African Development Bank, the Islamic Development Bank, and African member states for their

financial support making this flagship Report possible. We look forward to strengthening these partnerships and building new ones as we continue to build human and institutional capacity as well as knowledge societies for Africa's sustainable development.

My earnest hope is that this Report will form an important reference for understanding the capacity challenges to developing, coordinating, and implementing policies as well as well as reshaping exemplary initiatives around developing capacity for science, technology, and innovation in Africa.

Professor Emmanuel Nnadozie
Executive Secretary
The African Capacity Building Foundation
Harare, Zimbabwe
January 2017

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Thomas Chataghalala Munthali, PhD
Director, Knowledge and Learning
The African Capacity Building Foundation

ABBREVIATIONS

ACBF	African Capacity Building Foundation
ACI	Africa Capacity Index
ACR	Africa Capacity Report
AOSTI	African Observatory of Science, Technology, and Innovation
ARIPO	Africa Regional Intellectual Property Organisation
ASTIF	African Science, Technology, and Innovation Fund
ASTII	African Science, Technology, and Innovation Indicators
ASTIPI	African Science, Technology, and Innovation Policy Initiative
AU	African Union
AUC	African Union Commission
CPA	Consolidated Plan of Action
CSP	Concentrated Solar Power
EAC	East African Community
ECA	Economic Commission for Africa
ECOWAS	Economic Community of West African States
ECX	Ethiopian Commodity Exchange
EU	European Union
FIFA	Fédération Internationale de Football Association
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GII	Global Innovation Index
ICT	Information and Communications Technology
IP	Intellectual Property
IPRs	Intellectual Property Rights
JAES	Joint Africa–EU Strategy
MDGs	Millennium Development Goals
M&E	Monitoring and Evaluation
MENA	Middle East and North Africa
NCD	Noncommunicable Disease
NEPAD	New Partnership for Africa's Development
NIS	National Innovation System
NRI	Networked Readiness Index
OAPI	Organisation Africaine de la Propriété Intellectuelle

OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
RECs	Regional Economic Communities
RIEF	Rwanda Innovation Endowment Fund
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SIRDC	Scientific Industrial Research and Development Corporation of Zimbabwe
S&T	Science and Technology
STEM	Science, Technology, Engineering, and Mathematics
STI	Science, Technology, and Innovation
STISA-2024	Science, Technology, and Innovation Strategy for Africa 2024
TVET	Technical and Vocational Education and Training
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNISPAR	University-Industry-Science Partnership Programme
WIPO	World Intellectual Property Organization

All references to dollars are to US dollars unless otherwise noted.

OVERVIEW

The African Capacity Building Foundation (ACBF) has, over the past five years published its Africa Capacity Report (ACR). The ACR seeks to measure and examine the capacity of African countries to pursue their development agenda by focusing on key determinants and components of capacity for development. ACBF (2011: 31) defines capacity as the "ability of people, organizations, and society as a whole to manage their affairs successfully; and capacity development as the process by which people, organizations, and society as a whole unleash, strengthen, create, adapt, and maintain capacity over time."

In view of the growing importance of science, technology, and innovation (STI) as critical drivers to accelerate socioeconomic transformation in Africa, *ACR 2017* focuses on understanding the capacity imperatives for STI that need to be addressed in order to accelerate Africa's transformation. The *ACR 2017* theme—building capacity for STI for Africa's transformation—is timely and adds to the previous ACRs.

ACR 2017 provides the framework for STI development by focusing on the capacity dimensions in Africa. In particular, it examines the status of STI, delving into initiatives, challenges, and capacity gaps for African countries, regional economic communities (RECs), the African Union (AU), and non-state actors to pursue STI-driven economic activities.

For *ACR 2017*, the term "STI" encompasses all systematic activities that are closely concerned with the generation, advancement, dissemination, and application of scientific and technical knowledge in all fields of science and technology (S&T)—the natural sciences, engineering, medical, and agricultural sciences, and the social sciences and humanities.

The status of Africa's development is closely linked to its capacity to deploy STI for more inclusive sustainable development and transformation, which is why *ACR 2017*'s theme is so relevant. It lays emphasis on the need to build STI capacity in Africa so as to achieve the AU's Agenda 2063 and the United Nations' Sustainable Development Goals.

This year's Africa Capacity Index (ACI) shows, among its four sub-indices or "clusters," excellent policy environments and good processes for implementation in most African countries. Even though countries continue to struggle on development results at country level, 2016's results are a significant improvement on 2015's. In contrast, despite a slight gain over 2015, capacity development outcomes remain low and the most pressing issue. The performance of the thematic indices (policy choices for capacity development, development cooperation effectiveness related to capacity development, gender equality and social inclusion, and partnering for capacity development) is generally positive, with most countries posting strong gender equality and social inclusion outcomes.

ACR 2017 complements ACBF's capacity-building interventions on the continent by advocating for the integration of capacity building in Africa's wider development efforts. The capacity dimensions and imperatives for

STI are crucial as African countries, RECs, and nonstate actors develop strategic frameworks and build capacity to pursue STI-driven activities. ACBF's regionally oriented initiatives and programs help promote STI by planning and implementing strategic policies, investments, human capacity building, and research and development (R&D).

Highlights of the Africa Capacity Index 2016

The ACI measures and empirically assesses capacity against the development agenda in African countries. It highlights key determinants and components of capacity and maps out the continent's capacity development landscape, with the goal of sharpening the focus on capacity deficits as a major development policy issue.

The ACI is a composite index computed from four sub-indices, each of which is an aggregated measure calculated on a quantitative and qualitative assessment of components. The sub-indices cover policy environment; processes for implementation; development results at country level; and capacity development outcomes.

Results for the ACI 2016 are generally satisfactory. The ACI value ranges from 71.6 (Morocco) to 33.1 (Central African Republic) (table O.1).

There are no countries at the Very Low or Very High extremes of capacity. Nine countries are in the High bracket and two are in the Low bracket, but no countries are in the Very Low bracket (figure O.1). More efforts will be required for countries to move into the Very High bracket (ACI values of 80 and above).

The bulk of countries have Medium capacity. Of the 44 countries surveyed, most (75 percent) fall within the Medium bracket, 20.5 percent are in the High bracket, and 4.5 percent are in the Low bracket.

Analysis by cluster indicates a pattern that has slightly improved over the previous year. As in previous ACRs, the policy environment cluster remains the strongest, and capacity development outcomes the weakest (table O.2).

On the policy environment—underpinned by broad participation and good governance—nearly all countries ranked High or Very High. Processes of implementation remain impressive, with 80 percent of countries ranked High or Very High.

For development results, only 6.7 percent of countries are ranked Very High. Among the countries, 53.3 percent are in the High bracket, and 17.8 percent in the Low bracket.

Capacity development outcomes remain, as in previous ACRs, the worst cluster—84.4 percent of countries are in the Low or Very Low brackets (91 percent in 2015)—and are the most pressing issue.

The overall capacity score improved marginally from 52.0 in 2015 to 59.1 in 2016. Only 4.5 percent of countries are in the Low bracket, down from 8.9 percent in 2015. The number of countries in the High bracket has risen from eight in 2015 to nine in 2016, while a higher percentage of countries are in the Medium bracket (see figure O.1). No country was or is in the Very Low bracket.

Achievements on the four thematic indices are encouraging overall. More than 50 percent of countries are in the High or Very High brackets. The best performance is in gender equality and social inclusion, for which there are no countries in the Low or Very Low brackets.

Table O.1: Africa Capacity Index, 2016

Rank	Country	ACI 2016 value	Rank	Country	ACI 2016 value
1	Morocco	71.6	24	Gabon	52.3
2	Tanzania	68.8	25	Zambia	52.3
3	Rwanda	68.2	26	Djibouti	51.5
4	Mauritius	67.3	27	South Africa	51.1
5	Cabo Verde	62.6	28	Mozambique	50.8
6	Tunisia	62.6	29	Madagascar	50.7
7	Gambia	61.7	30	Togo	50.4
8	Mali	61.0	31	Guinea	50.1
9	Malawi	60.7	32	Senegal	49.0
10	Burkina Faso	58.8	33	Cameroon	47.3
11	Niger	57.4	34	Chad	46.4
12	Liberia	57.1	35	Zimbabwe	46.3
13	Ethiopia	56.5	36	Comoros	45.9
14	Namibia	56.2	37	Botswana	44.1
15	Lesotho	56.1	38	Côte d'Ivoire	43.6
16	Egypt	55.8	39	Nigeria	43.4
17	Kenya	55.2	40	Congo, Rep.	43.1
18	Ghana	54.1	41	Guinea-Bissau	41.8
19	Uganda	54.0	42	Mauritania	40.8
20	Burundi	53.4	43	Swaziland	35.3
21	Sierra Leone	53.3	44	Central African Rep.	33.1
22	Algeria	53.2			
23	Benin	52.6			

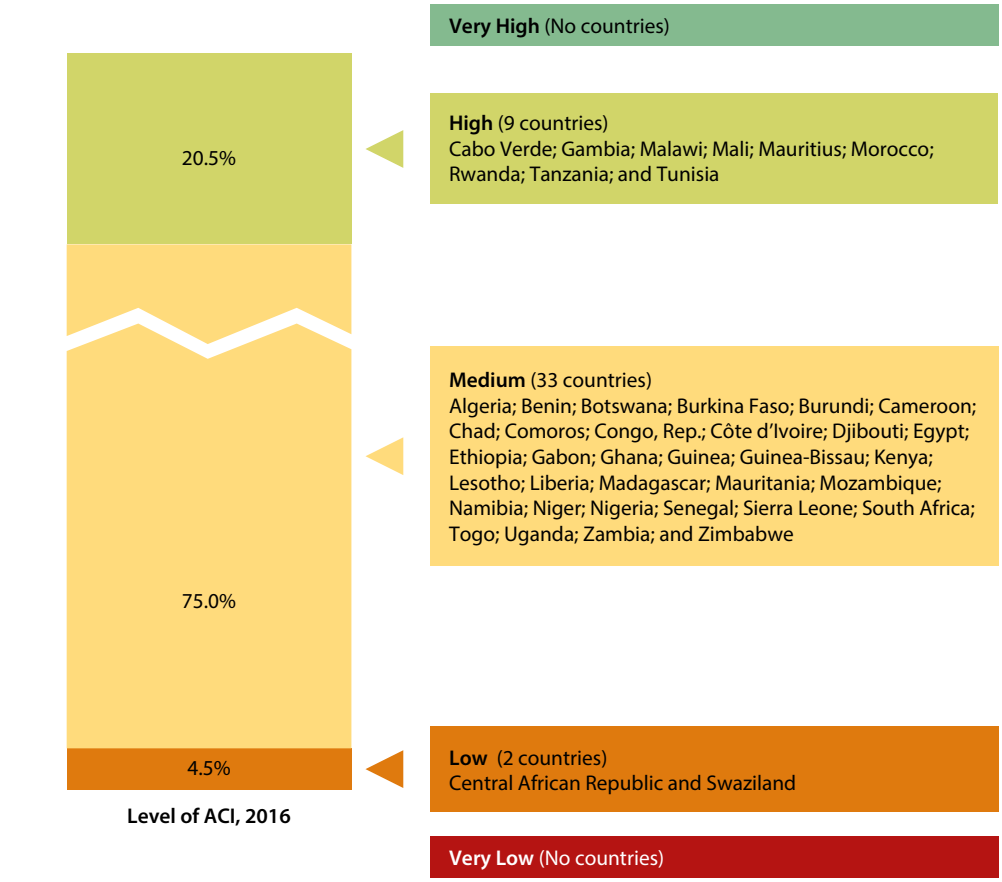
Source: ACBF 2016a.

The indicators suggest that Africa is making gradual progress in developing its capacity for STI, despite the numerous challenges confronting it. They also suggest that African countries have a long way to go in improving the outcome of capacity development, given that capacity-needs assessments are not a priority for most of them. ACBF plays a highly relevant role and is well positioned to make an important difference through funding, interventions, and technical assistance for capacity building projects and programs to meet the needs of African member countries and nonstate actors.

Importance and challenges of STI for Africa's development

Discussions on Agenda 2063 and Agenda 2030 have emphasized STI as a fundamental tool to achieve the region's visions. At the 23rd Ordinary Session of the African Union Heads of State and Government Summit in 2014, African leaders adopted the Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024) as the first of the five 10-year strategic frameworks for Agenda 2063 to accelerate Africa's transition

Figure O.1: Africa Capacity Index, 2016



Source: ACBF 2016a.

to an innovation-led, knowledge-driven economy. STISA-2024 provides a focus on improving Africa's STI status in human capital, technical competence, infrastructure, the enabling environment, innovation, and entrepreneurial mindsets (AUC 2014).

STI is enabling discoveries in many sectors of the economy, including health, energy, water, infrastructure, communication, and transportation. For a knowledge-based economy, economic success is not based only on its ability to generate knowledge, develop technology, or innovate, but also its capacity to interpret, select, adapt, diffuse, produce, and commercialize scientific and technological knowledge appropriately to its culture, aspirations, and level of development (World Bank 2014). Bashir (2015: 107) defines STI capacity as:

- The combination of "technological capabilities" required to generate knowledge and develop technology and innovation.

Table O.2: Africa Capacity Index 2016, percentage of countries by bracket and cluster

Bracket/cluster	Policy environment	Processes for implementation	Development results at country level	Capacity development outcomes
Very high	84.4	40.0	6.7	0
High	13.3	40.0	53.3	0
Medium	2.2	20.0	22.2	15.6
Low	0	0	17.8	80.0
Very Low	0	0	0	4.4
Total	100	100	100	100

Source: ACBF 2016a.

- The "social capabilities" required to acquire knowledge and technology, and to bring about diffusion, exploitation, and utilization for socioeconomic benefits.

- The common capabilities that shape these technological and social capabilities.

Despite the growing emphasis on STI for Africa's development, there are still significant bottlenecks hindering countries from using it effectively, including lack of specific capacities, critical technical skills, and resources to promote R&D, improve higher education, and foster growth (ACBF 2016b). To some extent, the capacity lag in STI is linked to the investment priority of African countries, which are yet to convert their political commitment into practical programs for STI-based development. The current average of African countries' expenditure on R&D stands at around 0.5 percent of gross domestic product (GDP)—a far cry from the 1 percent they pledged in 1980 and again in 2005 (World Bank 2015). Africa risks being left behind in the race toward inclusive globalization if countries do not build their STI capacities.

For a long time, Africa has had a short-term approach to human development, with continued reliance on external financial support, which often targets short-term goals (Mugabe 2011). As a result, the continent has failed to invest adequately in STI as evident in the low public expenditure in R&D (UNESCO 2015). And heavily dependent on raw materials exports, it is vulnerable to swings in global commodity demand and prices, as acutely seen in the 2008–09 global financial crisis when it suffered from the sharp global decline in demand for low-value commodities. Such circumstances reinforce the urgent need for Africa to develop its STI capacity and infrastructure so as to diversify its economy and create high-value added products, enabling it to become competitive in the global market.

Africa is in dire need of improved capabilities in STI development. *ACR 2017* makes it clear that the effective development and application of STI calls for substantial investment in building capacities and critical technical skills. By strengthening their STI capacity, infrastructure, and systems, African countries can generate, use, and diffuse technological innovations to foster sustainable development.

The state of STI in Africa

During the year, we have witnessed a growing commitment and a common aspiration in Africa to harness the potential of STI for sustainable development at the various levels. At the continental level, the African Union recently developed a new strategy, STISA-2024, which replaced Africa's 2005 Science and Technology Consolidated Plan of Action (CPA). In Agenda 2063, the African Union provides a broad vision and action plan for building a more prosperous and united Africa over the next 50 years.

At the national level, African countries are making progress through the integration and mainstreaming of STI into national development planning and agendas. The growing emphasis on STI is visible in the development blueprints adopted by African countries in recent years. For example, STI is identified in Kenya's Vision 2030 as a fundamental pillar for propelling the country to upper-middle-income status by 2030.

At the regional level, regional economic communities have put in place institutional mechanisms, policies, and strategies to promote STI development. Within the Southern African Development Community (SADC), the Protocol on Science, Technology, and Innovation (2008) provides the basis for developing institutional mechanisms for regional cooperation and coordination in policy training, women in science, strategic planning, intellectual property rights, indigenous knowledge systems, climate change mitigation, and high-performance computing.

In West Africa, the Economic Community of West African States (ECOWAS) Policy on Science and Technology, adopted in 2012, is integral to Vision 2020. The policy provides a framework for member states that want to improve, or elaborate, their own national policies and action plans for STI. In the East African Community (EAC), the East African Science and Technology Commission, which was officially launched in 2015, promotes and coordinates the development of S&T.

When compared with the rest of the world, Africa's STI is still abysmally low, though recent indicators show very slight improvements. On innovation, of 141 countries surveyed, only 12 African countries were ranked among the world's top 100 innovation achievers in the 2015 Global Innovation Index (Cornell University, INSEAD, and WIPO 2015). In terms of Africa's readiness to leverage information and communications technology (ICT) for increased competitiveness and well-being, African countries' performance in the 2016 Network Readiness Index ranking was very poor. Of the 31 African countries surveyed, only one (Mauritius) was in the world's top 50 network-ready countries (WEF, Cornell University, and INSEAD 2016).

Africa remains disadvantaged on overall STI efforts due to the low investment in STI capacity development. Africa accounts for about 5 percent of global gross domestic product, but is responsible for only 1.3 percent of global expenditure on R&D (UNESCO 2015). The impact of low investment is visible in its poor infrastructure, small pool of researchers, low patronage of science and engineering programs, weak intellectual property frameworks, and minimal scientific output relative to the rest of the world.

STI initiatives and contributions in Africa

Several initiatives have been established to promote STI in Africa. A milestone economic development initiative of the AU is the New Partnership for Africa's Development (NEPAD), which serves as a blueprint for Africa's development in the 21st century. Since its adoption in 2001, NEPAD has established networks of Centers of Excellence that are promoting STI initiatives, including the African Biosciences Initiative, the African Institute for Mathematical Sciences, the African Laser Center, and the African Science, Technology, and Innovation Indicators initiative.

A recent regional STI initiative is the Pan-African Institute of Science and Technology, which comprises the African University of Science and Technology in Abuja (Nigeria), the International Institute of Water and Environmental Engineering in Ouagadougou (Burkina Faso), and the African Institute of Science and Technology in Arusha (Tanzania). These institutions have been funded by ACBF as part of its support to developing STI education in Africa, under the Nelson Mandela African Universities of Science and Technology Capacity Building Program. For the 2015/16 academic year, ACBF awarded full scholarships to 22 female students admitted to the African University of Science and Technology to pursue Master's degrees in petroleum engineering, material science, computer science, and pure and applied mathematics (ACBF 2016c).

Africa's infrastructure for intellectual property (IP) is inadequate. The AU has established the Pan-African Intellectual Property Organisation to deal with IP issues; develop an IP system for economic, cultural, social, and technological development; and set IP standards that capture the needs of the AU, its member states, and RECs. To fulfill those endeavors, it will require capacity development of individuals and institutions of AU member states and RECs. The two regional IP organizations are the African Regional Intellectual Property Organisation and the Organisation Africaine de la Propriété Intellectuelle.

Africa's STI initiatives through bilateral, multilateral, and regional cooperation and economic treaties have recognized the crucial role of STI in promoting regional integration and economic development. For example, the Joint Africa–EU Strategy created a biregional framework for STI cooperation within the wider Africa–EU STI cooperation relationship. The AU–EU partnership resulted in several initiatives, including the Africa Research Grants Programme, the African Virtual Campus, African Leadership in ICT, and Global Monitoring for Environment and Security for Africa (EU 2013). Underpinning the cooperation and agreements is the understanding that African countries' economies are not on their own equipped for organizing scientific and technological resources for development. Such STI cooperation is thus essential to building the capacity of African countries.

Capacity gaps in STI in Africa

The annual survey of African countries undertaken by ACBF—44 in 2016—to assess capacity needs in priority STI areas showed that 91 percent of African countries consider training a High or Very High priority area in STI. Other areas also rated as High or Very High priority, and the percentage of countries,

were infrastructure (more than 80 percent), patent rights and trademarks (80 percent), investment (more than 75 percent), production/publication of scientific papers (72 percent), policy/strategy (more than 70 percent), regulation/laws (more than 65 percent), and a list of strategic areas (more than 80 percent).[1]

Most African countries are faced with weak institutional capacity to develop and sustain STI, as many of their public institutions have suffered years of decay, lack of human resources, paltry investment, and grudging recognition from government.

Another problem is the "brain drain" or mass migration of African skilled scientists and other experts. From 2007 to 2011, the number of tertiary-educated African migrants abroad who had arrived in the past five years was estimated at 450,000, exceeding the number of equivalent Chinese migrants (375,000) (UN-DESA and OECD 2013). Zimbabwe (43 percent), Mauritius (41 percent), and the Republic of Congo (36 percent) recorded the highest proportion of educated persons living in OECD countries. Burundi, Algeria, Mauritania, Chad, and Guinea are the top five African countries least able to retain their top talent (WEF 2014a).

A recent study by ACBF on the capacities needed to implement Agenda 2063 of the African Union (AU) shows serious gaps in critical technical skills to implement the Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024). Africa may be short of 4.3 million engineers and 1.6 million agricultural scientists and researchers, in part because more than 80 percent of current student enrollments are in social sciences and humanities (ACBF 2016b).

African higher education institutions are not producing enough professionals to meet market demands for skills in science and engineering. Poor investment in higher education over the past four decades has devastated their capacity to supply the productive sector with the requisite skills, especially in science, technology, engineering, and mathematics. Very few graduates in Africa gain the skills they need to find work. Low enrollment rates in science, technology, and engineering reflect the low interest in and limited demand for STI skills in the labor market (AfDB et al. 2012), as well as the often-high costs of the courses.

Inadequate capacity to conduct STI policy analysis can undermine the formulation and implementation of STI. Among 18 African countries, most ministries and departments responsible for STI policymaking lack the staff with the needed research and analytical skills to draft policy documents and to review the evidence for policymaking (AOSTI 2013).

Many African countries also face serious limitations in policy monitoring, given weak capacity, resources, and framework. Through monitoring, countries can gather vital information about interventions, which can be used to reposition STI policy or public investments, or even reconstruct national strategy.

Strategic capacities for STI

African countries' commitments to building STI capacity can be measured by the extent of domestic investment in R&D. For most African countries, the major proportion of domestic contribution to R&D activities is provided by the government, with little from the private sector. Private sector investment should be encouraged by policy incentives, tax relief, and public–private sector partnerships.

The current shortage of researchers impedes STI capacity development in many African countries, which should improve their STI capacity building by increasing the number of researchers.

By improving their higher education system—reoriented to STI—African countries can produce highly qualified engineers and scientists, shift student enrollment in higher education in favor of STI, improve their human resource, conduct practical training in cooperation with industry, and increase the share of females enrolled in STI.

Policies that encourage the expansion and development of STI activities, such as award systems for innovation and increased resources for STI in the education system, can make a big difference in the number of graduates in R&D, as seen in Ethiopia and Rwanda, for example. Other conducive steps include establishing STI ministries, research institutions, specialized higher education institutions, universities, and research and innovation funds.

STI capacity building through bilateral and multilateral agreements will lead to cooperation in STI between universities and research institutes in Africa. In 2013, for example, bilateral agreements signed by the government of Ethiopia and by those of Brazil and Kenya led to bilateral research projects, scientific meetings, and short-term training courses. In 2014, similar bilateral agreements were signed by the government of Ethiopia and the governments of China and the Republic of Korea. National, regional, and continental investments in STI must be accompanied by mutually beneficial collaborations and partnerships that explicitly outline the interest of Africa's development priorities.

Key takeaways

- The progress of Africa's STI capacity looks encouraging, given that most countries are within the Medium to High brackets of the overall Africa Capacity Index. This encouraging result is largely driven by strong policy environments, but capacity to implement policies and capacity development strategies remains a challenge.

- Most African countries have a strategy for the promotion of STI, with capacity development part of the overall strategy. What is still in short supply is actualized implementation of strategies.

- Becoming competitive globally and closing the development gap between Africa and the rest of the world will largely depend on its governments plugging the STI investment gap. They must commit to honoring the 1 percent of GDP pledge for R&D investment and even take it further, to around 3 percent of GDP. African countries must set up sustainable financing systems for STI that feature competitive and matched funding to reorient the STI system to focus not only on R&D but also on sustainable technologies and innovations designed and owned by emerging firms and start-ups at the bottom of the pyramid.

- In most African countries' domestic investment in R&D, the majority comes from the government, with little from the private sector. Increased government and private spending is imperative.

- In crafting national STI policies, African countries should conduct comprehensive assessments of the needs of the public and private sectors, including those of higher education institutions. These will offer a

view of disciplinary gaps and the capacity of these bodies to meet job market demands.

- International partnerships and cooperation are essential for STI development. They often open the space for capacity building, accelerate the pace of discovery, and improve commercialization of products. STI development in Africa must be carried out using a combination of collaboration and public–private partnerships, as well as competition, involving market incentives at regional and continental levels. Africa must promote and consolidate regional partnerships (such as EAC, ECOWAS, SADC, and the Common Market for Eastern and Southern Africa) and global partnerships (such as AU–EU and AU–China) for STI development, complemented by multi-actor partnerships.

- Regional bodies such as EAC, ECOWAS, and SADC should develop and implement coherent strategies for establishing regional STI systems as "nested networks" of national STI systems with differentiated capabilities and competitiveness. Such strategies should focus on establishing shared/regional R&D infrastructure and harmonizing technical standards and research regulations across Africa. They should also design mobility programs for scientists and engineers, foster regional universities' collaboration, encourage public–private partnerships across national borders, and facilitate the adoption of regional IP rights protection frameworks.

- Africa must deepen and expand North–South scientific cooperation with Europe and the Americas, while developing South–South cooperation with Asia and China, particularly to promote access to STI skills and knowledge, and to technology development, transfer, and diffusion, all on agreed terms. Already, EU–Africa scientific cooperation is changing the face of STI through R&D and academic mobility. An essential part of such cooperation will be to foster international support for effective and targeted STI capacity-building programs in Africa.

- Improving the quality of higher education rests on enhancing professional training, providing adequate school facilities, attracting good lecturers, and updating pedagogical materials. In particular, building an STI system and preparing for a future knowledge economy requires innovation-oriented curricula and contemporary teaching methods. There is a need for strong leadership at universities and research institutions to build the required STI skills and capacity—including knowledge in entrepreneurship and innovation—to prepare graduates for the job market.

- Increased enrollment in science, technology, and engineering courses at African higher education institutions means increasing their capacities through more and better laboratories, increasing the number of qualified lecturers and technicians, and incentivizing private universities to offer such courses. These measures could be partly funded through tax relief. Emphasis should also be placed on creating job and entrepreneurial opportunities in science, technology, and engineering in the public and private sectors alike.

Organization of the *Africa Capacity Report 2017*

ACR 2017 is structured as follows. The first chapter describes the Africa Capacity Indicators and discusses the results of the

Africa Capacity Index 2016, highlighting the performance of countries across clusters and thematic areas. Chapter 2 examines the state and challenges for STI in Africa, with a focus on capacity dimensions. Chapter 3 reviews the capacity dimensions of some initiatives and contributions to improve STI. Chapter 4 offers an assessment of capacity gaps. Chapter 5 looks at trends, as well as lessons and successes drawn from country case studies in Africa. Chapter 6 provides a summary and policy recommendations.

1

AFRICA'S CAPACITY DEVELOPMENT LANDSCAPE IN 2016

In the era of a new economic system tied to increasing globalization and development of information and communications technology (ICT), science, technology, and innovation (STI) are becoming more essential for all the world's countries, including those in Africa (Nour 2012 and 2013).

Given the growing importance of STI as a tool for pursuing sustainable development in Africa, the *Africa Capacity Report (ACR) 2017* focuses on building capacity for STI in Africa.[2] It focuses on the capacity building imperatives for STI to accelerate Africa's transformation, particularly key determinants and components. Africa's current development is linked to its capacity to deploy STI along a more inclusive and sustainable development pathway toward achieving the goals of the African Union (AU) Agenda 2063 and the UN Agenda 2030 for Sustainable Development and its Sustainable Development Goals (SDGs)—the development blueprint for the next 15 years.

In September 2015, United Nations (UN) member states adopted the SDGs. A much more inclusive global agenda than the Millennium Development Goals, Agenda 2030 recognizes that STI will be crucial for achieving the SDGs. STI features strongly in SDG 17 on Means of Implementation as well as cross-cutting issues to achieve several sectoral goals and targets.[3]

Africa has embraced the SDGs and fully incorporated the global agenda and role of STI into national, regional, and continental strategies. African countries have identified the need to enhance STI capacities for Africa's transformative agenda and enabling environment, increase support for research and development (R&D), and optimally use space and geospatial technologies.

Even before adopting the SDGs, African countries highlighted the role of STI and reiterated their commitment to put STI at the core of their development agenda, as reflected in the Conference of Ministers in charge of Science and Technology, organized to enable the AU to periodically deliberate and have a collective voice on STI issues. Attempts to promote STI in Africa's socioeconomic transformation and integration into the global economy also resulted in the AU Consolidated Science and Technology Plan of Action (CPA).

Agenda 2063 recognizes STI as one of the major drivers and enablers for achieving the development goals of the AU and its member states. To support the agenda's implementation, African countries have adopted a 10-year

Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024), which is part of the long-term people-centered AU Agenda underpinned by STI and necessary for achieving the continent's SDGs.

ACR 2017 drills down to examine the STI landscape in African countries, assess limitations and initiatives, and examine the capacity imperatives facing African countries, regional economic communities, continental bodies, and nonstate actors in developing and deploying STI.

As earlier pointed out, ACBF (2011: 31) defines capacity as the "ability of people, organizations, and society as a whole to manage their affairs successfully; and capacity development as the process by which people, organizations, and society as a whole unleash, strengthen, create, adapt, and maintain capacity over time." *ACR 2017* does find out that inadequate capacity for STI, both at the continental and country level, has often been a result of finance and policy shortfalls which in turn limit the capacity to implement STI interventions.

This report is therefore framed to help mobilize high-level political and financial support for sustainable STI capacity-building solutions to accelerate Africa's transformation. It employs country case studies to provide evidence-based policy-oriented recommendations to support such capacity building. This first chapter explains Africa's capacity development landscape in 2016.

Elements of the Africa Capacity Indicators

The Africa Capacity Index (ACI) provides a snapshot of the state of capacity in Africa. It is a composite index computed from a quantitative and qualitative assessment of the following four sub-indices or "clusters."

The **policy environment** cluster considers the conditions that must be in place to make transformational change and development possible, notably effective and development-oriented organizations and institutional frameworks. Broad participation and good governance underpin this cluster, which focuses on four components:

- Whether countries have put in place national strategies for development (including a strategy for agricultural development, given the importance of transforming agriculture and achieving food security), and their level of legitimacy.

- Countries' commitment to meeting the development and poverty reduction goals set under the Millennium Development Goals (MDGs).

- Country-level awareness and focus on better use of limited resources for capacity development, as measured by the presence of policies for development cooperation as set by the Busan Global Partnership for Effective Development Cooperation.

- The degree of inclusiveness that supports the country's long-term stability as measured by gender equality and other socially inclusive policies.

The **processes for implementation** cluster assesses the extent to which countries are prepared to deliver results and outcomes. It focuses on the creation of an environment that motivates and supports individuals; the capacity to manage relations with key stakeholders inclusively and constructively; and the capacity to establish appropriate frameworks for

managing strategies, programs, and projects. Equally important are processes for designing, implementing, and managing national development strategies to produce socially inclusive development outcomes.

The **development results at country level** cluster refers to tangible outputs that encourage development. The cluster's main components are the development of national programs for capacity development; a policy framework for statistics development, creativity, and innovation; success in implementing the Busan Global Partnership for Effective Development Cooperation; and gender equality and social inclusion.

The **capacity development outcomes** cluster measures change in the human condition. Indicators are captured mainly through the financial commitment to capacity development, actual achievement of MDGs, and gains in agriculture and food security.

Four thematic indices are calculated using the same dataset as the primary ACI but are grouped in different combinations by thematic area. A theme index is also sometimes computed and linked to the ACR's annual theme, which this year is building capacity for STI for Africa's transformation. The dataset employed to compute the indicators is obtained through the surveys that ACBF conducts in countries every year. The survey methodology is outlined in the technical notes.

Highlights of the Africa Capacity Index 2016

The results of ACBF's Africa Capacity Building STI Survey (2016) confirm the increasing recognition of the importance of STI strategies and capacity development in African countries. For instance, 65 percent of surveyed countries have a strategy for promoting STI, for 28 percent such promotion is part of their National Development Plan, and only 7 percent have no strategy. Moreover, among respondents, capacity development is part of that strategy, with clear objectives, for 67 percent; capacity development is part of the strategy, but without clear objectives, for 26 percent; and capacity development is not part of the strategy for 7 percent. But these less than stellar rates also point to the need for further efforts by stakeholders in all African countries.

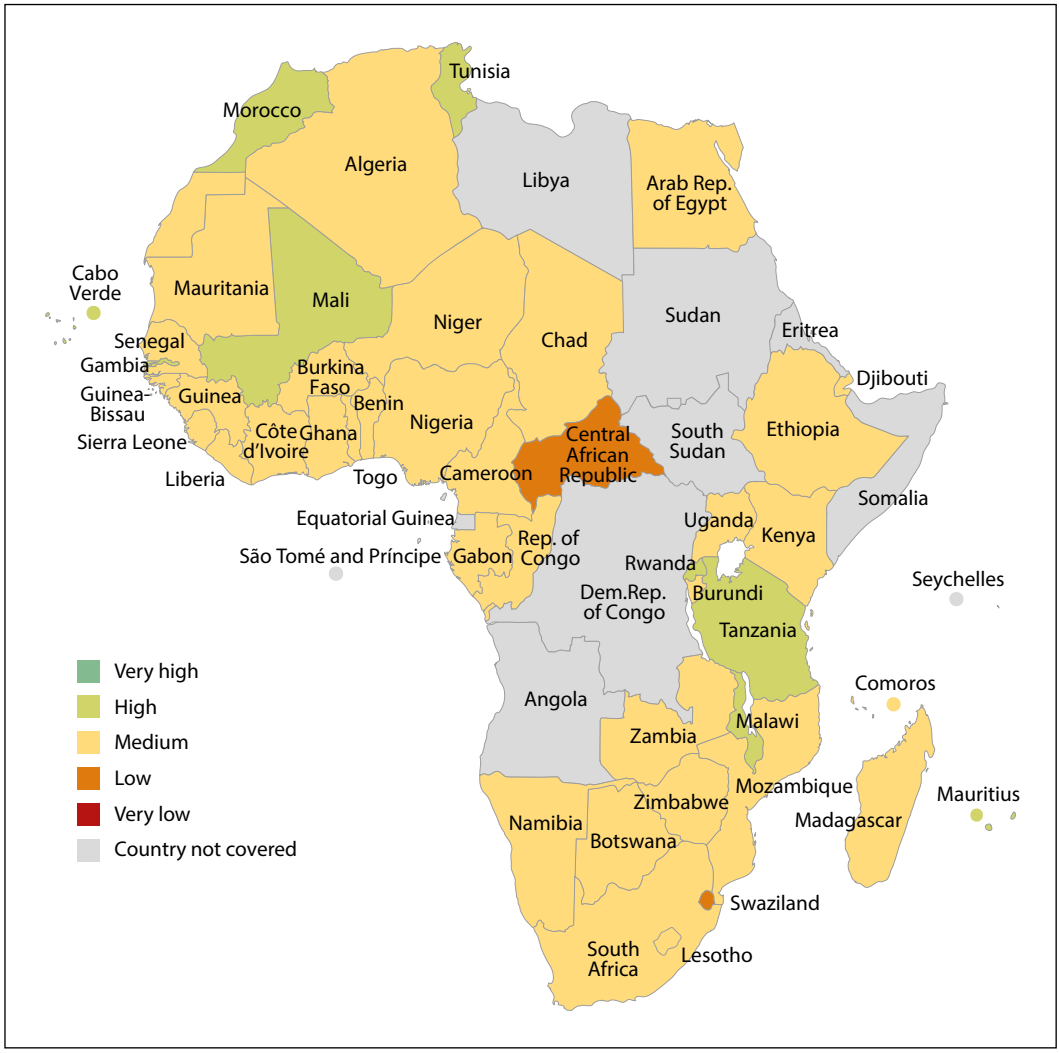
Country coverage in 2016

The ultimate aim of the ACR is to target all African countries. The inaugural issue of the ACR in 2011 covered 34 countries (42 in 2012, 44 in 2013 and 2014, and 45 in 2015). This year ACR covered 44 countries (map 1.1, table 1.1, and figure 1.1), because South Africa was included as a new entrant, while the Democratic Republic of Congo and South Sudan were not included, for technical reasons of data collection and validation.

Results of the Africa Capacity Indicators 2016

Results are generally satisfactory, largely driven by a strong policy environment. The ACI ranges from 71.6 for Morocco (which also topped the list in 2014) to 33.1 for the Central African Republic (see table 1.1). Even though the Central African Republic remains at the bottom of the list and is still in the Low bracket (less than 40), its ACI has improved from last year (20.7). Cabo Verde, first in 2015, is now fifth.

Map 1.1: Geographic Representation of Capacity levels, 2016



Source: ACBF 2016a.

There are no countries at the Very Low or Very High extremes of capacity. Nine countries are in the High bracket and two in the Low bracket, but no country is in the Very Low bracket (figures 1.1 and 1.2).

The bulk of countries have Medium capacity. Most countries (75 percent) fall within the Medium (yellow) bracket, 20.5 percent are in the High bracket, and 4.5 percent are in the Low bracket.

Table 1.1: Africa Capacity Index, 2016

Rank	Country	ACI 2016 value	Rank	Country	ACI 2016 value
1	Morocco	71.6	24	Gabon	52.3
2	Tanzania	68.8	25	Zambia	52.3
3	Rwanda	68.2	26	Djibouti	51.5
4	Mauritius	67.3	27	South Africa	51.1
5	Cabo Verde	62.6	28	Mozambique	50.8
6	Tunisia	62.6	29	Madagascar	50.7
7	Gambia	61.7	30	Togo	50.4
8	Mali	61.0	31	Guinea	50.1
9	Malawi	60.7	32	Senegal	49.0
10	Burkina Faso	58.8	33	Cameroon	47.3
11	Niger	57.4	34	Chad	46.4
12	Liberia	57.1	35	Zimbabwe	46.3
13	Ethiopia	56.5	36	Comoros	45.9
14	Namibia	56.2	37	Botswana	44.1
15	Lesotho	56.1	38	Côte d'Ivoire	43.6
16	Egypt	55.8	39	Nigeria	43.4
17	Kenya	55.2	40	Congo, Rep.	43.1
18	Ghana	54.1	41	Guinea-Bissau	41.8
19	Uganda	54.0	42	Mauritania	40.8
20	Burundi	53.4	43	Swaziland	35.3
21	Sierra Leone	53.3	44	Central African Republic	33.1
22	Algeria	53.2			
23	Benin	52.6			

Source: ACBF 2016a.

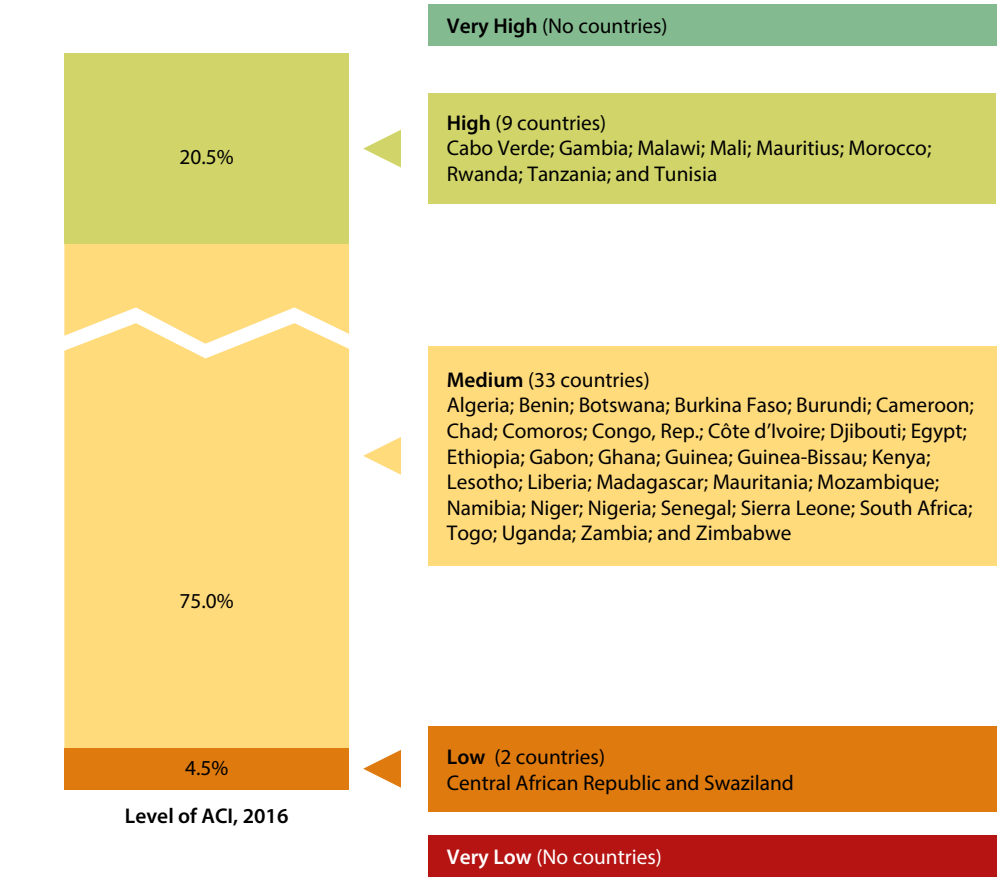
Achievements by cluster

By cluster, the pattern has not changed much since 2011. The policy environment cluster remains the strongest, and capacity development outcomes the weakest (table 1.2). Since 2014, the development results at the country level cluster have caught up somewhat with the processes for the implementation cluster.

Results show an excellent policy environment and very good processes for implementation. Some 97.7 percent of countries are ranked High or Very High on policy environment, as are 80 percent of countries on processes for implementation.

Capacity development outcomes remain the most pressing issue. Among countries in that cluster, 84.4 percent rank in the Low or Very Low brackets, against 91 percent in 2015. As reported in previous ACRs, capacity development outcomes are difficult to achieve because most of the countries allocate few resources to capacity building.

Figure 1.1: Africa Capacity Index, 2016



Source: ACBF 2016a.

Further, many countries have not made much progress on the MDGs, and several have not undertaken capacity profiling or capacity needs assessment over the past five years.

Trends in the Africa Capacity Index

Capacity scores have slightly (but steadily) improved since 2014. The average score across all surveyed countries rose from 49.9 in 2014 to 52.0 in 2015 and to 52.7 in 2016. The likely reasons are increasing investment in elements related to capacity building and more widespread awareness of the importance of enhancing the elements related to capacity building. In 2015, 8.9 percent of countries were in the Low capacity bracket, compared with 4.5 percent for 2016 (figure 1.2). Thus a higher proportion of countries (75 percent) have Medium capacity while the number of countries in the High category has edged up from eight to nine.

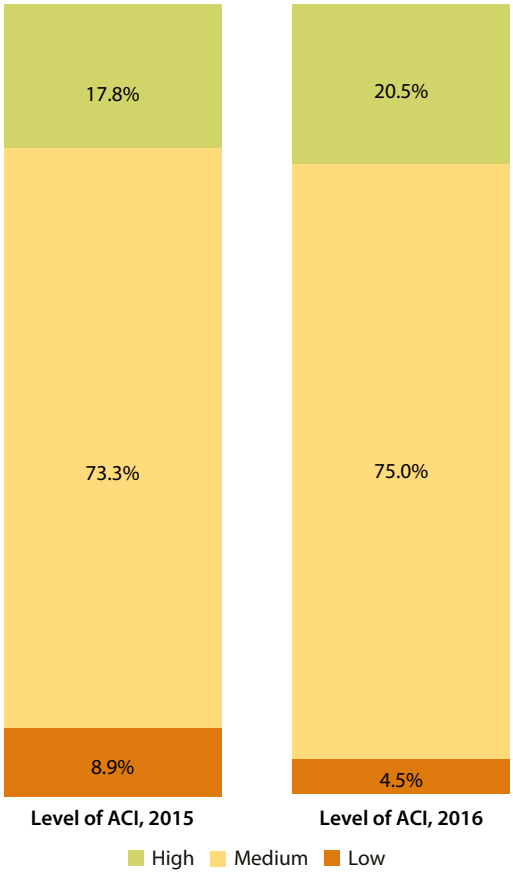
Of the 44 countries surveyed in 2015 and 2016, 26 (59.1 percent) saw an improvement in capacity while 18 (40.9 percent) saw their capacity, scores deteriorate. The biggest improvement was in Gabon, which raised its rank from 39th to 24th.

Only a few countries switched brackets. From 2015 to 2016, no country dropped from the High bracket to the Medium bracket. Guinea-Bissau and Mauritania rose from the Low bracket to the Medium bracket, and Malawi rose from the Medium bracket to the High bracket (figure 1.3). Malawi's movement to the High bracket is the same as in 2014. Some countries maintained the same rank in 2015 and 2016: Mauritius (4th), Mali (8th), Malawi (9th),[4] Namibia (14th), Chad (34th), Botswana (38th), the Republic of Congo (41st), Mauritania (43rd), and the Central African Republic (44th).

Achievements by thematic area

Achievements are encouraging overall. More than 50 percent of countries are in the High or Very High brackets on the four thematic areas (table 1.3). The best performance by far remains in gender equality and social inclusion, where no countries have Low or Very Low scores, and 2.2 percent of countries

Figure 1.2: Africa Capacity Index, 2015 and 2016



Source: ACBF 2015 and 2016.

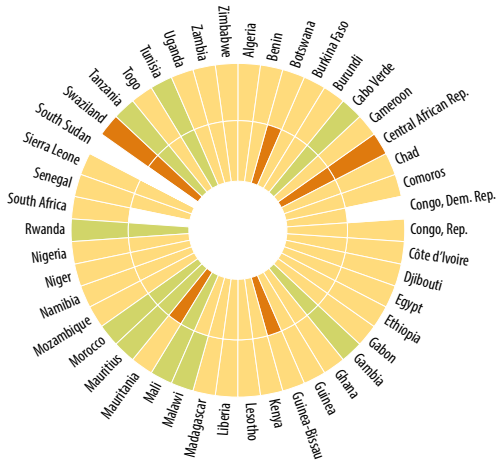
Table 1.2: Africa Capacity Index 2016, percentage of countries by bracket and cluster

Bracket/cluster	Policy environment	Processes for implementation	Development results at country level	Capacity development outcomes
Very high	84.4	40.0	6.7	0
High	13.3	40.0	53.3	0
Medium	2.2	20.0	22.2	15.6
Low	0	0	17.8	80.0
Very Low	0	0	0	4.4
Total	100	100	100	100

Source: ACBF 2016a.

have Medium scores. Good performance in this thematic area is due to countries' ratification, implementation, and reporting on the Convention on the Elimination of All Forms of Discrimination Against Women, the mainstreaming of gender in development planning, the allocation of resources to gender-related activities, and more generally, policies tackling social inclusion.

Figure 1.3: How did individual countries switch brackets in the Africa Capacity Index?



ACR 2015: Inner colored ring
ACR 2016: Outer colored ring

Source: ACBF 2015 and 2017.

Africa Capacity Index 2016, top performers

Nine countries have high capacity. Eight of these countries were also in the High bracket in 2014 and 2015. Malawi, which dropped out of this bracket in 2015, has rejoined in 2016, to the same rank (9th). The clusters reveal a pattern similar to the overall list (figure 1.4). The gap among the clusters for policy environment, processes for implementation, and development results at country level is relatively small.

Africa Capacity Index 2016, low performers

Two countries—the Central African Republic and Swaziland—are low performers. They were also among the four low performers in 2015. Guinea-Bissau and Mauritania have moved into the Medium category. The low performers have a good policy environment but perform poorly on the other clusters, especially on development results at the country

Table 1.3: Percentage of countries by level of thematic indices in 2016

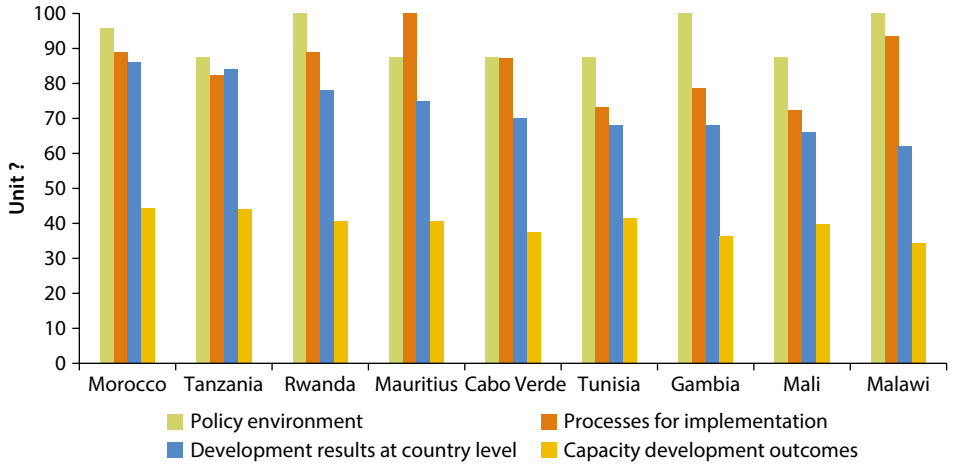
	Policy choices for capacity development	Development cooperation effectiveness related to capacity development	Gender equality and social inclusion	Partnering for capacity development
Very High	0	42.2	60.0	26.7
High	53.3	33.3	37.8	33.3
Medium	37.8	17.8	2.2	28.9
Low	8.9	2.2	0	8.9
Very Low	0	4.4	0	2.2
Total	100	100	100	100

Source: ACBF 2016a.

level and capacity development outcomes (figure 1.5).

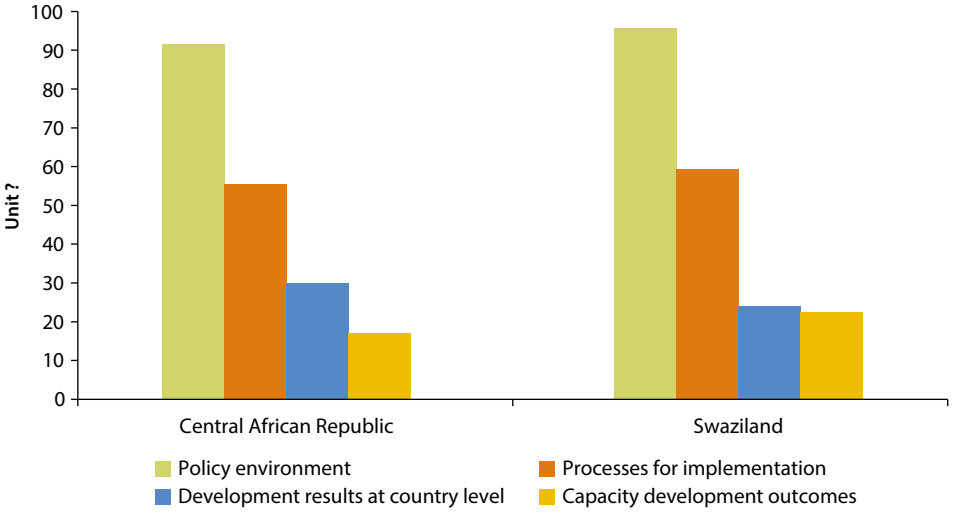
The poor performers will need continuous support and capacity development interventions to move out of the Low category. It is for that reason ACBF has supported the Central African Republic and Swaziland to strengthen their capacities (box 1.1).

Figure 1.4: Africa Capacity Index, 2016, top performers by cluster



Source: ACBF 2016a.

Figure 1.5: Africa Capacity Index, 2016, low performers by cluster



Source: ACBF 2016a.

Box 1.1: ACBF support to countries with low capacity: The Central African Republic and Swaziland

In 2008, ACBF supported the establishment of the Swaziland Economic Policy Analysis and Research Center in response to the need for more effective and better informed policies and management of the economy. The objective is to build sustainable national capacity to improve the quality and timeliness of public policies in Swaziland through the establishment of a semi-autonomous economic policy and research center, research in areas of policy formulation and management, provision of training and policy advice to government officials, and promotion of policy dialogue within Swaziland through dissemination workshops, conferences, and publications.

ACBF has also supported the Central African Republic in strengthening the capacity of the National Statistics Bureau to produce national accounts, price statistics, and social and demographic data on a regular and timely basis. The main goal is to contribute to the long-term development of the national statistical system. The specific objectives are to improve the quality of statistical data produced by the Institut Centrafricain des Statistiques et des Etudes Economiques et Sociales and the peripheral statistical units in line ministries and Délégations Régionales du Plan to routinely produce reliable and up-to-date statistical information for decision processes and monitoring of progress toward development goals; increase the number of skilled statisticians available to the government by setting up a scholarship program for certificate and diploma studies in statistics; and contribute to the design, implementation, and monitoring of the National Strategy for Development of Statistics.

Key messages and policy recommendations

- Capacity building for STI in Africa is vital for implementing STISA-2024 and for achieving the goals of AU Agenda 2063 and the SDGs.
- Africa has improved its average score on capacity development since 2015.
- None of the 44 countries surveyed is in the Very Low or Very High brackets, and 75.6 percent have Medium capacity.
- Nine countries show High capacity. All of them have a good policy environment.
- All countries need to invest more effort in for capacity development.
- The role of African capacity-building institutions, such as ACBF, is vital for supporting capacity building in STI in Africa.
- African countries must mobilize political and financial support for the development and implementation of sustainable STI capacity building to facilitate and accelerate Africa's transformation. More resources must be invested to enhance capacity building in STI in Africa at the national, regional, and continental levels.

2

SCIENCE, TECHNOLOGY, AND INNOVATION CAPACITY IN AFRICA: STATUS AND CHALLENGES

Africa's vision for socioeconomic transformation, which is driven by science, technology, and innovation (STI), can be traced back to the 1980 Lagos Plan of Action for the Economic Development of Africa, 1980–2000, which outlined the fundamental role of STI in addressing challenges such as food insecurity, poverty, energy deficiencies, health issues, pollution, water scarcity, and lack of industrialization. This chapter reviews the status of STI in Africa, and the continent's capacity challenges.

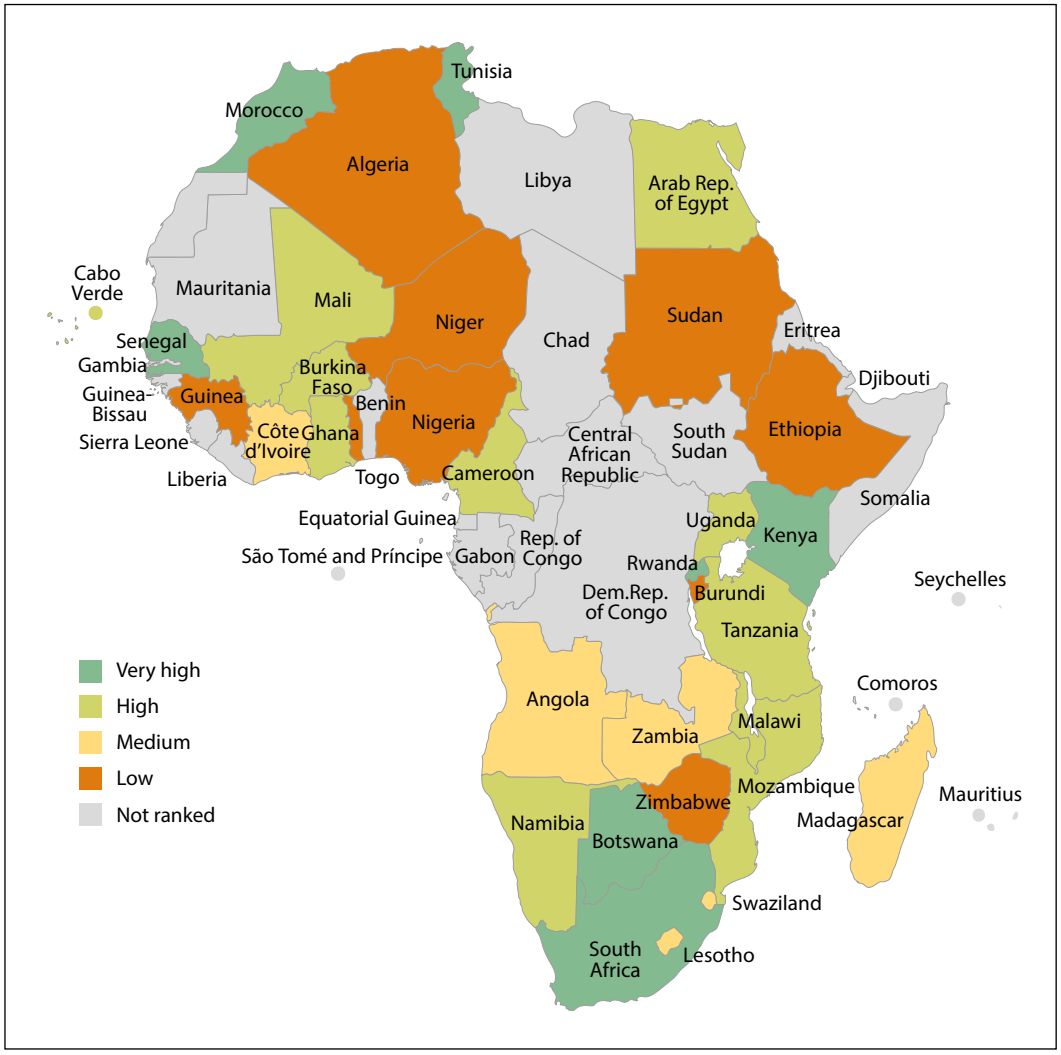
Status of STI in Africa

The status of Africa's STI capacity on a global scale is still very low, despite recent gains. The Global Innovation Index (GII) captures the multidimensional facets of innovation by measuring the innovation capacity of countries across the world and provides tools to tailor policies for promoting long-term output growth, improved productivity, and job growth (Cornell University, INSEAD, and WIPO 2015).

In 2015's GII ranking, of the 141 countries surveyed, 12 African countries were among the world's top 100 innovation achievers (map 2.1 and annex 1).[5] These countries are demonstrating rising levels of innovation inputs and outputs, driven by improvements in institutions and the business environment, greater effort to leverage STI policies, and rising innovation potential. Their strong performance can be attributed to the growth in general infrastructure, business and market sophistication, and improved knowledge and technology output.

Another useful index is the Networked Readiness Index (NRI), which measures countries' capacity to leverage information and communications technology (ICT) for increased competitiveness and well-being. Underlying the NRI are the following six principles, that: a high-quality regulatory and business environment is crucial to fully leverage ICT and generate impact; ICT readiness as measured by ICT affordability, skills, and infrastructure is a precondition for generating impact; fully leveraging ICT requires a society-wide effort—by government, business, and the population; the use of ICT should not be an end in itself; a set

Map 2.1: Global Innovation Index ranking, 2015



Source: Cornell University, INSEAD, and WIPO 2015.

of drivers—the environment, readiness, and usage—interact, coevolve, and reinforce each other to form a virtuous circle; and the networked readiness framework should provide clear policy guidance (WEF, Cornell University, and INSEAD 2016: 33).

In the 2015 report, the performance of Sub-Saharan Africa was particularly poor. Of the 31 regional countries surveyed, 30 appeared in the bottom half of the NRI rankings. The standout was Mauritius (45th), which has progressed since 2012 (WEF, Cornell

University, and INSEAD 2015). Among the large regional economies, Nigeria dropped by seven places to 119th, while South Africa dropped by five to 75th, placing it third behind Mauritius and Seychelles (74th) as the region's top performers. North African countries also recorded low performance, lying in the bottom half of the NRI. Morocco maintained 78th position, with no improvement since 2015. Egypt dropped two places to 96th, and Algeria also dropped two places to 119th (annex 2). Kenya has progressed slowly since 2012, up by six to 86th place in the global ranking in 2015.

The 2016 NRI saw some improvement in ranking among some Sub-Saharan African countries, including South Africa, which moved up 10 places to 65th, Côte d'Ivoire, up 9 places to 106th, and Ethiopia, which jumped 10 places to 120th (WEF, Cornell University, and INSEAD 2015). These countries have witnessed improvements in leadership in embracing a digital economy by different stakeholder groups. In Côte d'Ivoire and Ethiopia, the adoption of digital technology is pretty much driven by government, while the business sector is the driving force for momentum in South Africa. Yet Africa is still the lowest-scoring region globally on the NRI, and worryingly, its top-performing countries are improving, while its worst-scoring countries are trending down.

Some key messages emerge. First, some African countries are witnessing the transformative power of ICT in addressing economic and development issues. Second, in these countries, the era of global digitization is accelerating due to the rapid uptake of broadband internet, innovation more generally, and the democratization of technology. Third, many countries in Africa are yet to experience the ICT revolution. In leveraging ICT, they need to make a greater commitment through policies that promote ICT and that provide better infrastructure. Government leadership and vision are critical.

Investment trends in research and development

Many African countries have reiterated their political commitments to put STI at the core of national development, although these are yet to translate into investments in pragmatic STI-based development. A common measure of a country's investment in research and development (R&D) is gross domestic expenditure on R&D (GERD), which is on the rise in many African countries (UNESCO 2015). The sources of the increase are numerous, including digitization, creation of innovation hubs, and the global financial crisis of 2008–09, which hit commodity prices and focused attention on beneficiation policies in Africa (UNESCO 2015).

By region, spending on R&D in East and Central Africa is driven by the public and private sectors. Kenya has one of the highest R&D intensities in Africa, at 0.79 percent of gross domestic product (GDP) in 2010. This is expected to rise with the establishment of the National Research Fund, which makes provisions for the fund to receive 2 percent of GDP each year. Ethiopia has raised GERD from 0.17 percent in 2007 to 0.61 percent in 2013 (box 5.1). Malawi has raised its ratio to 1.06 percent and Gabon to 0.58 percent in 2009. In Gabon, the government is the main source of R&D spending, with about 29 percent from business. Foreign sources contribute 40 percent of GERD in Burundi, 47 percent in Kenya, 42 percent in Tanzania, and 57 percent in Uganda, where R&D funding rose from 0.33 percent to 0.48 percent of GDP over 2008–10 (annex 3).

Southern Africa has a wide disparity in R&D intensity, from 0.01 percent in Lesotho to

1.06 percent in Malawi. South Africa has witnessed a huge decline in private R&D since the global financial crisis, in spite of rising public spending on R&D, which partly explains why the GERD/GDP ratio declined from 0.89 percent in 2008 to 0.73 percent in 2012. Botswana has raised its GERD/GDP ratio from 0.26 percent in 2012 to more than 2 percent by 2016. Mauritius is expected to raise public expenditure on R&D to 1 percent of GDP by 2025, with a further 0.5 percent of GDP to come from the private sector (UNESCO 2015).

The average GERD for West African countries is up to 0.3 percent of GDP, with Mali the highest, at 0.66 percent of GDP. Although governments are the main source, foreign sources contribute 31 percent in Ghana, 41 percent in Senegal, and 60 percent in Burkina Faso. The Gambia receives nearly half of its GERD from private, nonprofit sources.

GERD in North Africa is usually higher than in Sub-Saharan Africa, though it still has to reach the 1 percent threshold: 0.79 percent in Morocco in 2015, and 0.68 percent in 2013 and 0.86 percent in 2014 in Egypt and Libya, respectively. Tunisia saw a dip from 0.71 percent in 2009 to 0.68 percent in 2012. The status of STI in North Africa, as in the rest of Africa, reflects a paucity of capacity for human and material resources, undermining ambitious measures.

Among global regions, Africa invests least in R&D and imports and uses technology the least, too. Its STI potential remains untapped, and its ability to generate new opportunities and meet emerging challenges is low, and it direly needs to improve its STI capabilities. It needs to build capacity among researchers, industry, communities, and individuals to tap into new and emerging opportunities in STI, meet its development challenges, and create a sustainable pathway toward self-sufficiency.

Trends in higher education

The importance of high-quality higher education in developing human capacity for economic growth and competitiveness in a knowledge-driven economy has prompted many African countries to prioritize it. Since its inception, ACBF has contributed to supporting countries by creating training programs across the continent (ACBF 2015).

For several decades, African countries neglected and underfunded higher education, believing that it yielded lower social returns than other investments in the field, particularly primary and secondary education. A theoretical underpinning was that investments in higher education were regressive, reproducing existing social and economic inequalities (APLU 2014). Against that, a study by Montenegro and Patrinos (2013) on rates of return to schooling around the world, using data from 545 households in 131 economies over 1970–2011, suggests that returns are highest globally at the tertiary level, with a world average of 16.8 percent, against primary returns at 10.3 percent and secondary returns at 6.9 percent. Higher education yields steep benefits not only for African young people but for society more widely: better job prospects, improved quality of life, and faster economic growth (AAI 2015).

The gross enrollment rate for tertiary education by region was, in West Africa, 9.2 percent in 2012 (UNESCO 2015). Some countries have made impressive progress, including Cabo Verde, which lifted the rate from 15.1 percent in 2009 to 20.6 percent in 2012 (annex 4), and Ghana (8.8 percent to 12.2 percent over the period). Niger and

Burkina Faso, however, stagnated at 1.7 percent and 4.6 percent, respectively, in 2012.

In Central and East Africa, Cameroon, Comoros, and the Republic of Congo have recorded tertiary enrollment rates of more than 10 percent in recent years, while Kenya's rate was a disappointing 4 percent in 2009 (the latest year with data); Cameroon has recorded rapid progress, raising its rate from 5.8 percent in 2005 to 11.9 percent in 2011 (UNESCO 2015). The ratio of engineering to science students was much higher in Ethiopia (59 percent) than in Cameroon (6 percent). In Ethiopia, enrollment in agriculture was almost as high as in engineering or health sciences.

In North Africa, Morocco has fostered a sharp rise in tertiary education enrollment over the past decade. In 2010, 39,381 students were enrolled in the "third cycle," including 19,195 taking a Master's (48.8 percent), 16,054 a PhD (40.8 percent), and 1,720 a medical specialty (4.4 percent) (Hassan II Academy of Science and Technology 2012). Tunisia had 315,513 students in 13 universities in 2012/13 (Ministry of Higher Education and Scientific Research 2014). In Egypt, the number of students enrolled in public universities declined from 1,880,460 in 2005 to 1,627,339 in 2013, while those in private universities increased from 83,108 to 86,784 over the period (UNESCO 2014a).

Overall, students' university enrollment jumped, from 3.53 million students in 1999 (2.25 million in Sub-Saharan Africa and 1.28 million in North Africa) to 9.54 million in 2012 (6.34 million and 3.2 million), straining the current system (TrustAfrica and *Mail and Guardian Africa* 2015). Tertiary enrollment in Africa grew at about 15 percent annually, more than the growth in population of the tertiary education cohort, lifting the enrollment ratio from about 4 percent in 2000 to 6 percent in 2008 (ECA 2014). Yet from a global perspective, Africa's university enrollment rate remains very low.

Africa's quality of tertiary education is a major concern: only five of the world's top 500 universities are in Africa (table 2.1), against six in Brazil and 32 in China. The ranking of universities is assuming greater importance, as a measure not only of university education but university outputs, including numbers of papers published in top journals, of awards and recognitions received by universities, staff, and alumni, and of citations of published papers.

Table 2.1: Ranking of the top 500 universities in the world in 2015

Region	Top 20	Top 100	Top 200	Top 300	Top 400	Top 500
Americas	16	55	86	121	150	176
Europe	4	35	80	122	158	205
Asia/Oceania	0	10	34	55	90	114
Africa	0	0	0	2	2	5
Total	20	100	200	300	400	500

Source: ShanghaiRanking 2016.

Patterns in human resource development

Number of researchers

Data collection on the number of STI researchers in Africa started in recent years (table 2.2). Data from the African Science, Technology, and Innovation Indicators (ASTII) initiative and the UNESCO Bureau of Statistics reveal too few researchers in African countries in 2011–13. In 2013, Tunisia led the rest of Africa with 1,394 full-time equivalent researchers per million inhabitants, followed by Morocco with 864. Sudan had the fewest with 19. South Africa—one of Africa's largest economies—had 818 (in 2012), comparable with Brazil but far lower than in innovative economies such as the Republic of Korea (4,627). The majority of countries had fewer than 300 researchers per million inhabitants (ASTII 2013).

Scientific publications

Several regional economic communities (RECs) saw a surge in scientific production with the indexed production of the Arab Maghreb Union growing by 60 percent, while that of the Community of Sahel-Saharan States was up by 50 percent. Those of the Common Market for Eastern and Southern Africa and the Economic Community of West African States (ECOWAS) were up by 47 percent respectively.

At the country level, scientists in South Africa and Egypt published the most scientific papers

Table 2.2: Researchers in Africa per million inhabitants in 2013 or closest year

No.	Countries	Researchers per million inhabitants	No.	Countries	Researchers per million inhabitants
1	Sudan (2012)	19	18	Benin (2007)	115
2	Lesotho (2011)	21	19	Nigeria (2007)	120
3	Central African Rep. (2009)	31	20	Malawi (2010)	123
4	Gambia (2011)	35	21	Zimbabwe (2012)	200
5	Burundi (2011)	40	22	Congo, Dem. Rep. (2009)	206
6	Zambia (2008)	49	23	Cameroon (2008)	233
7	Rwanda (2009)	54	24	Cabo Verde (2011)	261
8	Mozambique (2010)	64	25	Mauritius (2012)	285
9	Mali (2010)	66	25	Kenya (2010)	318
10	Tanzania (2010)	69	26	Namibia (2010)	343
11	Angola (2011)	73	28	Botswana (2012)	344
12	Burkina Faso (2010)	74	29	Gabon (2009)	350
13	Uganda (2010)	83	30	Egypt (2012)	581
14	Ethiopia (2013)	87	31	Senegal (2010)	631
15	Togo (2012)	96	32	South Africa (2012)	864
16	Ghana (2010)	105	33	Morocco (2011)	818
17	Madagascar (2011)	109	34	Tunisia (2012)	1,394

Source: Author's compilation from UNESCO 2015.

over 2005–10, followed by Nigeria, Tunisia, and Algeria. Some North African countries recorded strong growth in production, with Egypt recording 8,428 publications in 2014, followed by Tunisia with 3,068, Morocco with 1,574, Libya with 181, and Mauritania with 23.

Among regions, in 2005–14, Kenya recorded the most (1,374) and highest share (11.3 percent) of papers among the 10 percent most cited papers in 2008–12 in East African countries. Ethiopia more than doubled its production since 2005 with 865 publications and 6.3 percent of the 10 percent most cited papers in the period (UNESCO 2015).

West Africa has not seen the same growth in scientific publications as other African regions since 2005. Scientific output is very low. Cabo Verde and The Gambia published more than 40 articles per million inhabitants, while Guinea and Liberia are the least productive, with 4.1 and 2.5 articles per million inhabitants, respectively, in 2014. Nigeria produced 1,961 scientific publications in 2014, the most in the region.

South Africa recorded more than 9,000 scientific publications, followed by Tanzania (770), Malawi (322), Zimbabwe (310), Zambia (245), Botswana (210), and Madagascar (188). Lesotho had the fewest (16). The numbers in Malawi and Mozambique have almost tripled since 2005, from 116 to 322 and from 55 to 158, respectively (UNESCO 2015).

Almost one-third of publications from the Southern African Development Community region in 2008–14 were in chemistry, engineering, mathematics, and physics, although research in Mauritius and South Africa was oriented more toward health-related sciences. International research collaboration was important for these two countries, with 57 percent of South Africa's articles and 69 percent of Mauritius's having foreign coauthors in the period.

Africa's increasing number and global share of articles suggest that it is starting to emerge scientifically onto the world stage. In 1996–2012, the number of published scientific journal articles with at least one African author more than quadrupled from about 12,500 to more than 52,000, and Africa's share of articles published worldwide with African authors roughly doubled from 1.2 percent to around 2.3 percent (Schemm 2013).

Over the coming decade, African authors have the opportunity to increase the scientific production output, given the growing need for R&D to address the continent's development challenges. Much will depend on greater awareness and research capacity through scientific collaboration among institutions inside and outside the continent.

Capacity challenges

The Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024) stresses the importance of STI for economic growth and human development, highlighting the need for capacity building, and expresses concerns over African governments' failure to commit at least 1 percent of GDP to R&D or to establish a Science and Technology Fund, the continent's low innovative capacity, and its often weak application of STI. Building STI capacity is a formidable challenge, which may be broken down into several spheres.

Paltry investment

Despite its abundant natural resources, one reason Africa struggles to keep up with the development curve is its low investment in

STI capacity development. (In an ACBF survey of 44 African countries, 77 percent considered investment in STI capacity as a High or Very High priority capacity need.) Most African countries take a short-term view of human development and continue to rely on external financial support, which often has short-term goals. In short, the continent has failed to invest enough in STI to drive economic growth (Mugabe 2011), as we have seen in its low public spending on R&D. The impact of weak investment is also visible in poor scientific infrastructure, a small pool of researchers, and minimal scientific output on a global scale: Africa accounts for about 5 percent of global GDP, but only 1.3 percent of R&D outlays (UNESCO 2015).

Africa's exports are based heavily on natural resources, with little value added (ACBF 2013). This stems from and impedes growth in high-productivity areas, leaving African exporting countries at the mercy of changes in global demand and prices, as seen so clearly in the global financial crisis. Such events reinforce the urgent need for Africa to invest in STI capacity and infrastructure to diversify its economy and to create high-value-added products.

Limited human resources and capacity

Linked to the funding issue, STI stakeholders across Sub-Saharan Africa highlight inadequate human, financial, and infrastructure support for STI development, and the lack of skilled and experienced professionals, in part reflecting Africa's brain drain (Ramos 2014; and see "The brain drain" in chapter 4). Africa has insufficient professionals in the critical areas of ICT, due to the "brain drain" of ICT experts, who are in the international diaspora searching for greener pastures. This has resulted in a shortage of ICT scientists and engineers in most African countries (ACBF 2016d). African universities and research institutions are faced with a shortage of highly qualified and experienced researchers, lecturers, technicians, and management staff. Among nine universities surveyed, fewer than 50 percent of researchers and lecturers were PhD holders, with fewer for the humanities and social sciences (38 percent) than for science-related fields (51 percent) (ECA 2014). A worrying trend for the future is that the number of researchers and lecturers holding a PhD may be far lower at some of the new universities being set up (ECA 2014).

But it is not just about finances: Africa's institutions of research and higher education have struggled to recruit and retain highly skilled researchers and faculty also because of the scarcity of highly qualified candidates, which weighs heavily on these institutions' capacity to conduct experimental long-term research and academic research. Africa's research and higher education institutions do not have the capacity to produce PhD-qualified faculty themselves. An increase in the number of PhD lecturers and researchers is essential.

Infrastructure shortfalls and progress

Africa's share of the world's research output does not reflect its population size: less than 1 percent versus about 15 percent (Mwiti 2015). That shortfall is largely due to a lack of state-of-the-art R&D laboratories and facilities, poor transport systems, and inadequate energy and communications infrastructure.

Still, some signs are positive. In ICT, for example, Africa is seeing a rise in the number of terrestrial transmission networks

and submarine cables, with total design capacity of 14.0 terabytes per second. And after 2009, it saw a sharp expansion of its terrestrial high capacity transmission networks, from 465,659 km to 676,739 km in 2011. This suggests that some 36 percent of Africans were within reach of operational fiber nodes, up from 31 percent in June 2010 (ECA 2014).

South Africa launched its first satellite, SUNSAT, in 1999, and a second, SumbandilaSat, in 2009. Nigeria launched its first, NigeriaSat-1, in September 2003, and its second and third in 2011. Several African-owned earth observation satellites are now in orbit, such as Alsat-1 (belonging to Algeria), and Egyptsat-1 (belonging to Egypt).

But Africa's STI still needs heavy infrastructure investment. A concomitant necessity is to invest in and build its human capacity and skills to ensure that the infrastructure and systems are fully exploited. Exploring innovative ways of developing and financing infrastructures is therefore an urgent necessity in Africa (ACBF 2016e).

Missing and data

Due to the multisector nature of STI and the potential development impact it can have beyond R&D, it is essential to establish policy and technical indicators for benchmarking progress. In spite of calls to action, progress to the 1 percent of GDP investment target in R&D cannot be accurately ascertained due to lack of data.

Africa has a very poor history of measuring and managing STI data, exaggerating or understating them, which is reflected in global rankings on STI and networked readiness. In certain cases, STI data on Africa are collected by international institutions, and the interpretation of such data are at the mercy of external institutions. The lack of a robust common set of African STI indicators has constrained the continent's capacity to make evidence-based decisions on STI.

Gender issues

In Africa, gender issues have been strongly emphasized in strategic action documents, such as the Action Plan for the implementation of the Second Decade of Education for Africa (2006–2015), Africa's Science and Technology Consolidated Plan of Action, and the AU's progressive gender policies. Moves to attract women and girls to science and technology (S&T) include gender mainstreaming in STI policy and programs; fellowships, scholarships, and award systems; career guidance and mentoring in institutions of higher learning; adaptation of curricula; and continuous sensitization and lobbying of policymakers and legislators (ECA 2011). Outcomes, however, are mixed, but, on balance, encouraging.

Female researchers in Africa have made gains over the past few years. In North Africa, females make up one in three researchers. In social sciences and the humanities in Egypt, women have attained gender parity (UNESCO 2015).

In Southern Africa, women make up between 28 percent (South Africa) and 34 percent (Mozambique) of science graduates. The numbers of female graduates in agricultural science have been increasing steadily across the continent, with eight countries reporting the share of women graduates at 40 percent or more.[6] In health, this rate ranges from 26 percent and 27 percent in Benin and Eritrea, to 94 percent in Namibia. The two

Table 2.3: Percentage of women researchers in selected African countries

No.	Country	Women researchers (%)	No.	Country	Women researchers (%)
1	Namibia (2010)	43.7	15	Zimbabwe (2012)	25.3
2	South Africa (2012)	43.7	16	Senegal (2010)	24.9
3	Egypt (2013)	42.8	17	Uganda (2010)	24.3
4	Mauritius (2012)	41.9	18	Nigeria (2007)	23.3
5	Cabo Verde (2011)	39.8	19	Burkina Faso (2010)	23.1
6	Madagascar (2011)	35.4	20	Gabon (2009)	22.4
7	Mozambique (2010)	32.2	21	Cameroon (2008)	21.8
8	Lesotho (2011)	31.0	22	Rwanda (2009)	21.8
9	Zambia (2008)	30.7	23	The Gambia (2011)	20.0
10	Morocco (2011)	30.2	24	Malawi (2010)	19.5
11	Botswana (2012)	27.2	25	Ghana (2010)	18.3
12	Angola (2011)	27.1	26	Mali (2011)	16.0
13	Kenya (2010)	25.7	27	Burundi (2011)	14.5
14	Tanzania (2010)	25.4	28	Ethiopia (2013)	13.3

Source: UNESCO 2015.

African countries with the highest proportion of women researchers are Namibia and South Africa, at 43.7 percent each (table 2.3).

Despite policies for gender equality, women's participation in R&D remains low in some parts of Africa. In East and Central Africa, gender disparity is evident at the tertiary level and is particularly pronounced in the Central African Republic, Chad, Eritrea, and Ethiopia, where the male participation rate is more than 2.5 times higher than females' (UNESCO 2015).

The low participation of women in STI is seen at work. In Sub-Saharan Africa, about 74 percent of working women are in low-productivity informal employment, against 61 percent of men (ILO 2014). Women employed in vulnerable work or the informal economy tend to experience poor working conditions, have limited access to social security and representation, and receive lower earnings than other workers (Vanek et al. 2014).

Innovation capacity

Africa's economy is highly reliant on natural resources and a few industries. To become competitive in the global market, it needs to diversify its economic base, which requires innovation. Although African countries are working hard to boost their investment in R&D, such efforts may have limited impacts in achieving development goals without first building Africa's innovation capacity to translate knowledge from research into outputs.

By innovation capacity, we mean the ability of countries to apply knowledge for the generation of new and improved goods, services, and processes in all sectors of the economy. In African countries where economies are agricultural and natural resource–based, innovation rarely occurs within formal R&D. It is, however, to be noted that the majority of countries do have medium capacity to develop a good agricultural strategy and to invest in the

right areas to build the skills and innovation needed for the future (ACBF 2012).

Monitoring and evaluation

Given the dearth of public resources for STI, it is imperative for African countries to develop monitoring and evaluation (M&E) systems, as well as controls, for STI expenditure to ensure cost effectiveness. But one major challenge in most African countries is the low capacity to identify the main problems and determine how much to allocate to resolving them. Strong M&E systems can help here, providing a basis for sound STI governance. South Africa is among the few African countries to have created a high-level agency for M&E, strengthened its legal and regulatory frameworks to require regular M&E, and adopted innovative M&E tools to strengthen budgeting and planning (Lopez-Acevedo et al. 2010).

Key messages and policy recommendations

- The recognition of STI as the fundamental driving force behind Africa's pursuit of economic transformation from natural resource–based to innovation-led and knowledge-driven is embodied in the AU's Agenda 2063.

- For STI to contribute to Africa's sustainable development and economic transformation, African countries must invest in and build their scientific capacity.

- Africa has a poor history of measuring and managing STI data. The lack of capacity to apply and interpret STI indicators correctly to monitor the progress of STI development at the country level may hinder sound STI decisionmaking.

- Building STI capacity is a formidable challenge, and building and sustaining the quality of key institutions of research and learning is critical to it.

- African countries must strive to achieve critical mass in human resource development in STI through substantial investment in universities, laboratories, ICT infrastructure, and research-funding mechanisms. Capacity needs to be built for long-term observations and research.

- Reducing the gender gap through the promotion of women's participation in STI development, and encouraging girls to pursue science and engineering programs, have the potential to make African societies more vibrant and its institutions more resilient and responsive.

- Investment in science capabilities of countries, and development of STI institutional capacity, are critical to the application of STI in Africa, and are fundamental to sound policymaking, good governance, and economic transformation.

- Strategic investment in education, in capacity development in STI and engineering, and in innovation systems has the potential to catalyze innovation, promote competitiveness, and nurture the next generation of innovators, entrepreneurs, and scientists.

- African countries should develop and implement policies inspired by STISA-2014, as well as create institutional arrangements that promote STI in solving problems aligned to the Sustainable Development Goals.

- They should build STI capacity into donor development programs and ensure that these programs are Africa-led and sensitive to national social and cultural diversity.

- African countries should develop and implement sensitization and capacity-building programs on gender mainstreaming in STI for decisionmakers and gender focal points.

- They should develop information and knowledge repositories on gender parity in STI status in member states and sub-regionally so as to increase visibility of women in science and their publications. These will serve as career guidance and as tools for gender analysis and monitoring.

- There is a need for countries to strengthen the statistical capabilities through investment in human capital development and ICT infrastructure.

- There is a need to develop the capacity of institutions and individuals in African countries on how to develop innovative strategies and policies that fully integrate STI into national development goals.

- African countries should promote innovative and creative capacities by providing a conducive environment that propels creativity, innovation, and inventiveness and guides the acquisition and commercialization of R&D for sustainable growth and development. Longer term, the social recognition of inventors should be enhanced.

- Increase capacity support for R&D through international partnerships and linkages among researchers, academia, government, industry, and civil society actors. The aim is to improve commercialization of R&D, scale up investment in S&T parks, and encourage action-oriented research at all levels of education.

3

SCIENCE, TECHNOLOGY, AND INNOVATION INITIATIVES AND CONTRIBUTIONS

This chapter reviews the capacity dimensions of some of the key initiatives and contributions to improve science, technology, and innovation (STI) in Africa. Such mapping can help—at the regional, national, and international levels—provide guidance to policymakers.

STI research and development initiatives—regional

An early regional initiative on capacity building in STI research and development was the New Partnership for Africa's Development (NEPAD). This established the Department of Human Resources, Science, and Technology to develop human capital, education, and science and technology (S&T) in Africa.

The African Union Commission (AUC) established in 2003 a Conference of Ministers in charge of Science and Technology to develop STI in Africa. The African Union (AU) initiated the Consolidated Plan of Action (CPA) in 2005 as an instrument for capacity building, knowledge production, and technological innovation in African countries. The CPA generated political support, which paid off in the establishment of the Pan African University and of four networks of Centers of Excellence within the African Biosciences Initiative: the Bio-Innovate and the African Biosafety Network of Expertise; the Southern Africa and West Africa Networks of Water Center of Excellence; the virtual African Laser Center; and the African Institutes of Mathematical Sciences (UNESCO 2015).

Implementation of the CPA also led to the African Science, Technology, and Innovation Indicators (ASTII) initiative; the African Observatory of Science, Technology, and Innovation; and the introduction of the AU Research Grant, administered by the AUC. A major output of the ASTII initiative is the African Innovation Outlook Report, produced biennially, which provides evidence on the state of STI in surveyed African countries.

A landmark achievement during the period of the implementation of the CPA was Africa's successful bid to cohost the Square Kilometer Array, a $2 billion radio telescope project being built in South Africa and Australia. In line with the CPA's agenda to foster capacity development in STI on the continent, the African

Capacity Building Foundation (ACBF) facilitated the establishment of the Capacity Building for the African Institutions of Science and Technology program, which supports the Nelson Mandela African Institution of Science and Technology based in Arusha, Tanzania and other institutions in science and technology.

Based on the experiences of the CPA, the Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024) has emerged as the blueprint for implementing Agenda 2063, focusing on three interrelated pillars: STI capacity building, knowledge production, and technological innovation. STISA-2024 exhibits a stronger and sharper focus on innovation and science for developing the CPA, focusing on six priority areas (table 3.1). STISA-2024 also defines four action pillars: upgrading or building research infrastructure, enhancing technical and professional competencies, developing innovation and entrepreneurship, and providing an enabling environment for STI development in Africa.

STISA-2024 raises hopes that an African Science, Technology, and Innovation Fund (ASTIF) will be established, given how important it will be for sustaining STI programs, such as the networks of Centers of Excellence, which encourage creative individuals and institutions to generate and apply science and technology (S&T) and to promote technology-based entrepreneurship. However, funding sources and mechanisms for the ASTIF are problematic, notably the lack of dedicated internally generated funds from AU member states. Member states should deliver on their commitment to ramp up investment by devoting 1 percent of GDP to R&D to make ASTIF operational. In adopting STISA-2024, member states, regional economic communities (RECs), and

Table 3.1: Summary of STISA-2024 priority areas

	Priority area	Research and innovation areas
1	Eradicate Hunger and Ensure Food and Nutrition Security	Agriculture/agronomy in cultivation techniques, seeds, soil, and climate Industrial chain in terms of conservation or transformation and distribution, infrastructure, and techniques
2	Prevent and Control Diseases and Ensure Well-being	Better understanding of endemic diseases, including HIV/AIDS, malaria, and hemoglobinopathies Maternal and child health Traditional medicine
3	Communicate (Physical and Intellectual Mobility)	Physical communication via equipment for land, air, river, and maritime routes Infrastructure and energy Promotion of local materials Intellectual communication via ICT
4	Protect Our Space	Environmental protection including climate change studies Biodiversity and atmospheric physics Space technologies; maritime and sub-maritime exploration Knowledge of the water cycle and river systems, and river basin management
5	Live Together—Build the Society	Citizenship, history, and shared values Pan-Africanism and regional integration Governance and democracy, city management, and mobility Urban hydrology and hydraulics Urban waste management
6	Create Wealth	Education and human resource development Exploitation and management of mineral resources, forests, aquatics, marine areas, and so on Management of water resources

Source: AUC 2014.

development partners have been called on to align and use STISA-2024 as a reference framework for regional and national STI strategies.

Another regional initiative worth mentioning (and supported by ACBF) is the African Institutes of Science and Technology (AIST) which plays a leading role in the promotion of sciences within the continent through strong linkages with national universities and research institutions. The initiative was jointly hatched with the World Bank and endorsed by the Heads of African States in Abuja in January 2005, with the agreement to establish four AISTs (for Western, Eastern, Central, and Southern Africa). ACBF's support to the initiative has contributed in improving the quality of higher education in science and engineering in Africa. This has been critical for developing effective technological innovations that better support the economic development of Africa.

STI initiatives in higher education—national

African countries' higher education institutions have long built capacity and contributed to socioeconomic development. Typical African universities with specialized programs in science, technology, and engineering, and specialized S&T universities, are important for STI capacity building (annex 5), as their governments recognize.

Most S&T education in African countries has for many years been provided by public specialized S&T universities, although a shift has emerged to S&T education by private specialized institutions in some countries, including Benin, Cameroon, the Republic of Congo, Togo, and Zambia. Other countries, such as Egypt, Kenya, Nigeria, Sudan, and Tanzania, seem to rely on a combination of public and private specialized S&T universities, with a growing emphasis on public–private partnerships.

The Nelson Mandela African Institution of Science and Technology, inaugurated in 2012 with the support of ACBF, is a public educational and research institute in Tanzania, which focuses on education, training, and research in science, engineering, and technology. In Nigeria, the African University of Science and Technology, founded in 2007 with the support of ACBF, is a private educational and applied research university offering courses in science, engineering, and technology.

STI collaborative projects—international

The following international initiatives, selected from many, exemplify best practices and models of cooperation that may be of use to policymakers.

UNESCO–African Union Strategic Partnership for STI

UNESCO has a tradition dating back to the early 1960s in assisting AU member states in science policy reviews.[7] Many member states have sought, and are still seeking, UNESCO's support in formulating national science policies. The Addis Ababa Declaration on Science and Technology and Scientific Research for Development adopted by Heads of State and Government of the AU in 2007 requested UNESCO and other bilateral and multilateral organizations to support STI in AU member states.

The AU Heads of State and Government requested UNESCO's assistance in the implementation of the CPA for S&T in Africa over 2008–13. UNESCO, in 2007, approved a UNESCO Plan of Action and adopted three

flagship projects, including capacity building in STI policy, enhancing S&T education, and the African Virtual Campus.

UNESCO had undertaken several initiatives to support the CPA on building capacity in science policy, improving policy conditions, and building mechanisms for innovation. For instance, UNESCO launched the African Science, Technology, and Innovation Policy Initiative (ASTIPI) to build capacities in STI policy formulation and develop national STI policies for African countries.[8] In the context of ASTIPI, at least 100 specialists were trained in policy analysis, and an ASTIPI postgraduate course was run. Also, training seminars and workshops on STI policy indicators were held in 2008 for English-speaking Africa, and in 2009 for French-speaking Africa. National capacities for collection and interpretation of STI indicator data were strengthened.

Working with AU/NEPAD, UNESCO has also conducted a survey of African member states to determine the availability and adequacy of STI policies for meeting Africa's needs, including training needs. With AUC/NEPAD, it similarly developed and implemented training programs for policy analysts in formulating science policy and mapping science statistics and indicators. Thirty-six countries in Africa participated in statistics workshops over 2005–07. UNESCO, in cooperation with AUC/NEPAD, planned to establish the African STI observatory.

Partnerships for STI capacity building[9]

There is significant support for the notion that sustainable partnerships act as crucibles of capacity building outside the project environment, especially for human capital development through exchange of knowledge and experiences, mobility of scientists and engineers, and training.

The Joint Africa–EU Strategy

Outcomes of collaboration between the AU and European Union (EU), administered by their commissions, are joint policy statements, agreements, and cooperative frameworks (EU 2013). The Joint Africa–EU Strategy (JAES), signed in 2007, represents a major biregional policy partnership between the AU and EU, with some involvement of member states from both regions.

The JAES covers S&T in the form of the eighth partnership (P8) and its rolling action plan. P8 links three African development policy priorities, recognizing the contribution of science, the information society, and space to Africa's socioeconomic development. In 2008, the AUC identified and designed 19 large-outline projects for the "Book of Lighthouse Projects"[10] that formed the initial plan for implementing the P8, translating key P8 objectives into capacity building outcomes for Africa, which are consistent with the CPA and the African Regional Action Plan on the Knowledge Economy. This collaboration has led to several Lighthouse Projects, such as the Africa Research Grants Programme, the African Virtual Campus, and African Leadership in ICT.

STI collaboration with the AU as a whole or its bodies, such as the NEPAD Agency, and one or more EU member states, is seen, for instance, in funding for the ASTII initiative from the government of Sweden through the Swedish International Development Cooperation Agency. A key European partner in the initiative is Lund University, which provides technical backstopping. The university was instrumental in developing methodological tools for conducting STI surveys. Another key partner in ASTII is the Secretariat of the Organisation for Economic Co-operation and Development

(OECD), which has been a source of lessons for African countries.

Another example is the African Network of Centers of Excellence in Water Sciences and Technology Development, initiated by NEPAD. The initiative is administered by South Africa's Water Research Commission and the NEPAD Agency, and is funded by the government of France through the Ministry of Foreign Affairs. In addition to the European Commission, through its Joint Research Center, a major partner in the initiative is the French Institut de Recherche pour le Développement. Other African partners include the University of Stellenbosch in South Africa and the Abuja-based African Ministerial Commission on Water.

Public health

Partnerships for capacity building can also be explored by major theme—providing examples of best practice—the first of which is public health.[11]

European and Developing Countries' Clinical Trials Partnership, conducted over 2003–13, aimed to accelerate the development of new or improved drugs, vaccines, microbicides, and diagnostics for HIV/AIDS, tuberculosis, and malaria, with a focus on phase II and III clinical trials in Sub-Saharan Africa. It funded trials through a rolling process of calling for proposals. It contributed to skills development; offered resources for training people for every clinical trial run; and built capacity in the skills needed for such trials. The project recruited then trained some 400 individuals. The partnership granted fellowships, allowing trainees to continue working. It contributed to knowledge development, as clinical trials automatically generated new clinical knowledge, and aimed to empower individuals to protect that knowledge, despite the weak intellectual property regimes in Africa.

The West Africa Malaria Initiative of 2009–13 was an initiative for malaria research in the Economic Community of West African States. The objective was to provide regional support for strategies undertaken to control or eliminate malaria by developing regional capacities in research (strengthening research networks) and training (improving training for malaria specialists). It was supported by the Spanish International Agency for Development Cooperation.

The UK–Africa Academic Partnership on Chronic Disease, which ran from 2006 to 2009, was a model of good practice (box 3.1).

Agriculture, food security, and nutrition

The collaborative project under the African Food Tradition Revisited by Research, (FP7, 09/2010–08/2014) aimed to improve traditional African food products and know-how by sharing European and African food technology. The project intended to improve, develop, or create a product or technology for 10 product groups, either by upgrading traditional materials, which could be exported to the EU, or developing new "functional" foods. The consortium was composed of seven African countries and four EU countries.[12] The major outcomes helped to define standards for processing foods from raw material to products. It also set up a Europe–Africa network focusing on traditional food, and a South–South partnership among African partners.

A framework for enhancing Earth Observation capacity for Agriculture and Forest Management in Africa as a contribution to GEOSS (AGRICAB) is a small- to medium-scale research project. The project

Box 3.1: The UK–Africa Academic Partnership on Chronic Disease

This research partnership of medical and social scientists was based in Africa (Cameroon, Ghana, and Kenya), Europe (UK and the Netherlands), Asia (Malaysia), and the United States. Established in 2006 with funding from the British Academy, it aimed to develop interdisciplinary models for chronic disease research, intervention, and policy to address the public health challenges for Africans, whether in Africa or the diaspora. The capacity dimension was that the project led to training of graduate students by improving their writing skills through authoring papers.

With just a tiny three-year grant of £30,000 from the British Academy in 2006, it focused on lack of capacity for tackling the emerging crisis of noncommunicable diseases (NCD) in Africa. Initially it focused on publishing information on NCDs to build awareness, on training graduate students, and on conducting international meetings for networking and mobility. The partnership used the grant as seed funding to leverage additional resources for research. The network's extensive publication record permitted it to provide training in writing to graduate students. The partnership attracted researchers in the United States and grew, leading to a spin-off collaboration for community-based research and postgraduate training on NCD research. Despite the end of grant funding, the network continues.

Source: EU 2013.

provides short-term training in Africa, including on-the-job training for practitioners and stakeholder groups, and regional training conducted by regional African institutes. This is in addition to long-term training provided for experts, and for PhD and MA students from African countries—North–South and South–South exchanges. Another project contribution is the production of scientific knowledge, in the form of several joint and coauthored peer-reviewed publications.

Human resources development, education, and research

The Development Research Uptake in Sub-Saharan Africa initiative aims to improve the accessibility, uptake, and utilization of locally contextualized development research evidence on climate change and the environment, health, education, governance, and food security in Africa, to inform Sub-Saharan African and global development policy and practice. The initiative also aims to strengthen the capacity of 24 research-intensive universities in Africa by strengthening their research uptake management capacity and their participation in the international development scientific research system. The project offers three options: MSc, PhD, and short courses on knowledge utilization and research uptake. It provides bursaries and funded courses for about 60 students.

The African Virtual Campus is one of the JAES P8 Lighthouse projects. It aims to include an online African Virtual Campus Network for S&T Education and to develop a network of 54 national e-learning centers across the continent. Initial financial support has been provided by the governments of Spain and Japan for the development of four e-learning centers in West Africa (Senegal, Benin, Togo, and Côte d'Ivoire). The impacts of the project include the creation of the National Virtual University of Senegal by

the government of Senegal and the development of the National Virtual Networks for universities and teacher training institutes by the Ministries of Education and of Higher Education of Côte d'Ivoire.

Energy and the environment

The African, Caribbean and Pacific Group of States' nonfood oils S&T program, which ran from 2009 to 2013, was primarily a capacity-building project combining technology transfer and research. It aimed to build sustainable, nonfood, renewable biofuel supply chains by providing combined cooling, heat, and power. It also aimed to link S&T academics, professionals, decisionmakers, and support-scheme managers from Africa and Europe in a series of inter- and intra-regional workshops. The project ran 10 training programs and held workshops for stakeholders.

Another project—AfricanSNOWS—aims to build capacity for research on water supply, sanitation, and environmental health (box 3.2).

EnerMENA is a capacity-building project, funded by the German Federal Ministry of Foreign Affairs. It aims to prepare for the sustainable installation of Concentrated Solar Power (CSP) plants in the Middle East and North Africa (MENA) region. The project is coordinated by the Institute of Solar Research at the German Aerospace Center. It has 45 partner institutions in Germany, Egypt, Algeria, Morocco, Tunisia, and Jordan, including international organizations. It supports CSP technologies in the MENA region, transfer of expert knowledge, dissemination of information, and market development.

By focusing on training, technical support, and R&D project development, the project intends to strengthen the EU–MENA partnership in CSP and bring stakeholders in at an advanced stage of cooperation. The project contributes to enhancing the ability to use acquired materials. It offers training for different groups: engineers, onsite technicians, researchers, university professors and students, as well as technology and knowledge transfer agents. The training offered to professors is designed to support CSP teaching in the partner countries' universities.

Box 3.2: AfricanSNOWS

AfricanSNOWS (Wellcome Trust, African Institutions Initiative, 2008–2014) builds interdisciplinary capacity for research on water supply, sanitation, and environmental health, bringing together African universities and research universities in the global North. Outputs include:

- Skills development, such as training workshops for support staff in university administration and finance; for PhD student supervision and proposal development; and technical training workshops on the water sector.
- Strengthened networks and networking through a conference for young researchers in 2013.

Source: EU 2013.

Technology transfer and commercialization of innovations

Technology and knowledge transfer is made through channels such as foreign direct investment, trade, ICT, mobility of scientists and engineers, and university–industry collaboration, and is important for enhancing STI capacity building (boxes 3.3 and 3.4).

Intellectual property and access and benefit-sharing issues in STI

The concept of protection of intellectual property rights (IPRs) covers protection for multiple rights.[13] Every country needs a well-developed and healthy intellectual property (IP) system for economic and social well-being (WIPO 1999).

Box 3.3: Resource-oriented sanitation concepts for peri-urban areas in Africa

Resource-Oriented Sanitation concepts for peri-urban areas in Africa (ROSA) is a specific targeted research project between European and East African partners conducted over October 2006–March 2010 and coordinated by the University for Natural Sciences and Applied Life Sciences in Austria.

It aimed to transfer, adapt, and implement sustainable sanitation technologies in peri-urban African areas, and to promote resource-oriented sanitation concepts as a route to sustainable sanitation in four model cities in East Africa (Arbaminch, Ethiopia; Nakuru, Kenya; Arusha, Tanzania; and Kitgum, Uganda). It also aimed to develop a generally applicable and adaptable framework for strategic sanitation and waste plans.

The capacity building dimension included human and institutional development, via training and workshops for different local stakeholder groups, including bricklayers and other craftspeople in how to build sanitation infrastructure, and for farmers in how to use human waste as fertilizer.

With no suitable institution or funding source after the end of the project, training ceased.

Source: EU 2013.

Box 3.4: UNESCO's University-Industry-Science Partnership Programme

UNESCO's University-Industry-Science Partnership Programme (UNISPAR), is an example of technology and knowledge transfer. It aims to improve the quality of universities in developing countries, and to encourage their involvement in their country's industrialization.

After 2002, UNISPAR focused on capacity building and technical assistance in the governance of S&T parks, promoting stronger partnerships and linkages between universities and industry, innovation, and transfer of knowledge. The concept of science parks in Africa is recognized as one of the means to promote STI, commercialization of R&D, scientific and engineering education, and continued professional training.

Source: Nair-Bedouelle, UNESCO, and AU 2008.

IP protection encourages the use and development of local inventive and artistic talents and assets; nurtures and safeguards local IP assets, such as traditional knowledge and folklore; and attracts investment, providing a stable environment in which investors, local and foreign, can be confident that their IPRs will be respected.

In addition, an IP infrastructure allows participation in the exchange of commercially valuable information at the international level as promoted by the World Intellectual Property Organization (WIPO), including the quick and easy access to information in new technology such as international patent applications and abstracts. Beyond national boundaries, a well-functioning IP system contributes to stability and security for protected rights in an increasingly competitive global market, allowing efficient enforcement of those rights. In addition, the system can aid in combating illegal activities such as counterfeiting and piracy (WIPO 1999: 11).

A key issue is whether the dynamic indigenous innovations of African countries are properly identified or valued by the international standards of WIPO. According to De Beer et al. (2014), there is a likelihood that certain formal or informal or mixed modes of innovation and creativity in Africa cannot be fully acknowledged or properly accounted for through the Western-oriented prism of patents, copyrights, trademarks, and other formal IP outputs. Many measurements applied by developed countries, and exported to developing countries, betray the apparent misunderstandings of the nuances of IP law, policy, and practice, such as through blind citation of statistics regarding "patenting by population" or "share of world patents." Nonetheless, Africa must conform to globalization and align its innovations to WIPO.

A major inhibiting factor for assessing IPRs in Africa is the lack of reliable data. National reports submitted to WIPO suggest that there were only 10 IP offices in 2006 and four in 2008 in Africa. The lack of consistent and reliable data from IP offices in Africa makes it difficult to undertake any significant assessment of the status of African-owned IP (ECA 2013). In most African countries, the capacity for IP protection is unavailable, undeveloped, or ineffective. Moreover, the subject of IP property redounds with controversies on the range of rights enjoyed by the holder of the IP and the equity of international arrangements for IP protection (Sikoyo, Nyukuri, and Wakhungu 2006).

There is still little research examining systemic IP governance or knowledge governance in Africa. Some African countries display uncertainties over the protection of IP and the threat of innovation theft (Terroir 2016). Some African countries have, however, functional and enforced IP systems.

According to De Beer et al. (2014), most African patent applications filed were drafted by foreign patent lawyers, examined at the PCT Office in Geneva, and mailed to African capital cities simply for filing. In table 3.2, the volume of patents filed in Africa is very low, mainly because most patent applications were filed by nonresidents.

There are two regional organizations: the African Regional Intellectual Property Organisation (ARIPO) based in Harare, Zimbabwe, established in 1976 for English-speaking African countries, and the Organisation Africaine de la Propriété

Table 3.2: Patent applications, 2013

Patent body	Total	Residents	Nonresidents
African Intellectual Property Organisation	552	89	463
African Regional Intellectual Property Organisation	692	5	687
South Africa	7,295	638	6,657
Egypt (2012)	2,211	683	1,528
Morocco (2012)	1,144	316	828
Nigeria	919	50	869
Tunisia (2012)	626	150	476
Algeria (2012)	900	119	781

Sources: Terroir 2016; WIPO 1999.

Intellectuelle (OAPI), headquartered in Yaoundé, Cameroon, founded in 1977 for French-speaking countries. The current country membership for ARIPO stands at 19, OAPI 17. Conspicuously missing are the three largest African economies—Egypt, Nigeria, and South Africa, which have their own IP systems.

A major challenge for the AU is to establish a continental IP structure that will harmonize IP standards, strengthen the capacity of national IP institutions, and boost human capacity development in IP management. The AU has already established the Pan-African Intellectual Property Organisation, which will be responsible for IP and other emerging issues related to IP, promote the IP system as a tool for development on the continent, and set IP standards that reflect the needs of the AU, its member states and RECs, and ARIPO and OAPI. These efforts will require strengthened capacities of individuals and institutions.

Key messages and policy recommendations

- STI initiatives (in R&D and higher education) by institutions at various levels contribute to STI capacity building in Africa.
- At the regional level, African regional institutions such as the AU and NEPAD contribute to capacity building in STI in Africa; the initiatives promote regional STI collaboration.
- At the national level, the widespread adoption of specialized S&T universities emphasizes their importance in STI capacity building, as does the involvement of public and private higher education institutions.
- At the international level, collaborative bilateral and multilateral partnership projects and initiatives contribute to STI capacity building in Africa in a raft of sectors.
- African countries should increase investment in higher education and R&D, while encouraging partnerships between public and private institutions.
- African countries need to enhance regional cooperation and adopt a coherent framework of cooperation between governments, scientists, universities, policymakers, the private sector, and civil society.
- It is imperative for African countries to enhance technology and knowledge transfer for STI capacity building.
- International collaborative bilateral and multilateral partnerships based on best practice should be promoted by African countries.

4

SCIENCE, TECHNOLOGY, AND INNOVATION CAPACITY GAPS

Building appropriate science, technology, and innovation (STI) capacity tailored to achieving the socioeconomic development priorities of each country is highly likely to guarantee sustainable development (Watkins and Ehst 2008; Watkins and Mandell 2010; ECOSOC 2013). Thus building STI capacity for African countries is not an end in itself, but a necessity for realizing the vision and development objectives in the current era of globalization. The STI system, its program inputs, and effective functioning in a country largely determine that country's capacity to innovate and develop appropriate technologies to propel it to greatness. This chapter highlights the gaps in African countries' ability to harness the full potential of STI for transformation toward a knowledge-based economy.

Inadequate institutional capacity

Narrowly, STI institutions may be regarded as structures, such as universities, research institutes, and technology laboratories to promote STI development. In the broader sense, STI institutions encompass deeply embedded norms, practices, values, policies, legislative and regulatory frameworks, governance embodied in various STI structures, and networks, among others that govern relations and interactions between people.

The capacity of a country to generate and deploy STI depends heavily on the capacity (including expertise, skills, infrastructure, policies, and resources) of its STI institutions to innovate. The failure of countries to innovate and promote STI benefits is often due to failed institutions (Kebeba 2012). Such failure is deepened by the gap between STI knowledge generation and dissemination systems; for example, in how STI knowledge is misconceived as output only generated in laboratories, the fact that little emphasis is placed on the mode and mechanisms of dissemination, as well as uncertainty how this STI knowledge fits into existing STI systems (Kebeba 2012).

Establishing the right institutions to generate, sustain, and advance STI in Africa is challenging. The capacity of African institutions to facilitate hard and soft skill development in STI is far from adequate to drive Africa to STI self-sufficiency (ATPS 2010). Public STI institutions in most African countries have suffered years of infrastructure decay and paltry investment and recognition from government, leaving them (and the sector generally) debilitated. Most STI institutions are inadequately staffed with experts and scientists,

feeding into the decline in skilled scientists and engineers across Africa.

Institutional arrangements for STI development and implementation show wide variations in Africa. In most countries, they involve myriad institutions spearheaded by the ministry responsible for science, technology, and research (and usually education) with established specialized STI agencies (ECA, AfDB, and AU 2016). These arrangements aim to decentralize and demarcate agencies, but weak coordination creates weak linkages among institutions, virtually compelling them to work in isolation and stifling effectiveness. It may also result in unproductive resource utilization, with different institutions designing their own STI programs and competing for public funds (UNCTAD 2014).

Many African countries fail to appreciate the sophisticated nature of policy interactions and to foster strong coordination among STI ministries, agencies, and other public and private actors (UNCTAD 2011).

The brain drain

Mass migration of skilled African scientists and experts—the brain drain—persists. Low remuneration, lack of research facilities, and preference for foreign consultants due to bilateral and multilateral funding arrangements disincentivize domestic skilled experts, providing push factors for migration (ATPS 2010). Reliance on expatriate professionals in Africa's industrial and technological projects is troubling, given that these expatriates rarely impart their expertise and knowledge to their domestic partners (ACBF 2016b).

One in every nine persons born in Africa with a tertiary diploma lived in Organisation for Economic Co-operation and Development (OECD) countries in 2010/11 (UN-DESA and OECD 2013). The number of tertiary-educated African migrants abroad who arrived in the past five years was estimated at 450,000, which exceeded the number of Chinese migrants (375,000) (UN-DESA and OECD 2013). The proportion of highly educated persons living in OECD countries was substantial for Zimbabwe (43 percent), Mauritius (41 percent), and the Republic of Congo (36 percent) (UN-DESA and OECD 2013). Burundi, according to another source, is the African country least able to hold on to its top talent, followed by Algeria, Mauritania, Chad, and Guinea (WEF 2014a).

Such massive migration is a major hindrance to advancing technological performance and developing more robust STI institutions in African countries. Moreover, as Africa continues to lose its best and brightest to the developed world, the continent is losing the critical technological knowledge and development capacity that could put it onto the global conveyor belt (ACBF 2004). On the one hand, excessive reliance of African countries on external funding for research and development (R&D) drives continued poor investment in STI capacity building, and on the other hand, poor utilization of domestic capacity leads to frustrations and external migration.

A new model of "brain gain," called the "Fifarization" of STI, is being promoted by the African Technology Policy Studies Network. It encourages African governments to borrow the model of the Fédération Internationale de Football Association (FIFA) for African researchers and scientists working in foreign countries. Under FIFA rules, foreign professional football clubs are required to release their players to play for their home countries during major events like the African Nations Cup. The Fifarization model

of African scientists and researchers would entitle these scientists by such agreements to return to their home countries if the occasion presented itself and to request permission to participate occasionally in charting the way forward for their country's STI development. Once their mission is accomplished, they would return to their foreign base.

In this way, a team of medical professionals working in the United States or Europe, for instance, could travel to their home countries in Africa once in a while to share their knowledge and skills, and most important, contribute to national development (Urama et al. 2010). It will require recognition of prospective participants, a database of highly qualified diaspora Africans, and institutionalized partnerships with institutions and governments abroad. This idea has been enthusiastically received in various STI forums in Africa and could be used to assemble the best national brains in a given field to resolve a national issue, as with Ebola since 2014.

Shortage of critical technical skills

Most institutions, including public research institutes and universities, are far from performing well enough to foster STI capacity in Africa (Mugabe 2011). Few African institutions are producing enough skilled human resources to meet market demand for skills in science and engineering (Matthews et al. 2012). Very few graduates in Africa gain the critical technical skills they need to find work, and nowhere is this challenge more evident than in their transition to the labor market (McCowan 2014).

A recent study by ACBF on the capacities needed to implement Agenda 2063 of the African Union (AU) shows serious gaps in critical technical skills to implement the Science, Technology, and Innovation Strategy for Africa 2024 (STISA-2024). Africa may be short of 4.3 million engineers and 1.6 million agricultural scientists and researchers, in part because more than 80 percent of current student enrollments are in social sciences and humanities (ACBF 2016b). Science, technology, and engineering subjects were of least interest to students at university, as reflected in their low enrollment rates at African universities (AfDB et al. 2012). These low rates may be attributed to lack of incentives and awareness by African governments for training institutions and the youth on the gaps in these topics (as well as cost—see below).

There is also a mismatch between the knowledge and skills acquired in education and job market requirements (WEF 2014b). In the ACBF survey of 44 African countries to assess the extent of STI capacity needs, 91 percent of countries identified training as a High or Very High priority. The lack of training to develop critical technical skills in engineering and sciences means Africa will continue to rely on imported expertise, which comes at a huge cost and has serious implications for Africa's future skilled population.

Without reform, Africa is likely in 2020–30 to have more graduates without critical technical skills than those with them. Delivering on Agenda 2063 flagship programs and other continental initiatives could be severely hampered, given the aim to train and make Africans responsible for implementing the Agenda (ACBF 2016b).

Excessive costs of higher education

Africa's lack of focus on STI higher education in the last four decades has decimated African countries' ability to supply the productive sector with requisite skills, especially in science

and technology. Reliance on short-term solutions, such as imported technical skills, has not transferred the knowledge required for Africa to build its own STI capacities.

Most African countries now realize the potential role of STI in higher education, as seen in increased enrollment figures and construction of universities: Kenya had 67 in 2014, among the most in Africa. Ethiopia increased the number of public universities from seven in 2007 to 34 in 2012. Rwanda in contrast has merged all universities to concentrate resources and enhance collaboration among researchers (Iizuka, Mawoko, and Gault 2015). The problem, however, is that the focus has mainly been on noncritical technical skills such as social sciences and humanities rather than critical technical skills (as just seen).

The rising costs of higher education, particularly in the sciences and engineering, are a major challenge in African countries and partly explain the lower enrollment rates. Government funding to higher education has fallen sharply in many African countries due to policies such as the structural adjustment programs in the 1980s, the mid-1990s economic crises, and the economic and international debt crises in the late 2000s (Woldegiorgis and Doevenspeck 2013).

The high costs of science and engineering training excludes talented but poor students. Most African countries have instituted cost-sharing policies for higher education, such as Namibia and Zimbabwe. Ghana, Tanzania, and Zambia have put in place a dual-track system that comprises fee-paying and non-fee-paying students. In Namibia and South Africa, all higher education students are fee paying, with loan facilities to support students from poor backgrounds (Pillay 2008). Similarly, loan schemes have been adopted in other countries such as Tanzania, Lesotho, Ghana, and Kenya to address the financial needs of needy students (Pillay 2008).

Deficiencies in funding and research management

Despite African governments' reiterated commitment to fulfill the promise made almost a decade ago to invest 1 percent of gross domestic product (GDP) in R&D, they are the weakest R&D investors worldwide. A sizable chunk of R&D investment in Africa comes from foreign sources: 57 percent for Uganda, 47 percent for Kenya, 42 percent for Tanzania, 40 percent for Burundi, and 33 percent for Malawi (UNESCO 2015).

These trends fly in the face of African countries' intention to attain middle-income status by around 2020 or 2030, with STI a fundamental pillar of development, as does lack of specific budget allocations for priority STI areas. STI budgets are spread thinly across institutions, leaving little or no funding to development in priorities areas. Public research and academic institutions are faced with severe financial deficits, and lack the wherewithal to design and spearhead research attuned to national development priorities.

Many African countries also lack dynamic capacity, programs, and policies to attract investment in R&D, and are inadequately linked to international STI funding opportunities and networks. International cooperation and partnerships provide resources to build the STI capacity of African countries through collaborative research projects and through the matching of endowed researchers and innovators from well-resourced countries with local counterparts.

Examples are the European Union's Framework Programme, Canada's Grand Challenges Programme, and the United States Global Environmental Change Research Partnership Enhancement Awards. These allocate funding for collaborative research and capacity development with African researchers. Yet many bilateral and multilateral agreements on science and technology cooperation between African and developed countries remain unexploited due to lack of capacity to pursue international research partnerships and collaborative technology (UNCTAD 2011).

Low funding

The STI systems of most African countries find themselves in a vicious circle, with low funding to support high-quality socioeconomically supportive R&D programs and institutions (Watkins and Mandell 2010). A major portion of the current budget of most African countries and even the AU is provided by international partners. For example, the European Commission provides more than 80 percent of the program budget of the African Union Commission. In 2015, the volume of cooperation between the European and AU commissions amounted to €337 million (EC 2016). In most cases, such donor-funded programs are focused on poverty reduction activities with little or no emphasis on STI capacity building.

Africa's continued reliance on restricted funds from development partners implies that countries will find it difficult to mobilize additional funding or to follow up on donor support, leaving STI programs isolated from the national agenda and often failing to achieve mass impact. Due to the low significance granted to STI systems, they have failed to attract interest and funding, often undermining their potential to contribute to Africa's development.

Poor research management

All too frequently, poor research management in Africa means that many countries miss the opportunities to secure funding for research and equipment (UNCTAD 2011).[14]

The need to redress this lacuna is gradually gaining recognition in Africa. A benchmarking survey of 13 African universities in 2007 by the Association of Commonwealth Universities highlighted increased interest in research management by academics (with more international linkages being formed and more research undertaken) and by institutions. Yet the survey also showed that research management was constrained by lack of developed structures, of resources, and of experienced staff (Kirkland and Ajai-Ajagbe 2013). The survey also revealed that institutions lacked capacity to negotiate contracts, identify funding sources, facilitate technology transfer, and disseminate results. A follow-up program to develop structures for research management in several universities in Africa over 2009–12 revealed a major concern about the lack of staffing for research management functions due to rigid human resource policies.

A growing emphasis on research management is gaining currency in research and academic institutions, as reflected in the establishment of commercial research centers and emphasis on research groups operating with other institutions. By developing the capacity for research management, individuals and institution place themselves in a better position to attract and manage funding, liaise with funding bodies, plan and run projects, and conduct monitoring and evaluation (M&E) (Olsson and Meek 2013).

Uncoordinated policy outcomes

Formulation and adoption of STI policies highlight major steps toward a crucial role for STI in a country's development agenda. African countries share common objectives in fostering STI, but this has engendered a plethora of institutional arrangements and bodies to coordinate and support STI.

These objectives include developing education and human resources, expanding research and capacity, building networks of researchers, protecting intellectual property rights, developing ICT and infrastructure, enhancing institutional capacity, and strengthening linkages with the private sector (annex 6) (Iizuka, Mawoko, and Gault 2015; Nwuke 2015). A major challenge is that the sheer number of policy goals complicates M&E and makes implementation costlier. These policies exhibit a cross-cutting weakness, which makes it difficult to estimate the cost of implementing them. Such weakness may explain the poor outcomes of STI implementation in many African countries (Nwuke 2015).

Loose linkage for policy implementation

STI stakeholders are largely unaware of the need to ensure that national STI programs, projects, and policies are internally and externally consistent, and thus fail to promote policy coherence, complementarity, and effectiveness (Jowi and Obamba 2013). The lack of effective coordination and linkage among ministries and agencies tends to limit innovation in the STI system.

In Africa, evidence of weak linkage is prevalent among the public sector, research institutions, academic institutions, and the private sector in the promotion of STI, unlike the developed world. In OECD countries, private sector investment in R&D is very high relative to the public sector (Iizuka, Mawoko, and Gault 2015). In the United States, the federal government supports focus on basic research, while the private sector (largely industry) spearheads applied research and technological development (UNESCO 2015). In Canada, 52 percent of spending ($16 billion) on R&D in 2011 came from business (Ministry of Industry 2013). Building the capacity to promote STI is a cross-cutting issue that requires effective public–private sector linkages and a coherent STI strategy at the national level (ECOSOC 2009). The establishment of strong and effective linkages offers the opportunity to reach the 1 percent of GDP target for investment in R&D.

Outmoded governance for making, implementing, and monitoring policy

While the ultimate goal of STI policy is to develop STI, some policies may restrain the private sector in investing in R&D and innovation activities. For example, the lack of policies and understanding on issues such as intellectual property rights may act as a disincentive (Gassikia 2014).

The governance of STI policy processes allows for flexible and swift decisionmaking, effective implementation, and M&E—all essential for achieving development goals. However, many African countries lack the governance structure for STI policymaking, which tends to be highly complex, involving interactions between multiple stakeholders and economic sectors.

A study by AOSTI suggests that few African countries have well-established and dynamic STI policy processes. They are usually isolated from other issues (such as social, economic, or political). The public seems to lack

awareness of STI issues and has little engagement in STI policymaking. Policy gestation is common—a long time lag from when government reviews and/or formulates policy to when it is adopted (AOSTI 2013).

Monitoring the implementation of STI policy is critical for policymakers and implementers to stay up to date with economic and technological transformations, to anticipate emerging developments, and to use these outcomes to prioritize areas for innovation and investment. Many African countries face heavy challenges in STI policy monitoring because of lack of capacity, resources, and even framework (Nwuke 2015), though such monitoring is now getting more attention due to the need to demonstrate value for funding.

By improving STI policy implementation monitoring (exemplified in table 4.1), countries can gather information on STI policy interventions, which can be used to reposition STI policy or public investments, or even reconstruct national strategy.

Incoherent policy at national, regional, and continental levels

One of the key capacity gaps for African countries is lack of coherence of STI policy at different levels. African countries and

Table 4.1: Monitoring and evaluation frameworks of some African national STI policies

Country	STI policy	STI policy M&E mechanisms
Angola	Angolan Government Strategy (2025)	Annual assessment to determine the progress and difficulties encountered in implementing this policy
Botswana	National Policy on Research, Science, Technology, and Innovation (2011)	M&E strategies outlined in policy document
Ethiopia	National Science, Technology, and Innovation Policy (2012)	No M&E mechanisms specified
Ghana	National STI Policy (2010)	M&E mechanisms not yet specified, but planned
Kenya	Science, Technology, and Innovation Act (2013); Draft National Science, Technology, and Innovation Policy (2012)	M&E mechanisms not yet specified, but planned
Lesotho	National Policy on Science and Technology (2006–2011)	M&E mechanisms not yet specified, but planned
Mauritius	Draft National Policy and Strategy on Science, Technology, and Innovation (2014–2025)	M&E mechanisms not yet specified, but planned
Nigeria	Science, Technology, and Innovation Policy (2012)	M&E mechanisms not yet specified, but planned
Rwanda	The Republic of Rwanda's Policy on Science, Technology, and Innovation (2006)	M&E mechanisms not yet specified, but planned Chief Scientific Advisor will be appointed to oversee a system of independent evaluation of science policies and programs across a range of issues
South Africa	White Paper on Science and Technology (1996)	M&E mechanisms not yet specified Annual review to be conducted by Department of Science and Technology
Tanzania	National Science and Technology Policy (1996)	M&E mechanisms not yet specified or planned
Uganda	National Science, Technology, and Innovation Policy (2009)	M&E mechanisms not yet specified Management information system planned
Zambia	National Policy on Science and Technology (1996)	M&E mechanisms not yet specified, but planned

Source: Nwuke 2015.

their respective regional economic communities (RECs) are expected to align their policy frameworks to continental policies and strategies in order to support a common Africa agenda. The challenge is that national and regional policies existed before those at the continental level. For instance, STISA-2024 was recently agreed on and adopted by AU member states as well as RECs. Essentially, how do RECs and countries reconcile existing STI policies and strategies to goals of STISA-2024 to pursue an African agenda?

In another example, in West Africa, Economic Community of West African States (ECOWAS) member states adopted the ECOWAS Policy on Science and Technology in 2012. The policy gave directives to create a directorate for STI; to implement, monitor, and evaluate the policy; to create a one-stop science and technology window from its Solidarity Fund; to finance R&D and facilitate funding support from partners; to strengthen financial capacities of science and technology research institutions; and to promote regional and international cooperation in STI, mainstreaming it in national and REC sectoral policies.

Within the East African Community (EAC), Article 103 of the Treaty for the establishment of the EAC facilitated the East African Science and Technology Commission (EASTECO), to formulate regional science and technology policy. In the Southern African Development Community (SADC), member states adopted and ratified the SADC Protocol on Science, Technology, and Innovation in 2008. The objectives are to promote cooperation and the transfer and mastery of STI in member states in order to foster the development and harmonization of STI policies in the region; create institutional mechanisms for managing and administering STI at the regional level; optimize public and private investment in R&D; and leverage external contributions, among others.

An important but very challenging task for African countries is how to maintain policy coherence and functioning at the different levels. It requires both bottom-up and top-down approaches of iterative policy learning, where monitoring with sound evidence becomes critical (ECOSOC 2009).

Stuttering research and development

Over the past five years, Africa has witnessed a period of stable economic growth, and a growing policy focus on STI even though the region is very far behind in resources allocated to R&D.

South Africa has the highest budget for R&D. In 2012, it spent $4.9 billion, or 0.8 percent of GDP, followed by Egypt at $2.2 billion (in 2011), or 0.4 percent of GDP (UNESCO 2015). Other higher R&D spenders included Morocco ($1.1 billion or 0.7 percent of GDP in 2009) and Tunisia ($1 billion or 0.7 percent, also in 2009) (UNESCO 2015). These numbers have increased over the past three years in all these countries, which are reflected in their current status as the top African countries on competitiveness, innovation, technology readiness, and higher education.

Few scientific publications

Yet despite strong economic growth over the 2000s and beyond, Africa finds itself at the bottom of major indices that define the STI capabilities of a continent. The number of scientific publications produced by Africans has risen over the past decade, but still accounts for a tiny portion of the global total. For example,

only three African countries—South Africa, Egypt, and Tunisia—were ranked among the top 50 countries by number of science and engineering publications in 2013 (table 4.2), and produced only 1 percent of the total.

South Africa accounted for around 46 percent of Sub-Saharan Africa's publications in 2014, and low-income countries such as Benin and Gambia saw improvement in scientific productivity levels (articles per million inhabitants) comparable with those of middle-income economies (UNESCO 2015). Yet there is still a huge capacity gap in scientific publications between Africa and the developed world. From 1996 to 2015, the United States produced 9,360,233 publications, followed by China with 4,076,414 (SJR 2016). During the period, the whole of Africa produced 559,373 publications (annex 7).

Public R&D institutions: Behind the pack

Most public R&D institutions in Africa have limited capacity and facilities to carry out world-class scientific research that is socio-economically beneficial to their countries. Much of the scientific knowledge produced by public R&D institutions is not translated into useful products and services partly because these institutions lack the entrepreneurial culture and capacity to work closely with the private sector. Domestic private enterprises do not see the value of investing in R&D institutions to improve their productivity and competitiveness, and foreign enterprises make little or no use of domestic R&D institutions in Africa.

It is hard for most African countries to develop globally competitive enterprises without mobilizing the scientific knowledge and technological capacities in these institutions. While R&D is the cornerstone of scientific enquiry and vital solutions in the developed and emerging worlds, Africa is far from embracing this culture, partly because of the low capabilities of R&D institutions, which are yet to see themselves as scientific knowledge and technology service providers whose mandate is to provide solutions to address development problems. While R&D efforts are expected to produce commercially viable outputs and technologies, most get stuck in the laboratory due to limited capacity for commercializing them.

Table 4.2: Science and engineering publications of top African countries, the United States, and China, 2003 and 2013

Rank	Country	2003	2013	Average annual change (%)	2013 world total (%)
1	United States	299,876	412,542	3.2	18.8
2	China	71,113	401,435	18.9	18.2
35	South Africa	4,077	9,679	9.0	0.4
36	Egypt	3,045	9,199	11.7	0.4
50	Tunisia	975	4,207	15.7	0.2
	World	1,117,866	2,199,704	7.0	na

Source: National Science Foundation 2016.

Note: na = not applicable.

Most R&D activities are conducted in isolation at the national and regional levels, which often leads to duplication of effort. Africa's Science and Technology Consolidated Plan of Action called for the establishment of regional networks of Centers of Excellence and for greater mobility of scientists across the continent to facilitate collaborative research, regional cooperation, and knowledge sharing. However, most R&D institutions lack the capacity and skills for collaborative projects, especially between English- and French-speaking countries.

A major capacity gap for public R&D institutions is their inability to raise much income from R&D activities. Most were established by governments and rely on state subventions for operations. For example, in Egypt, R&D is carried out mainly by state-run universities and research centers supervised by the Ministry of Higher Education and Ministry of Scientific Research (Ouda and Ahmed 2014). Such institutions in Africa need to become financially self-sufficient, given declining budgets from government and external donors.

The necessity to build Africa's scientific capacities points to the critical contribution of research institutions and universities in the STI system which, in an increasingly globalized world, must transition from basic research to applied research in a bid to align R&D to the socioeconomic needs of society.

National innovation systems

A "national innovation system" (NIS) refers to the complex of knowledge-flow links between the private sector, public research organizations, government regulatory agencies, financial institutions, and academia, working toward innovation and technological change. The innovative capacity and performance of a country depends heavily on the strength of this system (UNESCAP 2016).

Four types of knowledge or information flows are needed to measure and assess an NIS (OECD 1997): interactions among enterprises, joint research activities, and other technical collaboration; interactions among enterprises, universities, and public research institutes, including joint research, co-patenting, co-publications, and more informal linkages; diffusion of knowledge and technology to enterprises, including industry adoption rates for new technologies and diffusion through machinery and equipment; and personnel mobility, focusing on the movement of technical personnel within and between the public and private sectors. High levels of such interactions, diffusion, and mobility improve enterprises' products, patents, and productivity (OECD 1997).

Understanding the NIS within a country can help policymakers and decisionmakers identify leverage points for improving innovative performance and overall competitiveness. A detailed analysis of a country's NIS can highlight mismatches among institutions and in relation to government policies. Policies to improve networking and enhance the innovative capacity of firms, particularly their ability to identify and absorb technologies, are the most valuable.

The idea of an NIS is quite recent in Africa. South Africa, Sub-Saharan Africa's second-largest economy after Nigeria, has the most robust NIS in Africa. With a population of only 53 million, it generates about one-quarter of Sub-Saharan Africa's GDP and, with its regional political influence and growing economic presence, is bound to drive economic growth across the continent (UNESCO 2015). Nigeria's innovation system is far less developed than those in peer

countries such as South Africa, Egypt, Libya, and Tunisia, particularly on firm-level technology absorption, private investment in R&D, patents obtained, scientific publications, and university–private sector partnerships (Radwan and Pellegrini 2010).

Ghana has one of the most established NISs in its subregion, with its Council for Scientific and Industrial Research having 13 specialized institutes for research on crops, animals, food, water, and industry (UNCTAD 2011). Other scientific institutions include the Cocoa Research Institute of Ghana, which conducts research into crop breeding, agronomy, pest management, extension services, and so on; the Ghana Atomic Energy Commission; the Center for Scientific Research into Plant Medicine; and the Noguchi Memorial Institute for Medical Research at the University of Ghana.

In East Africa, Kenya has one of the most developed innovation systems with an established agency, the Kenya Innovation Agency, institutionalizing linkages between stakeholders, including universities, research institutions, the private sector, and government; establishing science and innovation parks; promoting a culture of innovation; maintaining standards and databases; and disseminating scientific knowledge.

Other countries with a viable but struggling NIS include Angola, the Democratic Republic of Congo, and Zambia. In Angola, the biggest hindrance to the country's development prospects is poor governance, given the correlation between that and low scientific productivity (UNESCO 2013). In the Democratic Republic of Congo, armed conflict continues to hamper the development of an NIS.

Policymakers and politicians in Africa often reiterate the role of STI in economic and social progress and trade competitiveness and why their countries should invest more in their NIS. Yet actions to do so are rare. The status of NISs in African countries reflects the low ranking of African countries in global innovation, competitiveness, and networking among other indicators for STI advancement. Within the NISs, the private sector in most is relatively underdeveloped and does not have the capacity to generate the large-scale innovations needed to create a dynamic engine of growth in the medium and longer term without a more conducive policy environment.

Being in their nascent stages, most African NISs face several capacity challenges, such as an unspecified NIS, poor institutional arrangements and leadership, low funding for STI programs, limited capacities of STI institutions, and little capacity for technological learning (as discussed in more detail in earlier sections).

Key messages and policy recommendations

- Africa's current investment in STI capacity is very low, which accounts for STI's low status.
- Appropriate STI capacity tailored to socioeconomic development priorities is critical for sustainable development progress.
- Critical technical skills can assist Africa to move toward a technologically innovative society. The positive impact of strengthened STI in higher education will trickle down to primary and secondary education systems through the production of well skilled and trained teachers, particularly for science and math.
- Most African countries are far from developing globally competitive enterprises

unless they mobilize scientific knowledge and technological capacities in their R&D institutions.

- STI systems and a future knowledge economy require innovation-oriented curricula, which in turn require pedagogy and modern teaching methods with national and global perspectives.

- Understanding the NIS in African countries can assist policymakers and decision-makers in identifying leverage points for improving innovative performance and overall competitiveness.

- An effective NIS will thrive only within a conducive environment where STI is promoted from both the supply and demand sides, as represented by mutually reinforcing relationships among all stakeholders.

- It is vital that African countries take steps to transfer essential Africa-focused STI skills that are critical for strategic sectors. It is strongly recommended that policies and legislation be promulgated so that negotiated capacity-substitution mechanisms have a legal requirement for clear exit strategies and residual capacity outcomes in terms of skills and knowledge transfer, operational systems and processes, etc. Strategies and practical measures should also be developed to safeguard and retain essential indigenous skills.

- Governments must spearhead sustainable financing programs for STI development. These should feature competitive and matching funding designed to refocus the STI system on research needs and technology users. Sustainable financing may require some of the current core funding of research institutes to be rerouted into competitive funding that will enable productive STI areas to thrive. Additional financing mechanisms for STI, such as industry funds, association-based financing, tax incentives, and other measures, should be introduced or promoted.

- African research and higher education institutions must develop and implement strategic STI capacity building partnerships at the regional and global levels through collaborative STI programs and projects, public–private partnerships, and donor research programs. Those designed between African countries or regional STI institutions could foster implementation of STISA-2024. Such partnerships can build and then sustain African countries' STI capacity to address their own development priorities and tap into the technical expertise of global partners.

- African countries must develop their STI capabilities and build stronger NISs in light of their national development priorities and particular situations. A well-functioning NIS can facilitate the development, diffusion, and transfer of technologies; improve technological capabilities; and compensate for large market failures in a weak private sector setting amid the limited productive capacity that characterizes many African countries today.

5

SCIENCE, TECHNOLOGY, AND INNOVATION TRENDS, AND LESSONS AND SUCCESSES IN COUNTRY CASE STUDIES

This chapter provides a review of trends in spending on research and development (R&D) and human capital development at institutions, highlighting successes—and less happy outcomes—from country case studies.

Domestic expenditure on research and development

African countries' commitment to innovative activities and capacity can be measured by gross domestic expenditure on R&D (GERD) as a share of gross domestic product (GDP). This increased rapidly in countries like Ethiopia and Morocco (box 5.1). The government is the major R&D contributor in most countries, with a small role for the private sector (in, for example, Zimbabwe, Ethiopia, and Morocco). The key messages here are the importance of commitment from the government to increase spending on R&D and the need to lift the private sector contribution to R&D (see box 5.1).

Institutional and human capital development

The shortage of researchers has impeded STI capacity development in some African countries, including Zimbabwe and Ethiopia, and certainly relative to Kenya and South Africa (figure 5.1).

Morocco needs to keep increasing the number of private sector researchers. It should also expand human resources and the number of researchers in science, engineering, and technology fields to correct the bias to social fields (box 5.2).

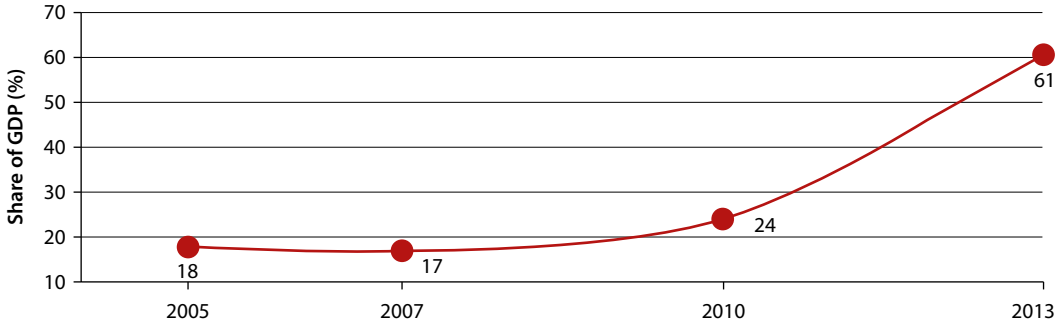
Numerous African countries improved their education system and thus human capital development, while many also focused their education policy on enhancing transfers of technology and lifting national technological capability. The important lesson from Ethiopia is that improvements in technical and vocational education and training (TVET) should strengthen human resource development (box 5.3).

Box 5.1: Ethiopia: Encouraging trends in R&D spending

Ethiopia's R&D spending as a share of GDP more than tripled between 2005 and 2013 (box figure 1). The government was the major contributor of R&D funding in 2013 (79.1 percent), and foreign sources contributed only 2.1 percent. Much of the research funding went to higher education and government institutions (Ethiopian Academy of Sciences 2015). The private sector played a small role.

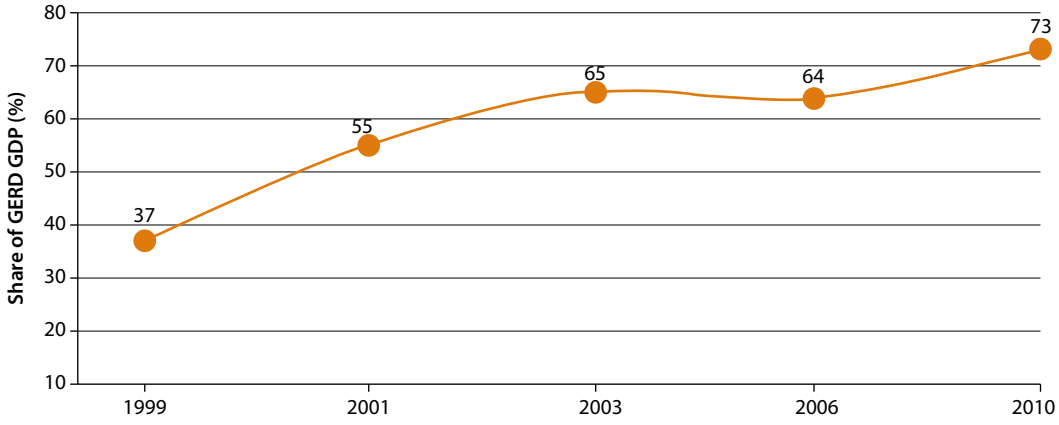
In Morocco between 1999 and 2010, the share of GERD in GDP nearly doubled, increasing from 0.37 percent in 1999 to 0.73 percent in 2010 (box figure 2). The highest share in GERD was attributable to higher education (45.3 percent), followed by private enterprises (29.9 percent), public research establishments (23.1 percent), and international cooperation (1.7 percent). University research was the major purpose in 2010 (45.3 percent).

Box figure 1: Ethiopia's R&D expenditure, 2005–13



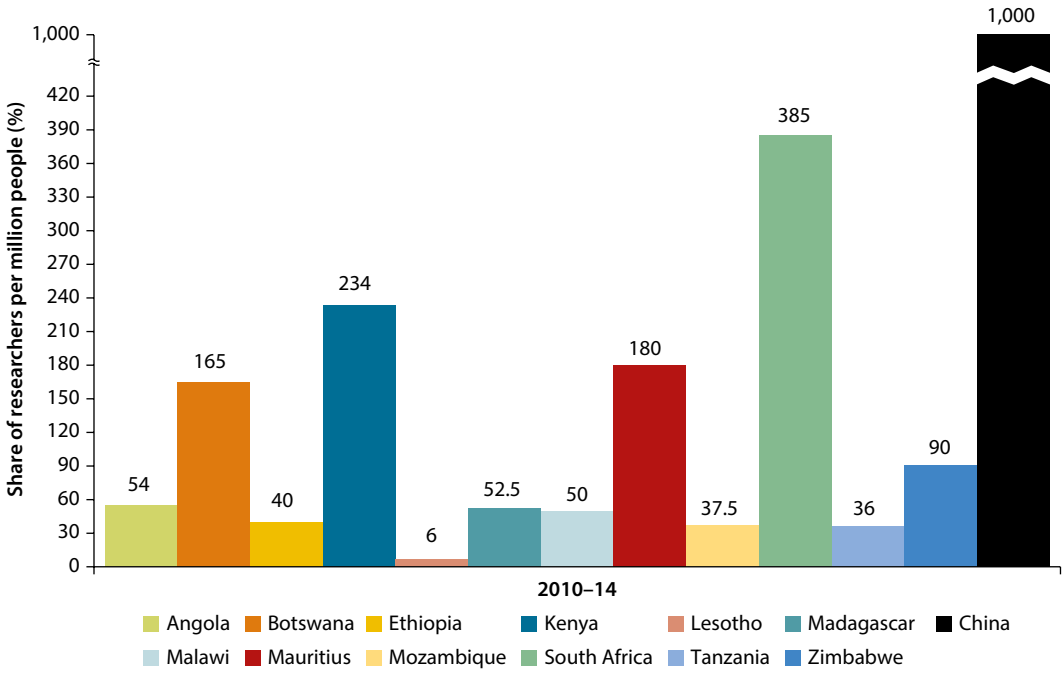
Source: World Bank 2015.

Box figure 2: Share of GERD in GDP in Morocco, 1999–2010



Source: Adapted from Hassan II Academy of Science and Technology 2012.

Figure 5.1: R&D researchers in selected countries, 2010–14



Source: ACBF and Zimbabwe Economic Policy Analysis and Research Unit 2016.

Box 5.2: Morocco increased its researchers, but kept its focus on social and human resources

In Morocco, between 1999 and 2010, the number of scientific research staff increased overall by 74 percent—64 percent in the public sector but more than 383 percent in the (far smaller) private sector. The single biggest group of scientific researchers in 2010 was in the social and human sciences (40.2 percent), followed by exact and natural sciences (mainly physics, chemistry, mathematics, biology, and geology), at 32.1 percent, engineering, sciences, and technology (21.3 percent), medical science (5.4 percent), and other disciplines (1.0 percent).

In 2014, public and private higher education institutions employed 80.0 percent of the total, public research institutions 12.9 percent, and the private sector only 7.1 percent.

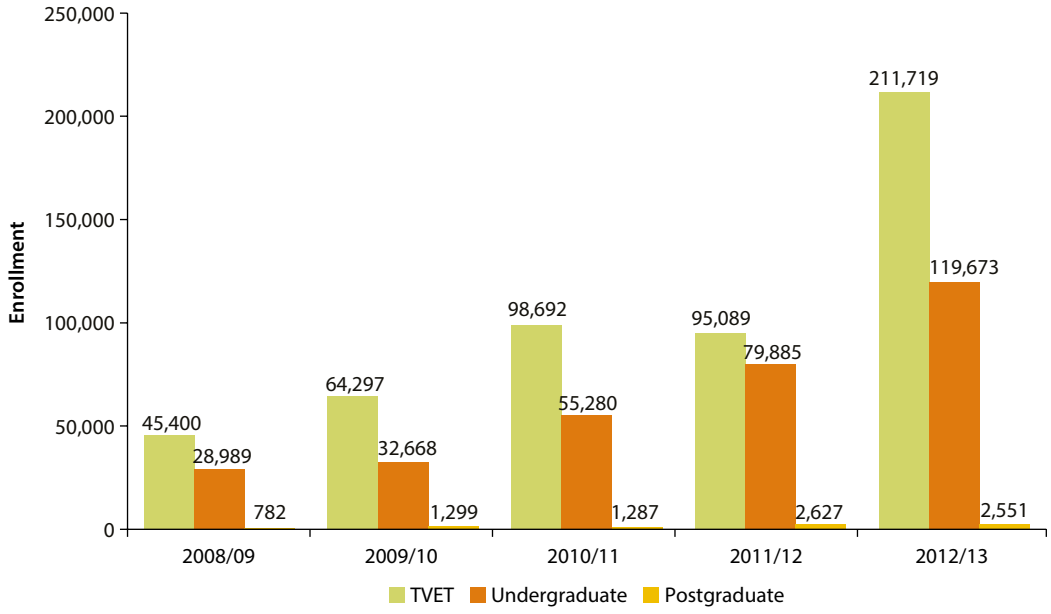
Source: Hassan II Academy of Science and Technology 2012.

Box 5.3: Technical and vocational education and training in Ethiopia

The Ethiopian government has designed a 70/30 education policy with 70 percent of tertiary education in natural, physical, and technology fields, and 30 percent in the social sciences and humanities (Ethiopian Academy of Sciences 2015). The government has opened TVET and two technical universities (Adama Science and Technology University and Addis Ababa Science and Technology University) that focus on technology. The enrollment rate for technology courses quadrupled at the TVET and undergraduate level between 2008 and 2013 (box figure 3).

After the introduction of the education and training policy in 1994, the number of formal and nonformal TVET institutions has grown steeply. The national development plan (2010/11–2014/15) put special emphasis on the role of TVET as a key development facilitator.

Box figure 3: Enrollment in technology at different levels, Ethiopia, 2008/09–2012/13



Source: Ethiopian Academy of Sciences 2015.

Successes (or otherwise) of STI policy

This section looks at successful, and less successful, examples of STI policy development and implementation in five African countries: Ethiopia, Morocco, Nigeria, Rwanda, and Zimbabwe, drawing on case studies.

Ethiopia

Despite the slow start to its STI policies, the Ethiopian government has given much emphasis to developing STI, including the 2006 and 2012 National STI Policies. The 2012 Policy was aligned to the national vision of "alleviating poverty and the country's

ambitious plan to join the middle-income countries by around 2025," as envisioned in the Growth and Transformation Plan.

Implementation has seen successes in health and trade (boxes 5.4 and 5.5), and disappointments in rainwater harvesting (box 5.6). These three sectors were chosen because of their significance for Ethiopia's sustainable economic development.[15]

The major lesson from Ethiopia is that, despite a slow start, a country can make rapid improvements in subsequent years. Other lessons are:

- The government's commitment in establishing institutions, such as ministries of science and technology (S&T), research institutions, universities, and TVET institutes, have contributed to progress.

- Policies that encourage expansion of STI, such as awards for innovation and 70/30 allocations, have made a big difference in the number of S&T graduates.

Morocco

STI initiatives include laws and policies. These include the new strategy of scientific research (2015–30) and the creation of the National Support Fund for Scientific Research and Technological Development. The new Moroccan strategy focuses on educational reform and scientific research through supporting the research funding system. So far, funding for research has been provided almost entirely by the state, with only few inputs from the private sector. Significant capacity-building programs were implemented (National Strategy for the Development of Scientific Research on the Horizon 2025).

The major lesson is that the provision of research funding was helpful in facilitating STI capacity-building programs for the country and could be implemented elsewhere in Africa.

Nigeria

Major developments in Nigeria were a new science university[16] and more polytechnics. The National STI Policy (2012) has developed new businesses geared toward advancing sustainable development. STI is now addressed nationally as an instrument of poverty alleviation and a road map catalyst for sustainable development. Several institutions were created in sectors including S&T, engineering, energy, the environment, water, agriculture, and industry. These institutions work in partnership with government institutions and the private sector (AUST 2016).

Box 5.4: Success: The Ethiopian Health Extension Program

The Health Extension Program (HEP), launched in 2014, is the most important institutional framework for achieving universal, rural, primary health care coverage in a context of limited resources. The program mobilizes health extension workers (HEWs) at the village level to deliver defined health service packages.

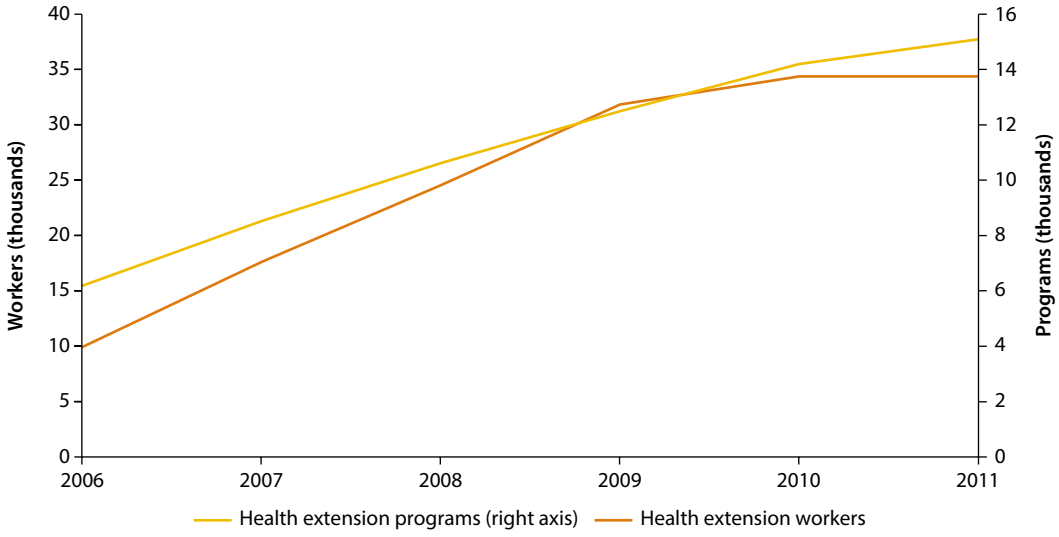
The HEP has been central to community health system strengthening, including providing standards and manuals and regular evaluation of the program and also providing in-service training focused on identified skills gaps and supportive supervision. The HEP lead to recruitment and training of HEWs. It aims to recruit, train, and deploy two female HEWs to a health post that serves a population of 3,000–5,000 people.

Box 5.4: Success: The Ethiopian Health Extension Program continued…

One distinctive feature is to recruit female high school graduates from their own and nearby villages and give them one year's intensive theoretical and practical training on 16 health service topics. The HEP led to improved access to health services in remote areas, with more than 15,000 health posts built and more than 34,000 HEWs deployed (box figure 4).

A 2010 study indicates that about 92 percent of households were within an hour (5 km) from a health facility. The HEP has enabled Ethiopia to increase primary health care coverage from 76.9 percent in 2005 to 90 percent in 2010. The average time taken to reach the nearest health facility has been reduced by half—from 60 minutes in 2005 to 30 minutes in 2010—for the three largest regions (Amhara, Oromia, and SNNP) (CNHDE 2011).

Box figure 4: Growth of number of HEWs and health posts in Ethiopia, 2006–11



Source: HESPI 2016.

Box 5.5: Success at the Ethiopian Commodity Exchange

The Ethiopian Commodity Exchange (ECX) integrated marketing activities and eased trade transactions by shortening the trading chain and increasing producer profits. It traded in increasing volumes of cereals and cash crops, especially coffee and sesame for export.

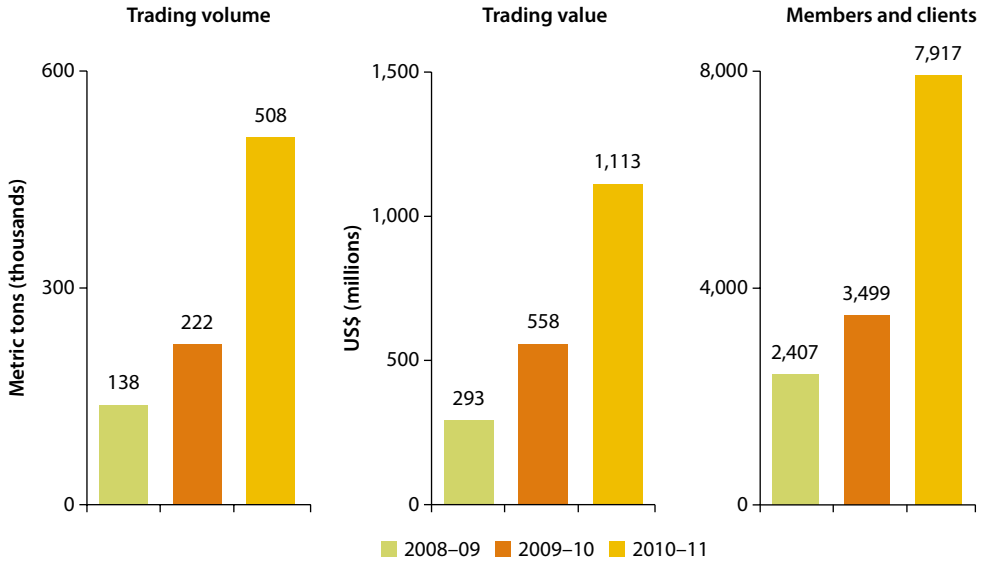
It grew out of ACBF-funded initial research by the Horn Economic and Social Policy Institute and was developed into a guide for the export market. Government legislation was key to its success, and in its initial

Box 5.5: Success at the Ethiopian Commodity Exchange continued…

years it received large support from the government and donors. Currently, however, ECX stands on its own, exemplifying a successful transition from dependence to self-reliance.

ECX showed impressive market performance. For instance, in its three first years, it traded $1 billion worth of commodities, with zero defaults; trading volume surged; and the number of members and clients soared (box figure 5). The number of warehouses also grew, from one in Addis Ababa to 55 in 17 districts.

Box figure 5.1: Key figures for the Ethiopian Commodity Exchange, 2008–11



Source: HESPI 2016.

Rwanda

STI activities are cross-cutting among the Ministry of Education, Ministry of Youth and ICT, National Commission of S&T, Rwanda Development Board, and National Industrial Research and Development Agency. Rwanda's Vision 2020 recognizes the role of STI in transforming its socioeconomic landscape from an agrarian economy into a knowledge-based one, and achieving socioeconomic transformation (figure 5.2). Vision 2020 sees STI as a strong enabler in all priority sectors including education, ICT, health, and agriculture.

Innovations promoted by the University of Rwanda have improved the quality of Maraba coffee, promoted biogas uptake in prisons, and banned plastic bags in the country. To support the projects, the Ministry of Education with ECA established a special fund in 2012 (box 5.7).

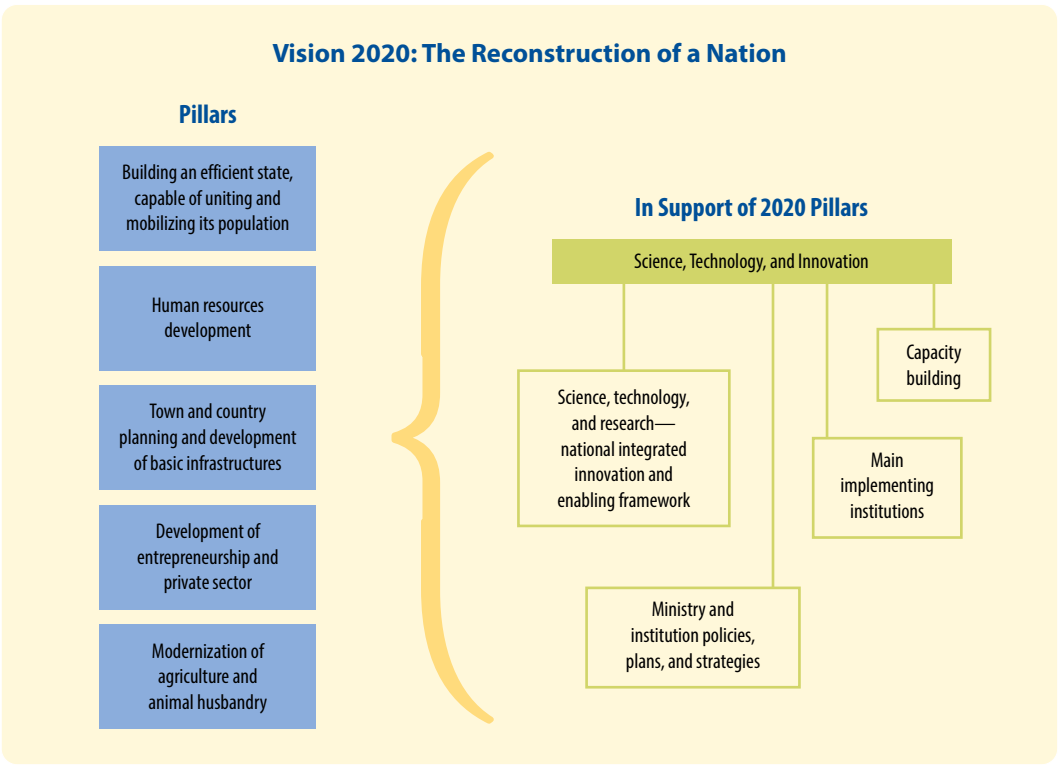
Box 5.6: Disappointment in Ethiopia: Rainwater harvesting

In Ethiopia, rainwater harvesting to increase off-season agricultural production and reduce food insecurity did not become the hoped-for success, for several reasons:

- Poor planning: the urge to increase the number of structures constructed; limitations in manpower; and the lack of a comprehensive water harvesting policy package are some of the capacity gaps documented in the literature.
- The consultations made with technology adopters (small-scale farmers) were bypassed.
- A holistic and integrated approach that considered social and economic implications was missing.
- Ethiopia was caught in surprise to find less absorption of the rainwater harvesting technologies and almost no cases of intervention replications registered.
- Most of the structures built for rainwater harvesting, which were fully financed by the government and donors, were dysfunctional.
- The structures created a habitat for mosquitos, and the number of malaria cases climbed sharply.

Source: HESPI 2016.

Figure 5.2: The role of STI in Rwanda's Vision 2020



Source: ACBF and Institute of Policy Analysis and Research in Rwanda 2016.

Box 5.7: Rwanda Innovation Endowment Fund

The Rwanda Innovation Endowment Fund (RIEF) was founded to stimulate economic transformation through applied S&T and research in innovative market-oriented products and processes in priority economic areas.

For the initial phase, the fund focused on three areas: agriculture, manufacturing, and ICT. For the second round, energy was included as the fourth priority area. The initial phase was supported by funding from the government of Rwanda and ECA.

- For the initial phase, a RIEF grant ($50,000) for three years was offered to eight innovation projects in 2013.
- For the second phase, a RIEF grant ($50,000) was offered to six projects in 2015.

Source: ACBF and Institute of Policy Analysis and Research in Rwanda 2016.

The major lesson from Rwanda is that the establishment of RIEF, despite insufficient financing, shows some commitment by government to fund STI. A further lesson is that applied research and innovation conducted with universities could significantly contribute to socioeconomic development.

Zimbabwe

Zimbabwe has developed several STI initiatives, including the development of centers of learning and R&D at numerous research institutions. In 2005, the Ministry of Science and Technology Development launched the Innovation and Commercialisation Fund to promote research and innovation. Zimbabwe launched the second Science and Technology Policy in 2012, and its six primary goals include strengthening capacity development in STI. In the policy, the government commits to making a budgetary allocation of at least 1 percent of GDP for expenditure on R&D and focusing at least 60 percent of university education on S&T skills development.

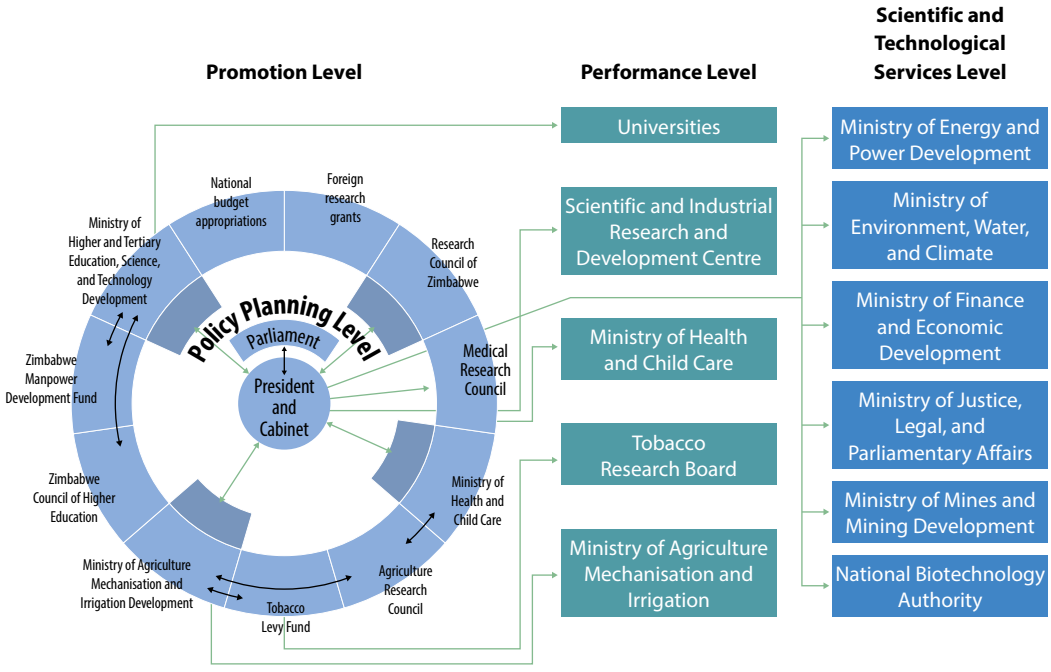
In 2016, the Ministry of Higher and Tertiary Education, Science, and Technology Development introduced the Science, Engineering, Technology, and Innovation system to promote learning in those disciplines (figure 5.3). It covers planning, implementation, performance, and scientific and technological services.

The key lesson from Zimbabwe is the importance of adopting an institutional framework for STI with clear policy design, the right institutions, and requisite funding. Others are:

- The STI sector needs to be aligned to the overarching national goals and development priorities.
- Given limited fiscal space, assistance from development partners and public–private partnerships is critical.
- An enabling regulatory framework is needed to foster public–private partnerships in higher and tertiary education institutions.
- The Innovation and Commercialisation Fund (set up in 2005), despite inadequate financing, shows a measure of commitment by the government to fund STI.

Zimbabwe presents success stories in green fuel and maize seed (boxes 5.8–5.9). These two

Figure 5.3: Zimbabwe's science, engineering, technology, and innovation system



Source: Adapted from UNESCO 2015.

projects are highlighted because of the potential to replicate them in two crucial fields.

Tanzania

Tanzania's UNESCO National Commission, established in 1963, has policies to foster and support STI in the country. STI-related policies include the National Science and Technology Policy, the Sustainable Industrial Development Policy, and the ICT Policy. For example, the 1985 National Science and Technology Policy aims to promote S&T as a tool for economic development. It identifies nine subsectors that need priority application of S&T for national development and economic growth: food and agriculture, industry, energy, natural resources, environmental health, sanitation and population planning, transport and communication, science and technology, and education and manpower.

The Tanzania Commission for Science and Technology, established in 1986, is responsible for coordinating and promoting research and technology development in the country and for advising the government on all matters relating to S&T—including but not limited to formulating S&T policy, setting priorities for R&D, and allocating and applying resources. The Tanzanian government, through the Tanzania Commission for Science and Technology, developed the National Research Agenda for 2015–2020 to consolidate and coordinate research activities in the National STI Ecosystem.

STI is seen as one of the principle means to achieve the Tanzania National Development

Box 5.8: Success in Zimbabwe's Chisumbanje Ethanol Project

The Chisumbanje Ethanol Project is a public–private partnership between the government of Zimbabwe (10 percent) and a local investor (90 percent).

The project is a success from several points of view:

- The plant is the biggest of its kind in Africa.
- The project company employs about 4,500 people in the agriculture department and mill.
- It can be leveraged for electricity generation, as it is reportedly able to generate 15 megawatts of power, enough for about 30,000 households.
- The project has many backward and forward linkages, include fertilizers, cosmetics, and explosives, which can harvest some of the carbon dioxide from the plant.
- After the project produced significant quantities of ethanol, in August 2013 the Zimbabwe Energy Regulatory Authority granted it an ethanol-blending license.

Source: ACBF and Zimbabwe Economic Policy Analysis and Research Unit 2016.

Box 5.9: A new maize seed variety in Zimbabwe: The Sirdamaize Project

The Scientific Industrial Research and Development Corporation of Zimbabwe (SIRDC) invented a seed variety, Sirdamaize, which is drought and disease tolerant, and offers higher yields than traditional strains.

In 1997, SIRDC (with support from Biotechnology Trust Zimbabwe, Directorate General International Cooperation of the Netherlands, and International Maize and Wheat Improvement Center) began work on drought-tolerant maize varieties. This was a four-phase project: capacity building in "marker-assisted selection" (a relatively new molecular biology technique at that time), selection of germplasm, development of inbred lines, and development of hybrids. Molecular biologists conducted tests in SIRDC's laboratories.

Using molecular biology and conventional breeding techniques, they identified 43 inbred lines as possessing drought-tolerant genes. After the hybrid development stage, the variety "Sirdamaize 113" was registered in 2009. Farmers from Buhera, Birchenough, and Hwedza had assessed it, and found that it yielded well, even under tough environmental conditions.

The main characteristic of Sirdamaize 113 is its drought tolerance, while its expected yield is up to 13 tons per hectare (although previous years' trials in communal areas from region two to region four had a yield of 1.5–9 tons per hectare). The variety has a low anthesis-silking interval of about –1, taking 66 days to silking and 67 to anthesis, suggesting improved synchronization for pollination, thereby guaranteeing yield even under water-stressed conditions. Sirdamaize 113 takes 136 days to reach maturity and has tolerance to diseases such as maize streak virus, gray leaf spot, rust, and phaeospharia leaf spot.

Source: Savadye and Shiri 2012.

Box 5.10: Developing the next generation of African scientists and engineers

The ACBF program is developed around centers of excellence in science and technology in three countries—Burkina Faso, Nigeria, and Tanzania. It promotes quality research and training in S&T by facilitating regional poles of excellence in areas essential for Africa's development and growth, such as water and environmental management, computer engineering, mathematical modeling, natural resource and environment management, and biotechnology. It also seeks greater female participation in higher education, science, technology, and engineering. And it seeks free movement of high-level expertise between Francophone West Africa, Anglophone West Africa, and Eastern Africa by harmonizing higher education systems and degrees.

The ACBF program enables participating institutions to attract world-class scientists and engineers to Africa on both a short- and long-term basis to build the capacity of local scientists and train students up to the PhD level. It also provides a platform for effective networking among universities.

One of the main pillars of the Nelson Mandela African Institution of Science and Technology is the ICT Resource Center, which enhances the core functions of teaching, learning, research, and innovation through the application of modern resources and services to students, societies, and industries both inside and outside the country. The Center also acts as a backbone in providing the ICT resources to facilitate teaching, learning, research, and innovation in various areas of life sciences, bio-engineering, environmental engineering, computing and computational sciences, material sciences and engineering, and sustainable energy and engineering.

Vision 2025, transforming Tanzania from a least developed country (with a low productivity agricultural economy) to a middle-income country (with semi-industrialized economy) by 2025.

The 2009 Public-Private Partnership Policy is beneficial to STI because it improves efficient delivery of goods and services by allowing both public and private sectors to collaborate in service delivery. For example, it encourages private participation in secondary and higher education through private universities and university colleges. The involvement of the private sector and communities in owning and managing schools and universities has rapidly increased the number of schools and universities, which are now contributing to STI capacity development.

The successes of STI in Tanzania can be seen in both higher education and health. In higher education, the most inspiring story is the Nelson Mandela African Institution of Science and Technology, which the ACBF supports (box 5.10). It aims to develop the next generation of African scientists, engineers, and technologists, who will drive the continent's development through the application of science, engineering, and technology. But perhaps the greatest successes have been in health and medical research and interventions, especially in malaria control and prevention. Tanzania has been applauded for its achievements in the battle against malaria.

Partnerships and collaboration

STI capacity building through bi- and multilateral agreements will generate cooperation between universities and research institutes. For instance, in 2013 bilateral agreements between the government of Ethiopia and those of Brazil and Kenya led to bilateral research projects, scientific meetings, symposiums, short-term training courses, and information exchanges. In 2014, the Ethiopian government signed similar

bilateral agreements with the governments of China and the Republic of Korea. Such cooperation is expected to promote STI potential in the country (HESPI 2016).

With support from the Japanese government, Nigeria benefited from a UNESCO-driven initiative to create a robust STI policy framework for several countries. From around 2005, it embarked on a comprehensive large-scale reform of its STI system, including a thorough review of all of the system's functions. The initiative adopted the national innovation system approach as a framework for STI system reform.

The Innovation for Poverty Alleviation Program is a result of the South African–EU STI bilateral agreement. It is funded by the EU and implemented and managed by the South African Department of S&T. The program aims to promote technological innovations to reduce poverty in the country, raise connectivity in remote areas, and set up technology transfer partnerships. It represents a good model of partnerships involving academic institutions, national science councils, private companies, provincial and national departments of S&T, and the spheres of social development, ICT, water, and energy (EU 2013: 20).

The Finnish-Southern Africa Partnership Programme for Biosciences is a collaborative initiative established between the governments of Finland and South Africa to support Southern African Development Community (SADC) countries (through the Southern Africa Network for Bioscience of the New Partnership for Africa's Development), in conducting scientific research and promoting innovations in bioscience. It is one of the few cases of an African country contributing to a regional initiative with a European partner. The program has been instrumental in building capacity for bioinformatics in the SADC region (EU 2013).

STI capacity gains in higher education

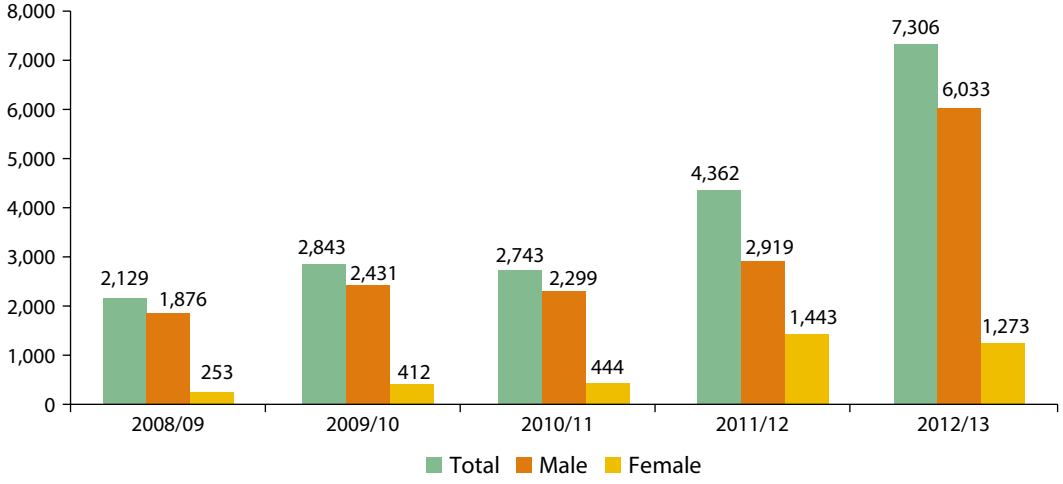
STI capacity for higher education shows real improvement in some African countries, such as Ethiopia, with its 70/30 education policy, new TVET and technical universities (see box 5.3), and a threefold rise in the number of students graduating from universities between 2008/09 and 2012/13, along with an increased share of women (figure 5.4). Enrollment and graduation in technology fields are forecast to grow strongly over 2016–25. Other African countries could learn from this experience by putting more emphasis on S&T education, TVET, and S&T universities.

The higher education system, too, shows strong growth in some African countries. For instance, Zimbabwe in 1953 had only one university, while in 2016 it had about nine state universities, eight polytechnic colleges, five private universities, four industrial training colleges, and three vocational training colleges that promote science, engineering, technology, and innovation.

The major lesson from Zimbabwe is that despite the expansion in higher education institutions, the number of students enrolled each year in the country's universities and colleges fluctuated over 2006–12 (figure 5.5), partly because of straightened budgetary allocations for developing STI. The national budget earmarked for S&T, including higher and tertiary education, remained below 8 percent of the total (figure 5.6).

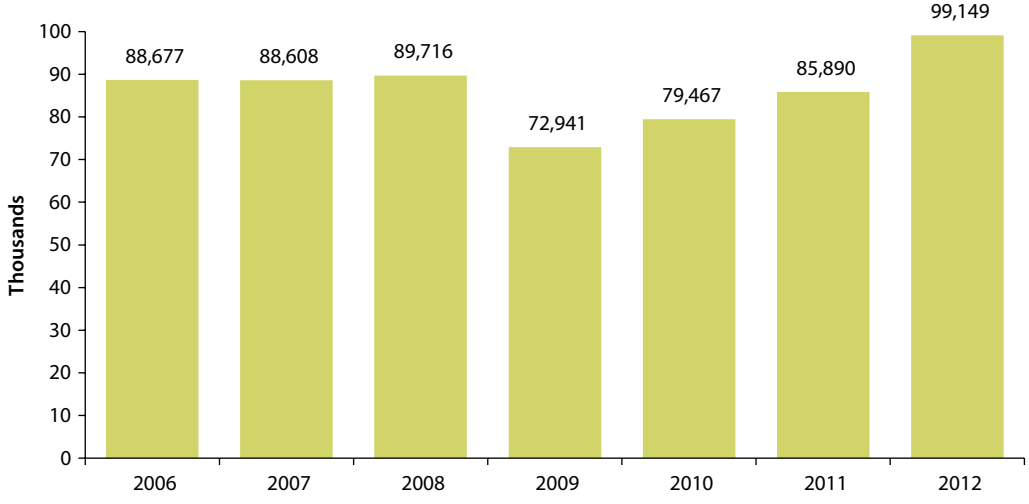
Rwanda has also made great strides in higher education. Before 1994 it had only one university, while in 2016 it has 29 higher learning institutions registered with the Higher Education Council. The shares of most government-funded and cooperation scholarship schemes are set

Figure 5.4: Technology graduates by gender in Ethiopia, 2008/09–2012/13



Source: Ethiopian Academy of Sciences 2015.

Figure 5.5: Enrollment in Zimbabwe's tertiary education institutions, 2006–12

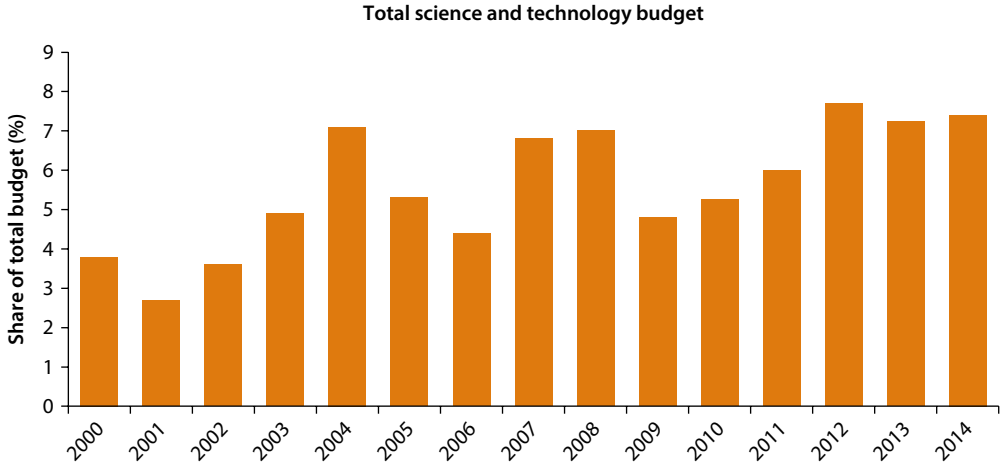


Source: UNESCO 2014b.

at 70 percent for S&T and 30 percent for non-S&T fields of study. The majority of students graduated from social sciences and humanities, and only a few from science, engineering, and technology fields.

The main lesson from Rwanda is that, despite many achievements in higher education skills development, critical capacity gaps remain in skills and knowledge, particularly in technology and engineering. Nor have women

Figure 5.6: Government expenditure on science and technology, Zimbabwe, 2000–14



Source: ACBF and Zimbabwe Economic Policy Analysis and Research Unit 2016.

benefited from enough opportunities for equal access to STI positions.

Key messages and policy recommendations

- Rapid increases in R&D expenditures as a share of GDP have been recorded in a number of African countries, but with only a small private sector contribution.
- There is a need to correct the emphasis on social sciences and humanities fields in some countries.
- Despite a slow start and still-low state of technology, improvements in recent years augur well for the continent's catching up.
- The role of stakeholders is critical for enhancing STI capacity building. For instance, the role of government is to create the right environment by formulating good policies, creating efficient institutions of implementation and follow-up, offering financial resources, improving investment in human resources, and the like. The role of the private sector, with development partners, is to complement government efforts by, for example, offering financial resources, improving investment in human resources, promoting exchange programs, sharing good practices (including funding their scaling up), and encouraging innovation in private firms.
- Government commitment in establishing institutions (such as ministries of S&T, research institutions, and specialized higher education institutions and universities) has influenced recent progress in STI capacity building.
- Policies that encourage expansion of STI activities (such as award systems for innovation and 70/30 allocation) have lifted the number of STI graduates.

- Innovation and research funds in some African countries, despite inadequate financing, show some commitments to fund STI.

- African governments should facilitate initiatives and put in place mechanisms that apply the lessons learned and values from indigenous knowledge and technologies, while ensuring their systematic integration into the national innovation system.

- It is vital to promote complementarities between institutions involved in STI capacity building, research, and innovation.

- The enabling regulatory framework and institutional environment for public–private partnerships in higher education needs to be improved.

- An incentive framework is required for regional economic communities and African nations to develop STI.

6

SUMMARY AND POLICY RECOMMENDATIONS

Summary

The *Africa Capacity Report (ACR) 2017* comes at a time when African governments have placed science, technology, and innovation (STI) at the forefront of Agenda 2063 of the African Union (AU) and the global 2030 Agenda for Sustainable Development. Backing their commitment with action, African Heads of State have adopted a Science, Technology, and Innovation Strategy for Africa (STISA-2024). STISA-2024 recognizes the need to strengthen Africa's STI capacity by developing or upgrading research infrastructure, enhancing professional and technical competencies, and providing an enabling environment for STI development for Africa to transition toward an innovation-led, knowledge-based economy.

This chapter summarizes Africa's capacity to achieve economic transformation and sustainable development through STI. It highlights the wide recognition of STI as a crucial driver of Africa's prosperity and competitiveness, bringing out the essential capacity challenges and limitations that confront African countries, as well as the policy recommendations that can help African countries leapfrog into the future. The key messages are:

- Building STI capacity is a key driver and enabler in promoting the ability of African countries to achieve economic transformation and development goals, such as food security, poverty eradication, job creation, and access to energy and health.

- Progress on Africa's capacity for STI looks encouraging, given that most African countries are in the Medium and High brackets of the overall Africa Capacity Index. The majority of African countries have a strategy for promoting STI, including capacity development, although capacity to implement it remains a challenge, given a narrow financing base.

- Africa's rising number of scientific publications and other outputs, as well as its increasing share of innovation in the global economy, suggest that it is starting to emerge scientifically onto the global stage. Recent economic growth has not, however, translated into better globally recognized STI performance, including

competitiveness, innovativeness, network readiness, and investment in research and development (R&D).

- All global indicators point to Africa as the region spending the least of its gross domestic product (GDP) on R&D, at less than 1 percent (though data are patchy). Africa is at the bottom of the global rankings on, for instance, human resources for STI development, STI infrastructure, institutions, and capacity to innovate. Most African countries' returns to current investments in STI development are low.

- African countries have limited capacity to generate, apply, and interpret STI indicators correctly to monitor the progress of STI development at the country level, hindering effective decisionmaking. At current rates and capacity, most African countries are far from developing globally competitive enterprises unless they mobilize the STI capacities in these R&D institutions. Fortunately, the African Science, Technology, and Innovation Indicators initiative and the African Observatory of Science, Technology, and Innovation are gradually addressing some of these issues by building Africa's capacity to develop and use STI indicators in development planning and policy.

- There is a growing emphasis on developing bi- and multilateral STI cooperation to create more initiatives in Africa. Provisions for fostering STI cooperation are increasingly being embedded in economic treaties and trade agreements at the national, regional, and continental levels. Their integration into regional and continental agreements is suffused by the idea that individual African economies are too small to amass the necessary scientific and technological resources.

- The capacity of African countries to generate and deploy knowledge and technological innovations for socioeconomic growth will heavily depend on the level to which STI institutions have the skills and expertise, financial resources, infrastructure, and equipment. Apart from lack of investment in STI, the failure of African countries to innovate and promote STI can be attributed to weak STI institutions and national innovation systems. At the current rate of STI development and capacity, few if any African countries are close to becoming innovation-led economies or putting Africa on the global platform as a strong competitive player in innovation, invention, and engineering.

- Africa is witnessing a surge in initiatives aimed at promoting STI at the continental, regional, and national levels. Partnerships and cooperation are intensifying in STI through continental bodies such as the AU, New Partnership for Africa's Development, and the regional economic communities. However, three critical issues stand out. First, most STI initiatives are mainly funded by external development partners, raising the question of sustainability. Second, the core focus of several of these initiatives is on R&D, with little focus on technological innovation. Third, the lack of coordination among these initiatives means that they are unable to add value and foster consolidated national and regional innovation systems.

- While African countries endeavor to develop their STI infrastructure, an essential component is to address their capacity gaps and ensure sustainable development through STI. Such capacity building remains a formidable challenge, involving the acquisition of all manner of skills, knowledge, and infrastructure; of adept public and private support and policies; and of financial resources.

Policy recommendations

The above issues and endeavors suggest the following directions for African policymakers:

- Closing the socioeconomic development gap between Africa and the rest of the world will depend on Africa's commitment to closing the STI investment gap. Countries with strong and effective STI systems invest up to 3.5 percent of their GDP in R&D, a rate far higher than seen in Africa. To break the poverty cycle and rise above the low rankings on technological and innovation capabilities, African countries must strive to meet their 1 percent of GDP STI target and even set a more ambitious target of up to 3 percent of GDP in STI.

- There is a need for a coordinated collective effort (from skills surveys and diagnostic analysis) to be mounted across countries to identify the critical STI skills essential for countries' economic growth— and the current gaps— depending on their resource endowments and national development plans. This exercise should involve government, the private sector, and academia.

- African governments, through their national commissions for STI, should set up sustainable financing mechanisms for STI that feature competitive and matched funding to reorient the STI system to focus not only on R&D but also on sustainable technologies and innovations for commercialization. Such innovations must be designed and owned by local emerging firms and start-ups at the bottom of the pyramid. Governments should partner with industries to create financing mechanisms such as industry funds, association-based financing, and tax incentives, among other measures, to mobilize resources to promote STI. The private sector and development partners should support and complement the governments' efforts by providing funding, investing in critical skills (education, training, and so on), promoting the sharing of good practices (including their scaling up), and encouraging innovation. These efforts can help set off innovations and technological solutions that can contribute to high productivity in the economy.

- The success of STI in delivering an innovation-led and knowledge-based economy for Africa's transformation will rely on the effectiveness of the science–policy–society interface. Within a holistic framework, government must provide an enabling environment that provides the impetus for local scientific research institutions and research think tanks to be the voice of scientific authority in Africa. These institutions must also produce outputs that contribute to African countries' transformation.

- The brain drain from Africa should be viewed not as a menace but as an opportunity to harness the skills and expertise of diaspora Africans. African governments should adapt the model of the Fédération Internationale de Football Association for diaspora African researchers and scientists, encouraging them to return for a period to their home country through specially designed programs to contribute to its development in STI. As a first step, however, Africa should proactively curtail brain drain by developing strategies for retaining, monizing and utilizing the STI capacity built on the continent.

- It is recommended that a Regional Database of Critical Skills for Agenda 2063 in support of STI be established from national skills inventories to create a comprehensive and adaptive skills pool as a basis for intra-African cooperation in using African skills. This could be coordinated by such bodies as the ACBF or the AUC.

- Africa must continue to pursue South–South scientific cooperation by promoting policies that allow scientists and students greater mobility across African and emerging countries. By exploring the STI comparative advantages of these economies, less-endowed African countries can benefit from technologies and innovations that have transformed other highly endowed countries. African governments should step up their efforts to develop academic and scientific mobility programs across African and emerging economies. Scientific cooperation programs in Africa led by China, Brazil, and India suggest that these three countries are willing to share their scientific and technological successes with Africa. This is a great opportunity for African countries to tap into.

- The AU should build on progress to nurture more regional and international Centers of Excellence in areas critical to Africa's STI development. Higher education and research institutions in Africa should forge strong regional networks and partnerships to develop such centers for world-class research by African scientists. These centers can help African institutions standardize and harmonize research outputs, expertise, and best practices in STI.

- To augment their investment in STI, African governments and the AU should pursue innovative funding alliances with bilateral and multilateral donors, governments, private foundations, and businesses. A dedicated share of all development loans and grants received from development partners should go into developing STI capacity programs. Africa must have clear strategies on the sources and levels of STI funding, inculcating discipline, focus, and commitment to the use of these allocated resources.

- Investment in education in science, technology, engineering, and mathematics (STEM) is vital for Africa to achieve a critical mass in educated human resources, to catalyze innovation, to promote competitiveness, and to nurture the next generation of innovators, entrepreneurs, and scientists. Africa's universities and higher education institutions must design and execute strategies for building and deploying STEM capacities, including STEM courses in private and public institutions; innovative programs that combine theory with local context practice; and scholarships to pursue STEM programs. Governments should aim to integrate these strategies into national STI policies.

- In pursuing STI-driven development, African governments should make commitments to develop institutional capacity by investing heavily in high-quality universities, state-of-the-art and well-equipped laboratories, information and communications technology infrastructure, and research funding. In the long term, the diagnostic analysis of skills needs should guide the development of curricula and targeted training programs intended to redress the skills shortage in the trade, craft, and engineering fields. Emphasis should be on TVET-related STI, including in-work apprenticeships and on-the-job experience. Lifelong learning for employable skills should be the guiding policy principle.

- There is a need to tighten links between universities, government, industry, non-state actors, and labor markets. This interface is important in ensuring that the supply of skills closely matches the needs of enterprises and labor markets. The alignment of skills development with market needs as well as Agenda 2063 priorities will bring industry practitioners into the development of capacity, enabling training institutions to draw on both policy and practice to enrich training curricula. This will nurture a virtuous circle in which more and better education and training fuels innovation, investment, economic diversification and competitiveness, as well as social and occupational mobility and greater work opportunities. The urgent need for fundamentally reforming the educational system and redesigning the content of a new African educational agenda that prioritizes STI cannot be overemphasized.

- Africa must intensify its efforts toward bridging the gender gap by promoting women's participation and leadership in STI, by gender mainstreaming and assuring gender equity in STI, and by developing gender-friendly policy frameworks that encourage young women and girls to pursue science and engineering programs.

- Regional bodies such as the East African Community, Economic Community of West African States, and Southern African Development Community should craft and implement coherent strategies for regional STI systems as "nested networks" of national STI systems with differentiated capabilities. Such strategies should focus on promoting shared/regional R&D infrastructure and harmonizing technical standards and research regulations across Africa. They should also design mobility programs for scientists and engineers, foster regional collaboration among universities, encourage public–private partnerships across national borders, and facilitate adoption of regional frameworks for intellectual property rights protection.

- Continental bodies with the mandate, knowledge and experience in coordinating capacity development in Africa, like ACBF, should support implementation of Agenda 2063 by putting together a coherent and coordinated capacity-building program on STI that includes clear strategies and knowledge sharing around good practices in STI that can be financed by African Governments, development partners, and development banks, such as the African Development Bank, Islamic Development Bank, and Afrixem Bank.

NOTES

1. Including commercialization, database management, collaboration, competitive environment, dissemination of innovation, intellectual property, market access, promotion of research, and scientific equipment.

2. Previous themes were "Capacity Development in Fragile States" (2011), "Capacity Development for Agricultural Transformation and Food Security" (2012), "Capacity Development for Natural Resources Management" (2013), "Capacity Imperatives for Regional Integration in Africa" (2014), and "Capacity Imperatives for Domestic Resource Mobilization in Africa" (2015).

3. Target 9.5 elevates the role of research and innovation policy well beyond STI as one of the Means of Implementation.

4. Though the same in numerical ranking, Malawi moved from the medium to the high capacity category.

5. Mauritius (49th), South Africa (60th), Seychelles (65th), Tunisia (76th), Morocco (78th), Senegal (84th), Botswana (90th), Kenya (92nd), Rwanda (94th), Mozambique (95th), Malawi (98th), and Egypt (100th).

6. Lesotho, Madagascar, Mozambique, Namibia, Sierra Leone, South Africa, Swaziland, and Zimbabwe.

7. For more details on this section, see Nair-Bedouelle, UNESCO, and AU (2008) and Nair-Bedouelle (2009).

8. UNESCO STI policy review and formulation in African member states cover Benin; Botswana; Burundi; Côte d'Ivoire; the Democratic Republic of Congo, Ethiopia; Kenya; Lesotho; Madagascar; Malawi; Morocco; Namibia; Nigeria; the Republic of Congo; Swaziland; Togo; Zambia; and Zimbabwe.

9. For all this section, see EU (2013).

10. The 19 projects are consistent with Africa's S&T CPA developed by the AUC and NEPAD and published in 2005. For information about The Book of Lighthouse Projects, see: http://www.africa-eu-partnership.org/sites/default/files/090515_p8lighthouse_1.pdf.

11. For health research capacity, see http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2607030.

12. Benin, Cameroon, Egypt, Ghana, Madagascar, Senegal, and South Africa; and France, Italy, Portugal, and the United Kingdom.

13. Including patents and inventions, trademarks, industrial designs, geographic indications of source, copyright and related rights, traditional (indigenous or local) knowledge, plant breeders' rights, and protection against unfair competition.

14. Research management comprises all administrative and operational functions dealing with the management of research. It covers pre- and post-award management, contractual arrangements, and can include any functions related to intellectual property, business development,

policy influence, spinout companies, and technology transfer (Green and Langley 2009).

15. Other good stories include the Woreda Plasma Network, in which remote rural areas are connected to the network in schools to increase access by students to high-level technology, and competitions and awards to secondary students for innovations in STI.

16. This is a campus of the Nelson Mandela Institution of Science and Technology.

STI ANNEXES

Annex 1: Global Innovation Index ranking for African countries, 2013, 2014, and 2015

Country	2015 score (1–100)	2013 ranking	2014 ranking	2015 ranking
Mauritius	39.23	53	40	49
South Africa	37.45	58	53	60
Seychelles	36.44	–	51	65
Tunisia	33.48	70	78	76
Morocco	33.19	92	84	78
Senegal	30.95	96	98	84
Botswana	30.49	65	–	90
Kenya	30.19	98	85	92
Rwanda	30.09	102	102	94
Mozambique	30.07	111	107	95
Malawi	29.71	125	113	98
Egypt	28.91	101	99	100
Burkina Faso	28.68	116	109	102
Cabo Verde	28.59	–	97	103
Mali	28.37	106	119	105
Namibia	28.15	109	108	107
Ghana	28.04	94	96	108
Cameroon	27.80	125	114	110
Uganda	27.65	89	91	111
Gambia	27.49	122	104	112
Côte d'Ivoire	27.16	136	116	116
Tanzania	27.00	123	123	117
Lesotho	26.97	124	117	118
Angola	26.20	135	135	120
Swaziland	25.37	104	127	123
Zambia	24.64	118	121	124
Madagascar	24.42	140	124	125
Algeria	24.38	112	133	126
Ethiopia	24.17	129	126	127
Nigeria	23.72	137	110	128
Zimbabwe	22.52	138	130	133
Niger	21.22	130	131	134
Burundi	21.04	–	138	136
Guinea	18.49	129	139	139
Togo	18.43	139	142	140
Sudan	14.95	141	143	141

Source: Cornell University, INSEAD, and WIPO 2015.

– = Not available.

Annex 2: Network Readiness Index ranking, 2016

Country	Value	2016 ranking (139 countries)	Value	2015 ranking (143 countries)	Value	2014 ranking (143 countries)	Value	2013 ranking (144 countries)
Mauritius	4.4	49	4.4	45	4.5	48	4.31	55
South Africa	4.2	65	4.2	70	4.0	70	3.98	70
Seychelles	4.0	74	4.0	74	4.0	66	4.02	79
Morocco	3.9	78	3.9	78	3.9	99	3.61	89
Rwanda	3.9	80	3.9	83	3.9	85	3.78	88
Cabo Verde	3.8	85	3.8	87	3.8	89	3.73	81
Kenya	3.8	86	3.8	86	3.8	92	3.71	92
Egypt	3.7	96	3.7	94	3.6	91	3.71	80
Namibia	3.6	99	3.6	102	3.5	105	3.41	111
Botswana	3.5	101	3.5	104	3.4	103	3.43	96
Ghana	3.5	102	3.5	101	3.5	96	3.65	95
Côte d'Ivoire	3.4	106	3.4	115	3.2	122	3.41	120
Senegal	3.4	107	3.4	106	3.3	114	2.30	107
Gambia	3.3	113	3.3	108	3.3	107	3.38	98
Lesotho	3.3	115	3.3	124	3.0	133	2.88	138
Zambia	3.2	116	3.2	114	3.2	110	3.34	115
Algeria	3.2	117	3.2	120	3.1	129	2.98	131
Nigeria	3.2	119	3.2	119	3.2	112	3.31	113
Ethiopia	3.1	120	3.1	130	2.9	130	2.95	128
Uganda	3.1	121	3.1	116	3.2	115	3.25	110
Zimbabwe	3.0	122	3.0	121	3.1	117	3.24	116
Mozambique	3.0	123	3.0	129	2.9	137	2.77	133
Cameroon	3.0	124	3.0	126	3.0	131	2.94	124
Gabon	2.9	125	2.9	122	3.0	128	2.98	121
Tanzania	2.9	126	2.9	123	3.0	125	3.04	127
Mali	2.9	127	2.9	127	3.0	127	3.00	122
Benin	2.9	128	2.9	–	–	–	2.82	123
Swaziland	2.9	129	2.9	125	3.0	126	3.00	136
Liberia	2.8	130	2.8	–	–	–	3.19	97
Malawi	2.7	132	2.7	133	2.8	132	2.90	129
Guinea	–	134	2.6	142	2.4	145	2.48	140
Madagascar	2.6	135	2.6	135	2.7	139	2.74	137
Mauritania	2.5	136	2.5	138	2.5	142	2.61	135
Angola	–	–	–	–	2.5	144	2.52	–
Burundi	2.4	138	2.4	141	2.4	147	2.31	144
Chad	2.2	139	2.2	143	2.3	148	2.22	142
Sierra Leone	–	–	–	–	–	–	2.85	143

Source: WEF, Cornell University, and INSEAD 2013, 2014, 2015, and 2016.

– = Not available.

Annex 3: Gross expenditure on research and development in Africa, 2011–14

Country	GERD (% of GDP)	GERD per capita (current PPP$)	GERD per researcher (current PPP$ thousands)	GERD by source of funds (%), 2011				
				Business	Government	Higher education	Private nonprofit	Abroad
Botswana	0.26^{+2}	37.8^{+2}	109.6^{+2}	5.8^{+2}	73.9^{+2}	12.6^{+2}	0.7^{+2}	6.8^{+2}
Burkina Faso	0.20^{-2}	2.6^{-2}	–	11.9^{-2}	9.1^{-2}	12.2^{-2}	1.3^{-2}	59.6^{+2}
Burundi	0.12	0.8	22.3	–	59.9^{-3}	0.2^{-3}	–	39.9^{-3}
Cabo Verde	0.07	4.5	17.3	–	100	–	–	–
Congo, Dem. Rep.	0.08^{-2}	0.5^{-2}	2.3^{-2}	–	100	–	–	–
Egypt	0.68	–	–	0.5	0.95			
Ethiopia	0.61^{+2}	8.3^{+2}	95.3^{+2}	0.7^{+2}	79.1^{+2}	1.8^{+2}	0.2^{+2}	2.1^{+2}
Gabon	0.58^{-2}	90.4^{-2}	258.6^{-2}	29.3^{-2}	58.1^{-2}	9.5^{-2}	–	3.1^{-2}
Gambia	0.13	2	59.1	–	38.5	–	45.6	15.9
Ghana	0.38^{-1}	11.3^{-1}	108.0^{-1}	0.1^{-1}	68.3^{-1}	0.3^{-1}	0.1^{-1}	31.2^{-1}
Kenya	0.79^{-1}	19.8^{-1}	62.1^{-1}	4.3^{-1}	26.0^{-1}	19.0^{-1}	3.5^{-1}	47.1^{-1}
Lesotho	0.01	0.3	14.3	–	–	44.7	–	3.4
Libya	0.86							
Madagascar	0.11	1.5	13.3	–	100	–	–	–
Malawi	1.06^{-1}	7.8^{-1}	–	–	–	–	–	–
Mali	0.66^{-1}	10.8^{-1}	168.1^{-1}	–	91.2^{-2}	–	–	8.8^{-1}
Mauritius	0.18^{+1}	31.1^{+1}	109.3^{+1}	0.3^{+1}	72.4^{+1}	20.7^{+1}	0.1^{+1}	6.4^{+1}
Morocco	0.73							
Mozambique	0.42^{-1}	4.0^{-1}	60.6^{-1}	–	18.8^{-1}	–	3.0^{-1}	78.1^{-1}
Namibia	0.14^{-1}	11.8^{-1}	34.4^{-1}	19.8^{-1}	78.6^{-1}	–	–	1.5^{-1}
Nigeria	0.22^{-4}	9.4^{-4}	78.1^{-4}	0.2^{-4}	96.4^{-4}	0.1^{-4}	17^{-4}	1.0^{-4}
Senegal	0.54^{-1}	11.6^{-1}	18.3^{-1}	4.1^{-1}	47.6^{-1}	0.0^{-1}	3.2^{-1}	40.5^{-1}
Seychelles	0.30^{-6}	46.7^{-6}	290.8^{-6}	–	–	–	–	–
South Africa	0.73^{+1}	93.0^{+1}	113.7^{+1}	38.3^{+1}	45.4^{+1}	0.8^{+1}	2.5^{+1}	13.1^{+1}
Tanzania	0.38^{-1}	7.7^{-1}	110.0^{-1}	0.1^{-1}	57.5^{-1}	0.3^{-1}	0.1^{-1}	42.0^{-1}
Togo	0.22^{+1}	3.0^{+1}	30.7^{+1}	–	84.9^{+1}	0.0^{+1}	3.1^{+1}	12.1^{+1}
Tunisia	0.68							
Uganda	0.48^{-1}	7.1^{-1}	85.2^{-1}	13.7^{-1}	21.9^{-1}	1.0^{-1}	6.0^{-1}	57.3^{-3}
Zambia	0.28^{-3}	8.5^{-3}	172.1^{-3}	–	–	–	–	–

Source: UNESCO 2015.

Note: –n/+n: data refer to n years before or after reference year. Data are missing for some countries. Whenever data do not add up to 100 percent for this indicator, it is because part of the data remains unattributed.

– = Not available.

Annex 4: Tertiary enrollment by level of program in Africa, 2006 and 2012 or closest year

Country	Year	Post-secondary non-degree	Bachelor's and master's	PhD or equivalent	Total tertiary	Year	Post-secondary non-degree	Bachelor's and master's	PhD or equivalent	Total tertiary
Angola	2006	0	48,694	0	**48,694**	2011	–	–	–	**142,798**
Benin	2006	–	–	–	**50,225**	2011	–	–	–	**110,181**
Botswana	2006	–	–	–	**22,357**	2011	–	–	–	**39,894**
Burkina Faso	2006	9,270	21,202	0	**30472**	2012	16,801	49,688	2,405	**68,894**
Burundi	2006	–	–	–	**17,953**	2010	–	–	–	**2,9269**
Cabo Verde	2006	–	–	–	**4,567**	2012	580	11,210	10	**11,800**
Cameroon	2006	14,044	104,085	2,169	**120,298**	2011	–	–	–	**244,233**
Central African Republic	2006	1,047	3,415	0	**4,462**	2012	3,390	9,132	0	**12,522**
Chad	2005	–	–	–	**12,373**	2011	–	–	0	**24,349**
Comoros	2007	–	–	–	**2,598**	2012	–	–	0	**6,087**
Congo, Dem. Rep.	–	–	–	–	–	2012	18,116	20,974	213	**39,303**
Congo, Rep.	2006	–	–	–	**229,443**	2012	–	–	–	**511,251**
Côte d'Ivoire	2007	60,808	–	–	**156,772**	2012	57,541	23,008	269	**80,818**
Eritrea	–	–	–	–	–	2010	4,679	7,360	0	**12,039**
Ethiopia	2005	0	191,165	47	**191,212**	2012	173,517	517,921	1,849	**693,287**
Ghana	2006	27,707	82,354	123	**110,184**	2012	89,734	204,743	867	**295,344**
Guinea	2006	–	–	–	**42,711**	2012	11,614	89,559	0	**101,173**
Guinea-Bissau	2006	–	–	–	**3,689**	–	–	–	–	–
Kenya	2005	36,326	69,635	7,571	**113,532**	–	–	–	–	–
Lesotho	2006	1,809	6,691	0	**8,500**	2012	15,697	9,805	5	**25,507**
Liberia	–	–	–	–	–	2012	10,794	33,089	0	**43,883**
Madagascar	2006	9,368	37,961	2,351	**49,680**	2012	33,782	54,428	2,025	**90,235**
Malawi	2006	0	6,298	0	**6,298**	2011	–	–	–	**12,203**
Mali	–	–	–	–	–	2012	8,504	88,514	260	**97,278**

Annex 4: Tertiary enrollment by level of program in Africa, 2006 and 2012 or closest year continued…

Country	Year	Post-secondary non-degree	Bachelor's and master's	PhD or equivalent	Total tertiary	Year	Post-secondary non-degree	Bachelor's and master's	PhD or equivalent	Total tertiary
Mauritius	2006	9,464	12,497	260	**22,221**	2012	8,052	32,035	78	**40,165**
Mozambique	2005	0	28,298	0	**28,298**	2012	0	123,771	8	**123,779**
Namibia	2006	5,151	8,012	22	**13,185**	–	–	–	–	–
Niger	2006	2,283	8,925	0	**11,208**	2012	6,222	15,278	264	**21,764**
Nigeria	2005	658,543	724,599	8,385	**1,391,527**	–	–	–	–	–
Rwanda	2006	–	–	–	**37,149**	2012	–	–	0	**71,638**
São Tomé and Príncipe	2006	0	0	0	**0**	2012	0	1,421	0	**1,421**
Senegal	2006	–	–	–	**62,539**	2010	–	–	–	**92,106**
Seychelles	2006	0	0	0	**0**	2012	–	–	–	**100**
South Africa	–	–	–	–	**–**	2012	336,514	655,187	14,020	**1,005,721**
Swaziland	2006	0	5,692	0	**5,692**	2013	0	7,823	234	**8,057**
Tanzania	2005	8,610	39,626	3,318	**51,554**	2012	–	14,2920	386	**166,014**
Togo	2006	3,379	24,697	0	**28,076**	2012	10,002	55,158	457	**65,617**
Uganda	2006	–	–	–	**92,605**	2011	–	–	–	**140,087**
Zimbabwe	–	–	–	–	**–**	2012	26,175	–	–	**94,012**

Source: UNESCO 2015.

– = Not available.

Annex 5: Science and technology universities and higher education institutions in Africa

Country	Name of university	Year of establishment	Type of ownership
Algeria	University of Science and Technology–Houari Boumediene	1974	Public
	Oran University of Science and Technology	1975	
Angola	Universidade Técnica de Angola		
Benin	University of Science and Technology of Benin	1996	Private
	Institut Supérieur des Sciences et Techniques		Private
Botswana	Botswana International University of Science and Technology	2005	Public
Burkina Faso	University of Ouaga I–Pr Joseph Ki-Zerbo	1974	Public
	Polytechnic University of Bobo-Dioulasso	1996	Public
	Institute for Science	2004	Public
	Polytechnic center of Fada N'Gourma	2009	Public
	Polytechnic center of Ouahigouya	2010	Public
	Polytechnic center of Dédougou	2012	Public
	Higher Institute for Informatics	1996	Private
	St. Thomas d'Aquin University	1995	Private
	Catholic University of West Africa	–	Private
	University Aube Nouvelle	1989	Private
	Higher school of applied sciences	–	Private
	Other small R&D schools (4)		Public
	Other small R&D schools (10)		Private
Cameroon	Bamenda University Institute of Science and Technology		Private
	Bernice University of Science and Technology		Private
	Catholic University Institute of Buéa–School of Engineering	2010	Private
	Catholic University Institute of Buea–School of Information Technology		Private
	Institute of Science Technology Cameroon–Bamenda		Private
	University College of Technology Buea		Private
	Institut Supérieur des Technologies et de l'Innovation		Private
	The ICT University		Private
	Christian University Institute–Higher Institute of Sciences, Engineering and Technology		Private
Congo, Dem. Rep.	University of Technology of the Congo	2010	Private
Congo, Rep.	Higher Institute of Technology of Central Africa	2002	
Côte d'Ivoire	Institut National Polytechnique Félix Houphouët Boigny		
	The University of Science and Technology of Ivory Coast	2009	Private
	Ecole Superieure Africaine des Techniques de la Communication		
	The Higher Institute of Technology of Ivory Coast	2007	Private
	Institut Supérieur de Technologie Dubass		

Annex 5: Science and technology universities and higher education institutions in Africa continued…

Country	Name of university	Year of establishment	Type of ownership
Egypt	University of Science and Technology at Zewail City	2011	Public
	Egypt–Japan University of Science and Technology	2010	Public
	Institute of Aviation Engineering and Technology	1997	Private
	Alexandria Higher Institute of Engineering and Technology	1996	Private
	Arab Academy for Science, Technology, and Maritime Transport	1972	Private
	Cairo Higher Institute for Engineering, Computer Science & Management	1995	Private
	Higher Institute for Engineering and Technology in Kafr Elsheikh	2011	Private
	International Academy for Engineering and Media Sciences	2002	Private
	Misr University for Science and Technology	1996	Private
	Modern University for Technology and Information	2004	Private
Eritrea	Eritrea Institute of Technology	2003	
Ethiopia	Addis Ababa Science and Technology University		
	Graduate School of Telecommunications and Information Technology		
	HiLCoE School of Computer Science and Technology college		
	Eprom Technology College		
	Kombolcha Institute of Technology		
	Mekelle Institute of Technology	2002	
	Ethiopia Institute of Technology		
	Adama Science and Technology University		
	Universal Technology College		
Gabon	Université des Sciences et Techniques de Masuku		
Ghana	Kwame Nkrumah University of Science and Technology	1952	Public
	University of Mines and Technology	2001	Public
	Accra Institute of Technology	2005	Private
	Anglican University College of Technology	2008	Private
	Osei Tutu II Institute for Advanced ICT Studies		
	Accra Polytechnic		
	Ghana Telecom University College		
	Kumasi Polytechnic		
	Koforidua Polytechnic		
	University of Energy and Natural Resources		
	Takoradi Polytechnic		
	Ho Polytechnic		
	Cape Coast Polytechnic		

Annex 5: Science and technology universities and higher education institutions in Africa continued…

Country	Name of university	Year of establishment	Type of ownership
	Tamale Polytechnic		
	Sunyani Polytechnic		
	Bolgatanga Polytechnic		
Côte d'Ivoire	The University of Science and Technology of Ivory Coast	2009	Private
	Ecole Superieure Africaine des Techniques de la Communication		
	The Higher Institute of Technology of Ivory Coast	2007	Private
	Institut Supérieur de Technologie Dubass		
Kenya	Masinde Muliro University of Science and Technology	1972	Public
	Dedan Kimathi University of Technology	1972	Public
	Jomo Kenyatta University of Agriculture and Technology	1981	Public
	Jaramogi Oginga Odinga University of Science and Technology	2009	Public
	Meru University of Science and Technology	2008	Public
	International Center of Technology (ICT-Thika)–Thika		Private
	The Kenya College of Science and Technology		Private
	Kenya Institute of Biomedical Sciences and Technology– Nakuru		Private
Libya	College of Electronic Technology–Tripoli		
	College of Electrical and Electronic Technology–Benghazi		
	College of Engineering Technology–Houn		
	College of Engineering Technology–Janzur		
	College of Engineering Technology–Zuwarah		
	College of Mechanical Engineering Technology–Benghazi		
	College of Computer Technology–Zawiya		
	College of Medical Technology–Derna		
	College of Medical Technology–Misurata		
Madagascar	Institut Supérieur de Technologie d'Antananarivo		
	Institut Superieur Polytechnique de Madagascar		
Malawi	Malawi University of Science and Technology	2012	Public
Mali	École Nationale d'Ingénieurs Abderhame Baba Touré		
Mauritania Mauritius	Université des Sciences, de Technologie et de Médecine		
	University of Mauritius (Faculty of Science)	1965	Public
	University of Technology, Mauritius	2000	Public
Morocco	The Scientific Institute	1920	
	École Nationale de l'Industrie Minerale		
	École Marocaine des Sciences de l'Ingenieur		
	High Technology School in Morocco		

Annex 5: Science and technology universities and higher education institutions in Africa continued…

Country	Name of university	Year of establishment	Type of ownership
	Institut de Formation en Technologie Alimentaire		
	Institut Supérieur du Génie Appliqué		
	École Supérieure d'Ingénierie en Sciences Appliquées		
	Institut Polytechnique Privé de Casablanca		
	École Polyvalente Supérieure d'Informatique et d'Electronique		
	École Marocaine d'Ingénierie		
	École d'Ingénierie en Génie des Systèmes Industriels Casablanca		
	École Supérieure Vinci d'Informatique et des Telecoms de Rabat/Maroc		
	École Polytechnique Privée d'Agadir		
Namibia	Namibia University of Science and Technology		
Nigeria	Our Saviour Institute of Science, Agriculture and Technology	1989	Private
	Akwa Ibom State University (formerly Akwa Ibom State University of Science and Technology)	2010	Public
	Bells University of Technology	2004	Private
	Cross River University of Technology	2002	Public
	Enugu State University of Science and Technology	1979	Public
	Kano State University of Science and Technology		
	Kebbi State University of Technology		
	Ladoke Akintola University of Technology	1990	Public
	Modibbo Adama University of Technology Yola		
	Ondo State University of Science and Technology	2010	Public
	Rivers State University of Science and Technology	1980	Public
Rwanda	Tumba College of Technology		Private
Senegal	Institut de Technologie Alimentaire		
Somalia	Juba University of Science and Technology		
	Modern University for Science and Technology		
South Africa	Tshwane University of Technology	2004	Public
	Central University of Technology	1981	Public
	Durban University of Technology	2002	Public
	Vaal University of Technology	2004	Public
	Walter Sisulu University for Technology and Science	2005	Public
	Cape Peninsula University of Technology	2005	Public
	Mangosuthu University of Technology	1979	Public
	University of Mpumalanga	2014	Public
	The Sol Plaatje University	2014	Public

Annex 5: Science and technology universities and higher education institutions in Africa continued…

Country	Name of university	Year of establishment	Type of ownership
South Sudan	John Garang University of science and technology	2006	Public
Sudan	Sudan University of Science and Technology	1932	Public
	Bayan College for Science & Technology	1997	Private
	Garden City College For Science and Technology		Private
	The Future University of Sudan	1991	Private
	University of Medical Sciences and Technology	1995	Private
	University of Science and Technology–Omdurman	1995	Private
Tanzania	Nelson Mandela African Institution of Science and Technology	2010	Public
	Mbeya University of Science and Technology	2012/13	Public
	International Medical and Technological University	1997	Private
Togo	The University of Science and Technology of Togo	2012	Private
Tunisia	Higher Institutes of Technological Studies		
Uganda	Mbarara University of Science and Technology	1989	Public
Zambia	Information and Communications University	1998	Private
	Victoria Falls University of Technology Livingstone Zambia		Private
Zimbabwe	Chinhoyi University of Technology	2001	Public
	Harare Institute of Technology	1988	Public
	Manicaland University of Science and Technology		
	National University of Science and Technology	1991	Public
	National University of Technology		Public

Source: Wikipedia 2016; CSIC 2016.

– = Not available.

Annex 6: Objectives and priorities of some African countries' STI policies

Country	STI policy objectives	STI priorities
Angola	The advancement of technological innovation in parallel with the transfer of technologies in the productive sector for the sustainable development of the economy	1. Education, culture, and professional training; 2. Higher education; 3. Agriculture and fishery; 4. Telecommunications and information technologies; 5. Industry, oil, gas, and mineral resources; 6. Health; 7. Water resources; 8. Energy; 9. Environment
Botswana	The adopting, development, generation, and transfer of suitable technologies for poverty reduction	1. Agriculture; 2. Education and human resource development; 3. Health; 4. Meteorology; 5. Mining; 6. Wildlife; 7. Population planning and human settlement; 8. Transport and communications; 9. Tourism; 10. Water

Annex 6: Objectives and priorities of some African countries' STI policies continued…

Country	STI policy objectives	STI priorities
Ethiopia	The transfer of suitable technologies for sustainable economic development and betterment of the livelihood of Ethiopian people	1. Technology transfer; 2. Human resources development; 3. Manufacturing and service-providing enterprises; 4. Research; 5. Financing and incentive schemes; 6. National quality infrastructure; 7. Universities, research institutes, TVET institutions, and industry linkages; 8. IP system; 9. Science and technology information system; 10. Environmental protection and development; 11. International cooperation
Gambia	STI knowledge transfer, adopting, and diffusion to find solutions to the social, economic, and cultural challenges facing the country	1. Technology transfer; 2. Human resources development; 3. Manufacturing and service-providing enterprises; 4. Research; 5. Financing and incentive schemes; 6. National quality infrastructure; 7. Universities, research institutes, TVET institutions, and industry linkages; 8. IP system; 9. Science and technology information system; 10. Environmental protection and development; 11. International cooperation
Ghana	Promotion of science and technology culture, which fosters the transfer of technologies for the development of the economy	1. Agriculture; 2. Health; 3. Education; 4. Environment; 5. Energy; 6. Trade; 7. Industry; 8. Natural resources; 9. Human settlements and communications; 10. Tourism; 11. Youth innovation; 12. Basic research; 13. Sports and recreation; 14. Nuclear science and technology; 15. Building and construction; 16. Information and communications technology; 17. Science acceleration; 18. Natural resources
Kenya	Identify and develop new knowledge-intensive industries	1. Agriculture; 2. Human resource development; 3. Industry and entrepreneurship; 4. Physical infrastructure; 5. Energy; 6. Environment and natural resources; 7. Education and training; 8. Information and communications technology; 9. Health and life sciences
Lesotho	The transfer of technologies for the betterment of the lives of the people of Lesotho	1. Education; 2. Biotechnology; 3. Agriculture; 4. Tourism and culture; 5. Health and social welfare; 6. Energy; 7. Environment; 8, Wildlife and tourism; 9. Meteorology; 10. Industry and trade; 11. Natural resources; 12. Mining; 13. Gender equity in science and technology; 14. Standardization and quality assurance; 15. Private sector and parastatals
Nigeria	Build a strong science, technology, and innovation capability and capacity needed to evolve a modern economy	1. Agriculture; 2. Water resources; 3. Biotechnology research; 4. Health research and innovation; 5. Energy; 6. Environmental science and technology; 7. Mines and material development; 8. Ferrous and nonferrous materials and chemical technologies; 9. Information and communications technology; 10. Space research and investment; 11. Industrial research, development, and production; 12. New and emerging technologies; 13. Transport; 14. Youth, sport, and tourism development; 15. Works, land, housing, and urban development; 16. Raw materials and manufacturing; 17. Defense and national security; 18. Works, land, housing, and urban development
Rwanda	To help overcome the challenges and problems across all sectors of the economy	1. Agriculture and animal husbandry; 2. Biotechnology; 3. Health; 4. Environment; 5. Education; 6. Transport; 7. Energy; 8. Information and communications technology; 9. Geo-information; 10. Industry; 11. Private sector; 12. Water and sanitation; 13. Tourism
South Africa	To enjoy an improved and sustainable quality of life, participate in a competitive economy by means of satisfying employment, and share in a democratic culture	1. Human capital development; 2. Knowledge generation and exploitation and R&D; 3. Knowledge infrastructure; 4. Expanding the limits of space science and technology; 5. Search for energy security; embracing renewable energy technologies; 6. Responding to global climate change
Tanzania	The establishment of a conducive legal environment for the development and transfer of technology	1. Food and agriculture; 2. Industry; 3. Energy; 4. Natural resources; 5. Environment; 6. Health, sanitation, and population planning; 7. Transport and communication; 8. Science and innovation education and manpower

Annex 6: Objectives and priorities of some African countries' STI policies continued…

Country	STI policy objectives	STI priorities
Uganda	To build a strong national conducive system for the generation, transfer, and application of technologies in line with Uganda's development objectives	1. Technology forecasting, assessment, and transfer; 2. Industrial development; 3. Intellectual property management; 4. Traditional, conventional, and emerging technologies; 5. Gender and equity; 6. Sector financing and investment; 7. Human capital development and retention; 8. STI infrastructure; 9. Research; 10. Technology incubation; 11. STI safety regulations; 12. Standards and quality assurance in STI; 13. Public awareness and appreciation of STI; 14. Information management system; 15. Sector coordination and partnerships
Zambia	To promote science and technology in key sectors to encourage competitiveness in the production of quality goods and services	1. Gender concerns in science and technology; 2. Technology diffusion, transfer, innovation, and commercialization; 3. Standardization, quality assurance, and environmental protection; 4. Development of appropriate skills; 5. Gathering and dissemination of information; 6. Cultural and public awareness; 7. Regional and international cooperation in science and technology; 8. Mechanism for funding for science and technology R&D

Source: Nwuke 2015.

Annex 7: Publications from African countries, 1996–2015

Rank	Country	Publications	Citable publications	Citations	Self-citations	Citations per publication	H index
1	South Africa	188,104	172,424	2,125,927	454,537	11.3	320
2	Nigeria	59,372	56,630	334,059	72,718	5.63	131
3	Tunisia	58,769	55,904	342,429	73,636	5.83	123
4	Algeria	42,456	41,544	215,922	43,297	5.09	106
5	Morocco	40,737	38,371	279,731	51,031	6.87	129
6	Kenya	24,458	22,347	379,560	57,594	15.52	179
7	Ethiopia	13,363	12,625	118,656	24,840	8.88	101
8	Tanzania	11,964	11,140	170,144	25,866	14.22	122
9	Ghana	11,543	10,578	111,205	13,874	9.63	105
10	Uganda	11,528	10,599	171,367	26,995	14.87	128
11	Cameroon	11,128	10,513	108,649	21,111	9.76	94
12	Zimbabwe	7,243	6,691	94,533	9,757	13.05	99
13	Senegal	7,220	6,752	75,373	9,377	10.44	95
14	Sudan	6,099	5,792	50,784	5,797	8.33	70
15	Botswana	5,107	4,545	52,195	5,234	10.22	79
16	Malawi	4,952	4,520	77,829	9,975	15.72	104
17	Côte d'Ivoire	4,842	4,621	52,446	5,510	10.83	89
18	Burkina Faso	4,814	4,606	57,772	8,671	12	82
19	Libya	4,160	4,020	18,971	1,158	4.56	51
20	Zambia	3,992	3,623	56,481	6,207	14.15	92

Annex 7: Publications from African countries, 1996–2015 continued…

Rank	Country	Publications	Citable publications	Citations	Self-citations	Citations per publication	H index
21	Benin	3,851	3,681	35,470	6,223	9.21	65
22	Congo, Rep.	3,304	3,069	34,559	3,348	10.46	72
23	Madagascar	3,207	3,059	39,217	5,950	12.23	74
24	Mali	2,490	2,353	36,254	3,647	14.56	75
25	Mozambique	2,382	2,193	37,433	3,285	15.71	73
26	Namibia	2,303	2,125	28,985	2,673	12.59	72
27	Mauritius	2,206	2,035	17,629	1,534	7.99	54
28	Gabon	2,048	1,936	34,704	3,737	16.95	80
29	Gambia	2,004	1,859	54,925	4,683	27.41	99
30	Rwanda	1,759	1,554	15,356	1,456	8.73	54
31	Niger	1,623	1,553	19,835	1,782	12.22	59
32	Togo	1,470	1,367	8,850	841	6.02	39
33	Swaziland	1,091	988	9,618	450	8.82	43
34	Angola	715	680	5,422	411	7.58	35
35	Guinea	597	552	8,320	346	13.94	46
36	Sierra Leone	590	529	5,551	462	9.41	31
37	Reunion	581	544	6,605	143	11.37	38
38	Central African Republic	538	500	6,940	367	12.9	41
39	Congo, Dem. Rep.	517	481	7,641	200	14.78	43
40	Eritrea	488	468	5,260	421	10.78	35
41	Seychelles	482	453	8,579	657	17.8	44
42	Mauritania	482	456	4,762	300	9.88	32
43	Lesotho	459	425	3,524	180	7.68	28
44	Guinea-Bissau	458	421	9,357	1,791	20.43	50
45	Burundi	421	392	3,761	191	8.93	32
46	Chad	382	363	5,122	382	13.41	33
47	Liberia	263	216	1,934	136	7.35	21
48	Cabo Verde	199	194	1,501	128	7.54	17
49	Djibouti	190	178	1,206	94	6.35	18
50	Equatorial Guinea	153	147	1,587	168	10.37	20
51	Somalia	115	97	685	33	5.96	15
52	Comoros	96	89	839	52	8.74	13
53	São Tomé and Príncipe	47	45	695	60	14.79	15
54	Western Sahara	11	9	22	0	2	3
	Total	559,373	522,856	5,356,181	973,316		

Source: SJR 2016.

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TECHNICAL NOTE

ACR Team organization

The ACR team comprises a dedicated ACBF group supported by various stakeholders and partners at different levels (figure TN1).

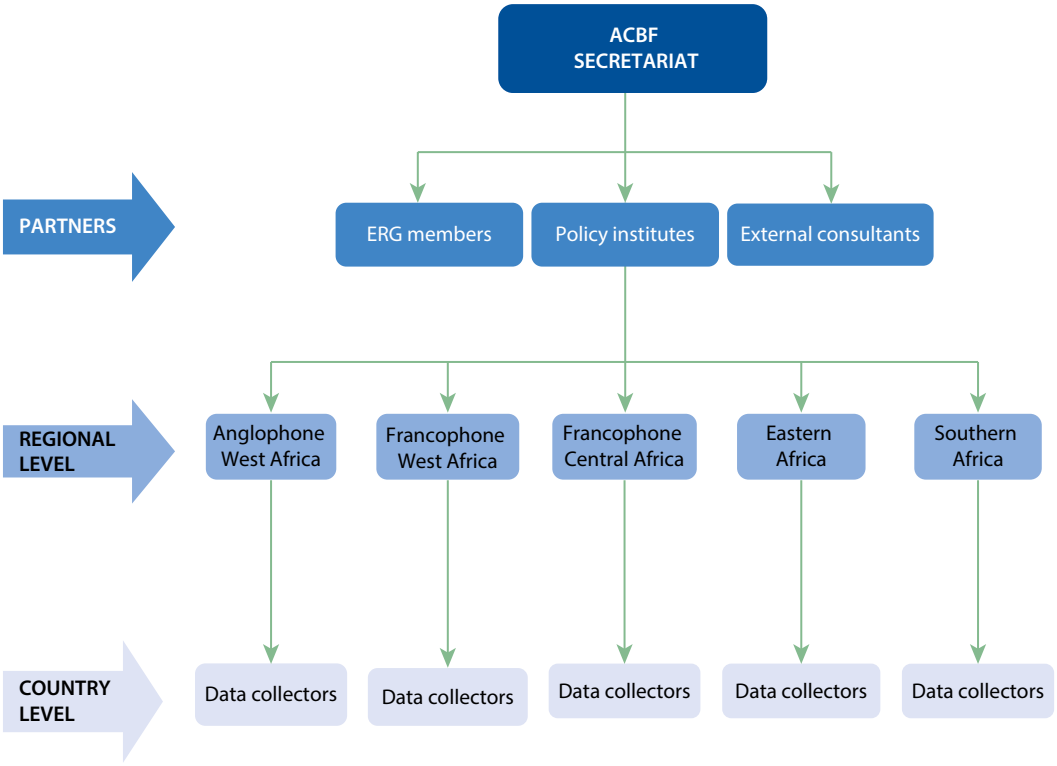
ACBF ACR Team

A dedicated group of individuals (the ACR Team) within the ACBF Secretariat is constituted to spearhead the process from conceptualization through to the publication of the ACR Flagship Report. Team members come from the various units and departments within the Secretariat.

External Reference Group

The (ERG) was created to provide motivation and intellectual guidance, as well as to challenge the ACBF ACR team to develop its thinking behind the assessment and

Figure TN.1: ACR Team organogram



ensure that the team achieves its objective of delivering a quality publication. To this end, the ERG acts as the ACR team's strategic partner to ensure that:

- The approach and methodologies employed in preparing the Flagship are theoretically sound, conceptually appropriate, rigorous, and balanced, drawing on divergent views as appropriate.
- The data-capturing instruments are adequately reviewed and appropriate.
- Comments on the ACR survey template, selected indicators, case studies, and stories are provided in a timely manner.
- The presentation of findings balances views from across the broad spectrum of opinion and reflects current and innovative practice.
- The review and report balance public, legal, and operational perspectives appropriately.
- There is feedback on implementation support and costing tools for specific topics examined, and on the appropriateness of, for example, the costing assumptions and the approach adopted within the tools as well as peer review of the background papers.
- Where needed, ACBF is supported in the identification of appropriate networks and/or experts with whom to engage to assist in the development of the tools.
- All conclusions drawn and policy recommendations provided are sound and evidence-based.

Policy Institutes

For the production of *ACR 2017*, the ACBF has commissioned the drafting of case studies on science, technology, and innovation (STI) that will serve as background materials for the production of the Report. Eight ACBF-supported think tanks conducted the case studies in their respective countries of location. The case studies are primarily aimed at documenting the experience of the country with respect to STI and drawing lessons for the rest of the countries. The specific objectives include the following:

- Conduct a mapping of the STI strategies, approaches, and special initiatives undertaken by the country.
- Discuss the efficiency of the country's STI system based on best practices paying a special attention to the capacity imperatives.
- Discuss how the strategies have affected the country's performances.
- Identify and note specific capacity arrangements (including institutional systems and human processes) and/or challenges with respect to STI.
- Showcase the challenges, opportunities, and possibilities with respect to STI.
- Interrogate the capacity development issues, challenges, opportunities, and possibilities for STI in the country.
- Identify the lessons learned including the best practices.
- Suggest the way forward (clear and evidence-based recommendations) in terms

of key capacity needs and the roles of state and nonstate actors involved in STI efforts.

Focal regional points

On the basis of their geographic and linguistic affinity, the targeted countries were grouped into five broad regions: Anglophone West Africa; Francophone West Africa; Central Africa; East Africa and the Horn; Southern Africa and the Indian Ocean. A Policy Unit was tasked with coordinating and supervising the country data collection process within each of the above-mentioned regions.

Data experts

At the country level, a national familiar with the country context, was identified and selected through an open and competitive process, invited to a training session on the annual theme (STI) as well as the ACI survey instrument. That person then conducted the administration of the questionnaire in his/her country.

Data collection

Coverage

In line with the target of covering all African countries, the number of countries covered during this sixth edition stood at 44 (table TN1).

Data collection instrument

The data collection instrument was initially designed along the three dimensions of capacity: (i) Enabling environment; (ii) Organizational level; and (iii) Individual level. These dimensions constitute the three

Table TN.1: Countries covered by the study

Group 1 West and North Anglophone countries	Group 2 West and North Francophone countries	Group 3 Central Africa and other Francophone countries	Group 4 Eastern Africa	Group 5 Southern Africa
Cabo Verde	Algeria	Burundi	Ethiopia	Botswana
Egypt	Benin	Cameroon	Kenya	Lesotho
Gambia (The)	Burkina Faso	Central African Republic	Malawi	Mauritius
Ghana	Côte d'Ivoire	Chad	Rwanda	Mozambique
Liberia	Guinea	Comoros	Tanzania	Namibia
Nigeria	Guinea-Bissau	Congo (Rep. of)	Uganda	South Africa
Sierra Leone	Mali	Djibouti		Swaziland
	Mauritania	Gabon		Zambia
	Morocco	Madagascar		Zimbabwe
	Niger	Tunisia		
	Senegal			
	Togo			

primary components of the data collection instrument. However, specific sections are dedicated to explicit issues, with regard to the annual theme: section I on Agricultural Transformation and Food Security, section J on Natural Resources Management, section K on regional integration; section L on domestic resource mobilization; section M on science, technology, and innovation the thematic focus of this year's Report. The structure of the questionnaire is presented in figure TN2. A single questionnaire was administered in each of the countries covered by the study.

Training workshop

As alluded to above, a training workshop was organized on 16-19 November 2015 for all the selected in-country data experts who were to administer the main questionnaire. During the workshop, the data experts were familiarized to the annual theme (STI), the data collection instrument was reviewed, revised, and the final version adopted. Also during the workshop, the potential sources of information per country were discussed and agreed upon. However, it was acknowledged and agreed that the list could be adjusted during the field data collection to suit country-specific needs (e.g. Ministry of Finance in country A, could be Ministry of Economic and Finance in country B, etc.).

Period of field data collection

The field data collection was conducted further to the training workshop. Reporting was done on a weekly basis. At the end of the field data collection, the data experts submitted their completed questionnaires along with their final field report, including the sources of the information they collected.

Computing the indices

Scoring the answers to questions

Each question is assigned an associated variable indicator whose nature depends on the type of question asked. The scoring of the variable indicators is in relation with their respective natures. The scores are standardized on a scale ranging from 0-100.

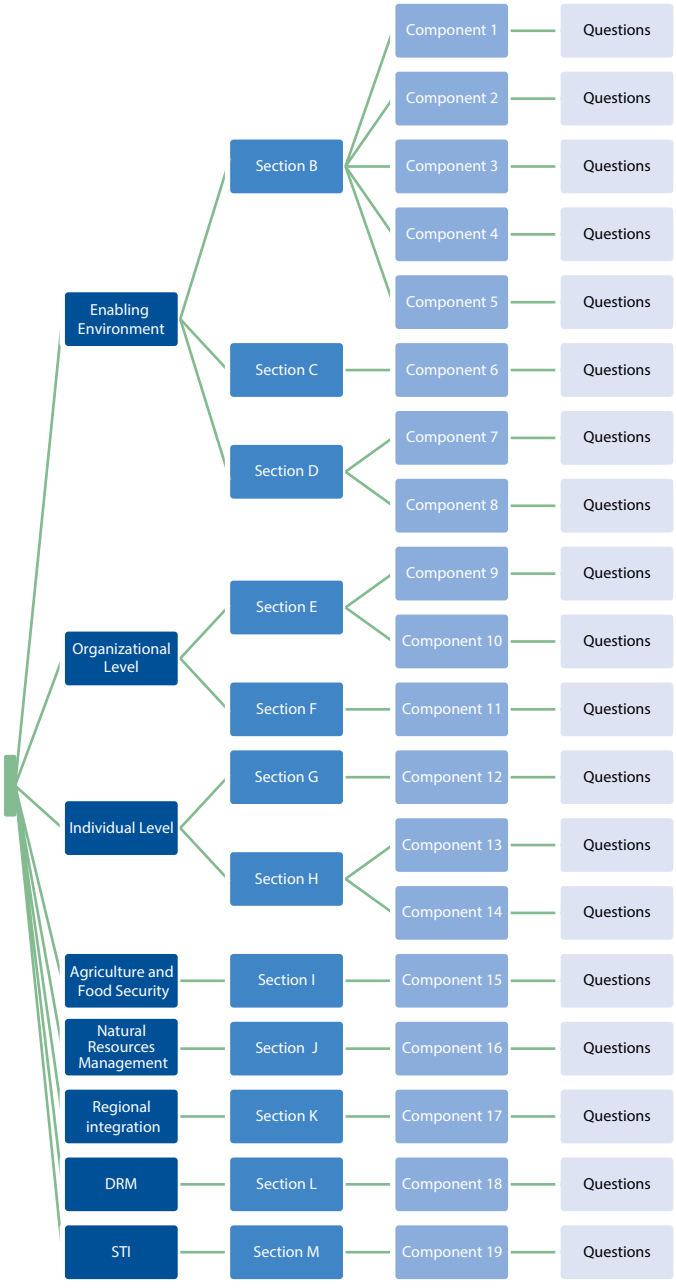
Qualitative variables

A value is attributed to each expected answer. Questions with a YES or NO answer are scored 0 or 100. Questions with three possible answers are scored 0; 50; and 100. Questions with 4 answers are scored 0; 33.3; 66.7 and 100. Questions with 5 answers are scored 0; 25; 50; 75 and 100.

Some examples:

Question No.	Question	Expected answers	Score
B1	Does the country have a National Development Strategy (Poverty Reduction Strategy Paper, National Development Plan, Vision Strategy, and so on?)	YES	100
		NO	0
B4	Is Capacity Development (CD) integrated in the country's Poverty Reduction Strategy/National Development Plan?	*CD is not mainstreamed in the current PRSP/National Development Plan*	0
		CD is mainstreamed, but with no clear objectives and targets	50
		Clear objectives and targets set in the PRSP/National Development Plan	100
B13b	How effective is the dialog mechanism with development partners?	*Very High*	100
		High	75
		Average	50
		Low	25
		Very Low	0

Figure TN.2: Structure of the data collection instrument



Numerical variables

The answer is a proportion

The score is the answer (assuming that moving from 0 to 100% is improving; otherwise, one may just read backwards).

Numerical variable in the form of ordinal scales

The values on the predetermined scale are on a scale ranging from 0 – 100.

Example:

C4: On the scale 1 (very weak) to 6 (very strong), assess how support to capacity is being coordinated in the country Very weak = 1 2 3 4 5 6 = Very strong						
Answer	1	2	3	4	5	6
Score	0	20	40	60	80	100

The ACI Composite Index

During the first edition of the ACR Report, the exploratory approach was used to define the components of the ACI composite index. To this end, the hierarchical cluster analysis was carried out, using the Ward's method applying squared Euclidian distance as the distance or similarity measure. From the findings of the analysis, four groups of factors appeared to be the most relevant.

Cluster 1: Policy environment

Cluster 2: Processes for implementation

Cluster 3: Development results

Cluster 4: Capacity development outcomes.

Four cluster indices are then calculated, each one the arithmetic mean of its cluster variable indicators.

Cluster Index j ($j = 1, 2, 3, 4$) is the arithmetic mean of variable indicators within cluster j.

$$CLj = \frac{1}{n_j}\sum_{i=1}^{i=n_i} VI_{ji}$$

V_{ji} = *Score assigned to variable i within Cluster j*

n_j = *Number of variable indicators within Cluster j*

The ACI Composite Index is the harmonic mean of the four cluster indices. The rationale for choosing the harmonic mean formula is that capacity development is an indivisible whole of its dimensions. As such, none of the capacity development factors as given by the four clusters should be neglected. Weakness in one of the four components should be easily captured by the harmonic mean formula, which is sensitive to small values.

$$ACI = \frac{1}{\frac{1}{4}\sum_{j=1}^{j=4}\frac{1}{CLj}}$$

C.2.2 Sub-indices

In addition to the clusters indices, a number of sub-indicators are also calculated. They are built around the component and the sections of the questionnaire (see structure of the questionnaire, Chart 2)

Component indicators

Ten component indices are calculated as follows:

Component Index j ($j = 1, 2\ldots 9$) is the arithmetic mean of the variable indicators within that component.

$$CIj = \frac{1}{n_j}\sum_{i=1}^{i=n_j} VI_{ji}$$

VI_{ij} = *Score assigned to question i within Component j*

n_j = *Number of Variable Indicators associated with Component j*

The component indices include:

No.	Name of the component
1	Strategic choices for capacity development
2	Policy environment/Efficiency of instrument
3	Dialog mechanisms for capacity development
4	Strategic policy choices for improving the capacity of statistical system
5	Development cooperation effectiveness
6	Gender equality
7	Social inclusion
8	Partnering for capacity development
9	Capacity profiling and capacity needs assessment

Section indicators

Five thematic indices are calculated with the same formula as for the component indices.

Section index k (k = 1, 2, …, 5) is the arithmetic mean of component indexes within that section.

$$SI_k = \frac{1}{m_k}\sum_{i=1}^{i=m_k} CL_{ki}$$

m_k = *Number of Component indices associated with Section k.*

$m_1 = 5, m_3 = 2.$

The section indices include:

1. Policy choices for capacity development
2. Development cooperation effectiveness
3. Gender equality mainstreaming and social inclusion
4. Partnering for capacity development
5. Capacity profiling and capacity needs assessment

Ranking the countries

According to the index values, the countries are ranked into five categories:

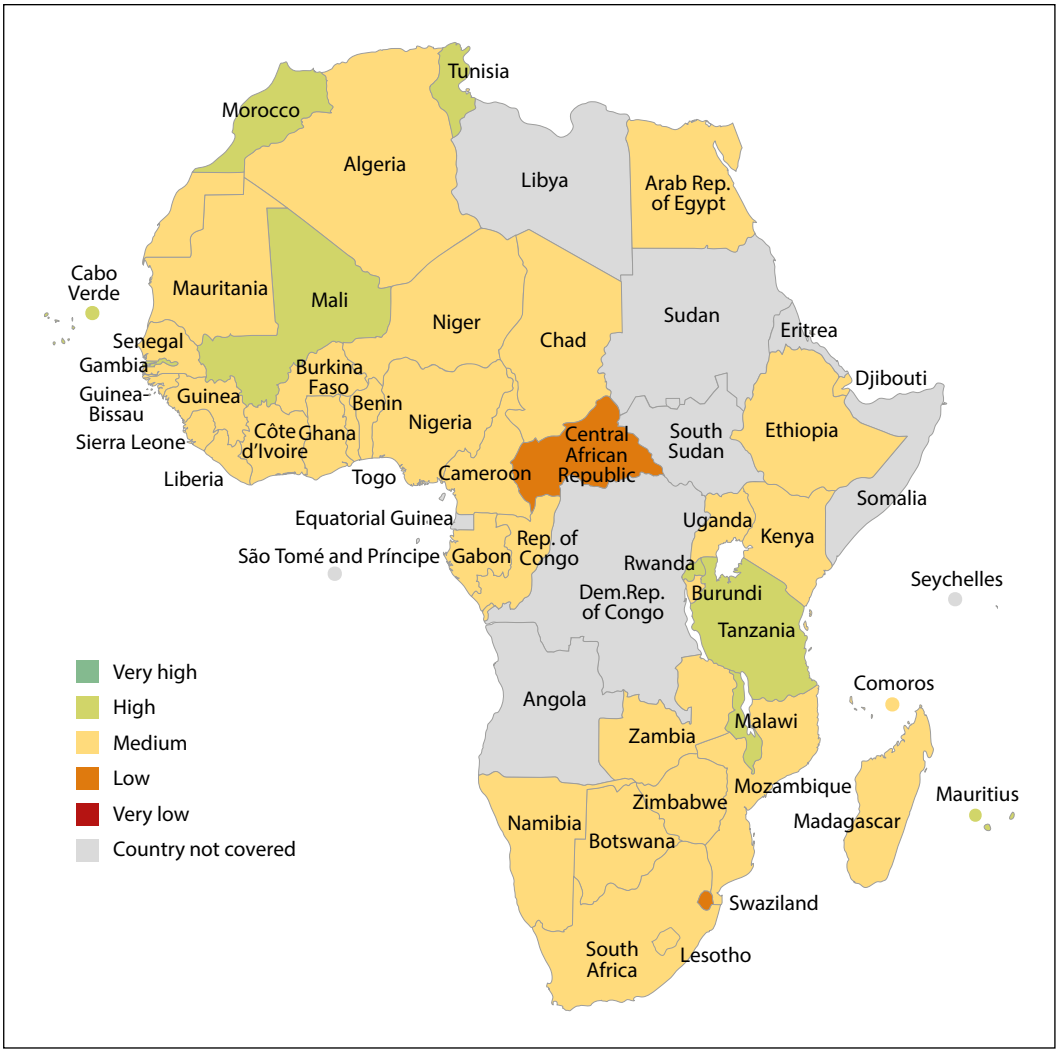
	Index value	Category	Color
1	0 to less than 20	Very low	
2	20 to less than 40	Low	
3	40 to less than 60	Medium	
4	60 to less than 80	High	
5	80 and above	Very high	

AFRICA CAPACITY INDICATORS

Table A.1: ACI composite index by countries (in alphabetical order)

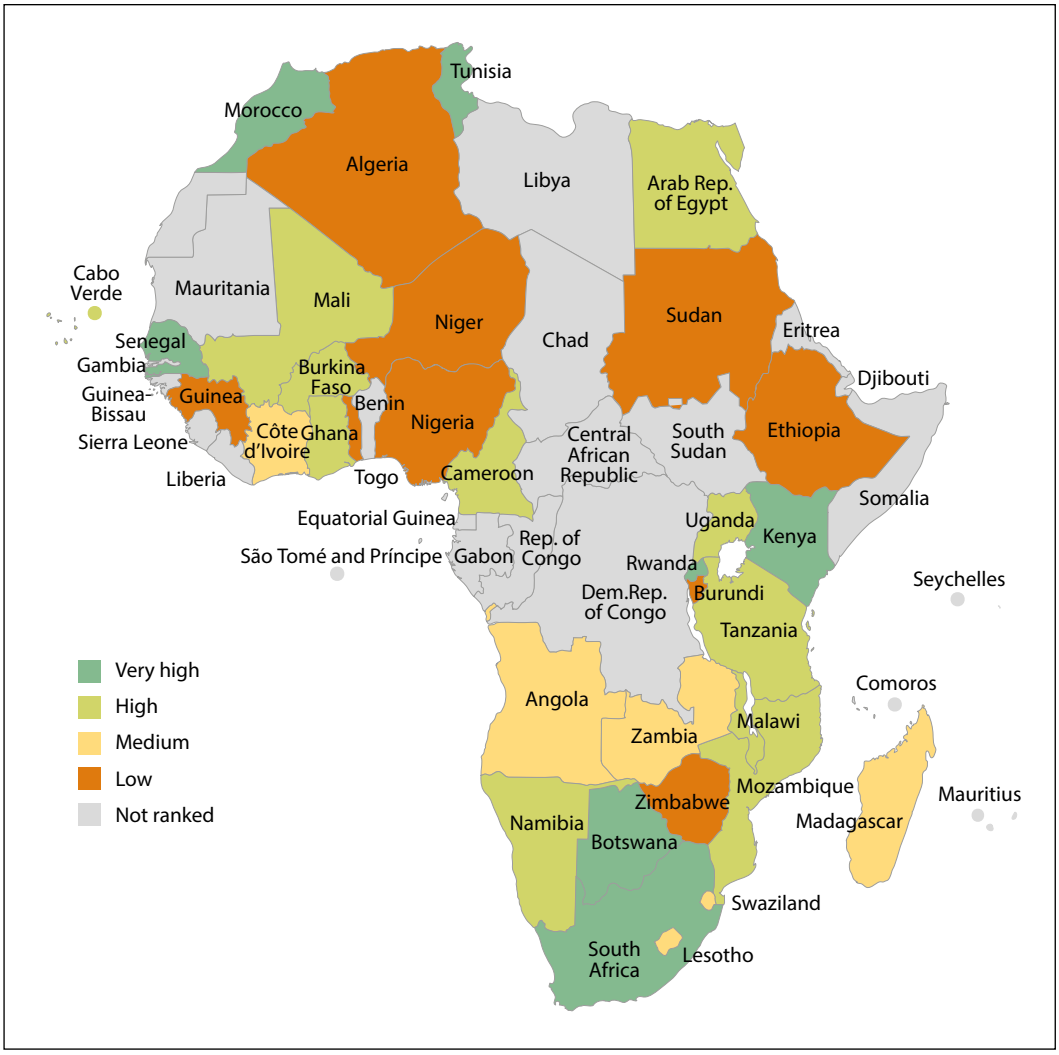
No.	Country	ACI 2016	Level of capacity development	Rank
1	ALGERIA	53.2	Medium	22
2	BENIN	52.6	Medium	23
3	BOTSWANA	44.1	Medium	37
4	BURKINA FASO	58.8	Medium	10
5	BURUNDI	53.4	Medium	20
6	CABO VERDE	62.6	High	5
7	CAMEROON	47.3	Medium	33
8	CAR	33.1	Low	44
9	CHAD	46.4	Medium	34
10	COMOROS	45.9	Medium	36
11	CONGO, REP.	43.1	Medium	40
12	CÔTE D'IVOIRE	43.6	Medium	38
13	DJIBOUTI	51.5	Medium	26
14	EGYPT	55.8	Medium	16
15	ETHIOPIA	56.5	Medium	13
16	GABON	52.3	Medium	24
17	GAMBIA	61.7	High	7
18	GHANA	54.1	Medium	18
19	GUINEA	50.1	Medium	31
20	GUINEA-BISSAU	41.8	Medium	41
21	KENYA	55.2	Medium	17
22	LESOTHO	56.1	Medium	15
23	LIBERIA	57.1	Medium	12
24	MADAGASCAR	50.7	Medium	29
25	MALAWI	60.7	High	9
26	MALI	61.0	High	8
27	MAURITANIA	40.8	Medium	42
28	MAURITIUS	67.3	High	4
29	MOROCCO	71.6	High	1
30	MOZAMBIQUE	50.8	Medium	28
31	NAMIBIA	56.2	Medium	14
32	NIGER	57.4	Medium	11
33	NIGERIA	43.4	Medium	39
34	RWANDA	68.2	High	3
35	SENEGAL	49.0	Medium	32
36	SIERRA LEONE	53.3	Medium	21
37	SOUTH AFRICA	51.1	Medium	27
38	SWAZILAND	35.3	Low	43
39	TANZANIA	68.8	High	2
40	TOGO	50.4	Medium	30
41	TUNISIA	62.6	High	6
42	UGANDA	54.0	Medium	19
43	ZAMBIA	52.3	Medium	25
44	ZIMBABWE	46.3	Medium	35

Map A.1: Geographical distribution of overall capacity (ACI)



Source: ACBF 2016a.

Map A.2: Global Innovation Index ranking, 2015



Source: Cornell University, INSEAD, and WIPO 2015.

Table A.2: Cluster indices

No.	Country	ACI 2016	Cluster 1 Policy environment	Cluster 2 Processes for implementation	Cluster 3 Development results at country level	Cluster 4 Capacity development outcomes
1	ALGERIA	53.2	58.3	52.8	60.0	44.5
2	BENIN	52.6	100.0	86.1	54.0	27.9
3	BOTSWANA	44.1	66.7	73.1	44.0	25.5
4	BURKINA FASO	58.8	95.8	92.6	76.0	29.8
5	BURUNDI	53.4	100.0	72.2	72.0	26.9
6	CABO VERDE	62.6	87.5	87.0	70.0	37.5
7	CAMEROON	47.3	75.0	83.3	64.0	22.9
8	CAR	33.1	91.7	55.6	30.0	17.1
9	CHAD	46.4	91.7	61.1	39.0	30.0
10	COMOROS	45.9	79.2	77.8	33.0	31.9
11	CONGO, REP.	43.1	83.3	72.2	30.0	29.8
12	CÔTE D'IVOIRE	43.6	100.0	72.2	72.0	18.5
13	DJIBOUTI	51.5	95.8	80.6	69.0	24.8
14	EGYPT	55.8	91.7	67.6	66.0	32.5
15	ETHIOPIA	56.5	91.7	78.7	56.0	34.2
16	GABON	52.3	75.0	77.8	38.0	41.8
17	GAMBIA	61.7	100.0	78.7	68.0	36.4
18	GHANA	54.1	100.0	88.9	64.0	27.0
19	GUINEA	50.1	100.0	86.1	76.0	22.2
20	GUINEA-BISSAU	41.8	87.5	51.9	67.0	20.0
21	KENYA	55.2	91.7	66.7	47.0	39.5
22	LESOTHO	56.1	95.8	88.9	83.0	26.6
23	LIBERIA	57.1	83.3	81.5	58.0	35.0
24	MADAGASCAR	50.7	83.3	55.6	48.0	35.7
25	MALAWI	60.7	100.0	93.5	62.0	34.5
26	MALI	61.0	87.5	72.2	66.0	39.8
27	MAURITANIA	40.8	95.8	57.4	34.0	24.5
28	MAURITIUS	67.3	87.5	100.0	75.0	40.5
29	MOROCCO	71.6	95.8	88.9	86.0	44.3
30	MOZAMBIQUE	50.8	95.8	80.6	78.0	23.2
31	NAMIBIA	56.2	100.0	89.8	59.0	30.2
32	NIGER	57.4	87.5	83.3	74.0	30.6
33	NIGERIA	43.4	91.7	78.7	48.0	21.0
34	RWANDA	68.2	100.0	88.9	78.0	40.7
35	SENEGAL	49.0	79.2	72.2	46.0	30.0
36	SIERRA LEONE	53.3	100.0	88.0	66.0	26.0
37	SOUTH AFRICA	51.1	70.8	51.9	66.0	33.6
38	SWAZILAND	35.3	95.8	59.3	24.0	22.5
39	TANZANIA	68.8	87.5	82.4	84.0	44.1
40	TOGO	50.4	100.0	55.6	76.0	26.2
41	TUNISIA	62.6	87.5	73.1	68.0	41.5
42	UGANDA	54.0	87.5	77.8	44.0	37.0
43	ZAMBIA	52.3	95.8	54.6	60.0	32.1
44	ZIMBABWE	46.3	100.0	78.7	34.0	29.2

Table A.3: Thematic indices

No.	Country	Policy choices for capacity development	Development cooperation effectiveness related to capacity development activities	Gender equality mainstreaming & social inclusion	Partnering for capacity development	Capacity profiling & capacity needs assessment
1	ALGERIA	59.1	18.8	60.0	50.0	0.0
2	BENIN	63.8	67.5	80.8	75.0	100
3	BOTSWANA	47.6	61.3	60.8	100.0	100
4	BURKINA FASO	72.4	88.8	83.3	75.0	100
5	BURUNDI	58.4	83.8	84.2	50.0	100
6	CABO VERDE	59.6	75.0	91.7	75.0	100
7	CAMEROON	63.8	48.8	92.5	75.0	100
8	CAR	35.4	56.3	82.5	75.0	100
9	CHAD	60.5	67.5	60.8	25.0	0.0
10	COMOROS	64.9	66.3	62.5	75.0	50.0
11	CONGO, REP	66.7	12.5	75.8	25.0	50.0
12	CÔTE D'IVOIRE	58.8	71.3	91.7	75.0	50.0
13	DJIBOUTI	55.5	86.3	90.0	75.0	100
14	EGYPT	50.5	88.8	81.7	50.0	50.0
15	ETHIOPIA	60.8	63.8	78.3	50.0	100
16	GABON	55.9	41.3	73.3	75.0	50.0
17	GAMBIA	58.5	85.0	84.2	100	100
18	GHANA	70.4	73.8	78.3	100	100
19	GUINEA	66.2	88.8	83.3	75.0	100
20	GUINEA-BISSAU	32.9	52.5	92.5	50.0	100
21	KENYA	60.1	40.0	75.8	50.0	50.0
22	LESOTHO	68.5	91.3	86.7	100	100
23	LIBERIA	62.6	85.0	54.2	100	100
24	MADAGASCAR	26.7	72.5	87.5	75.0	50.0
25	MALAWI	72.6	90.0	81.7	100	100
26	MALI	68.6	76.3	68.3	50.0	50.0
27	MAURITANIA	41.2	61.3	75.8	25.0	100
28	MAURITIUS	78.1	81.3	80.8	100	100
29	MOROCCO	68.4	82.5	97.5	75.0	100
30	MOZAMBIQUE	64.1	85.0	91.7	0.0	100
31	NAMIBIA	68.1	73.8	91.7	50.0	100
32	NIGER	66.7	67.5	84.2	100	100
33	NIGERIA	62.8	85.0	70.8	50.0	50.0
34	RWANDA	71.4	97.5	84.2	100	100
35	SENEGAL	51.7	57.5	65.8	100	50.0
36	SIERRA LEONE	67.5	95.0	78.3	75.0	100
37	SOUTH AFRICA	49.1	26.3	75.8	25.0	0.0
38	SWAZILAND	47.0	80.0	57.5	50.0	0.0
39	TANZANIA	68.3	86.3	87.5	50.0	100
40	TOGO	46.2	82.5	85.0	100.0	0.0
41	TUNISIA	54.4	85.0	74.2	100	100
42	UGANDA	59.4	48.8	80.8	75.0	50.0
43	ZAMBIA	38.3	62.5	84.2	50.0	100
44	ZIMBABWE	60.9	61.3	86.7	50.0	0.0

COUNTRY PROFILES

ALGERIA

ACI Composite Index	
ACI Composite Index value	53.2
Level of capacity development	Medium
Rank	22

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	59.1
Development cooperation effectiveness	18.8
Gender equality mainstreaming and social inclusion	60.0
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	0.0
Domestic resource mobilization (tax effort index 1996–2013)	0.75
Global Innovation Index ranking, 2015	24.38

BENIN

ACI Composite Index	
ACI Composite Index value	52.6
Level of capacity development	Medium
Rank	23

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	63.8
Development cooperation effectiveness	67.5
Gender equality mainstreaming and social inclusion	80.8
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.14
Global Innovation Index ranking, 2015	Not available

BOTSWANA

ACI Composite Index	
ACI Composite Index value	44.1
Level of capacity development	Medium
Rank	37

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	47.6
Development cooperation effectiveness	61.3
Gender equality mainstreaming and social inclusion	60.8
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.95
Global Innovation Index ranking, 2015	30.49

BURKINA FASO

ACI Composite Index	
ACI Composite Index value	58.8
Level of capacity development	Medium
Rank	10

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	72.4
Development cooperation effectiveness	88.8
Gender equality mainstreaming and social inclusion	83.3
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.96
Global Innovation Index ranking, 2015	28.68

BURUNDI

ACI Composite Index	
ACI Composite Index value	53.4
Level of capacity development	Medium
Rank	20

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	58.4
Development cooperation effectiveness	83.8
Gender equality mainstreaming and social inclusion	84.2
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.14
Global Innovation Index ranking, 2015	21.04

CABO VERDE

ACI Composite Index	
ACI Composite Index value	62.6
Level of capacity development	High
Rank	5

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	59.6
Development cooperation effectiveness	75.0
Gender equality mainstreaming and social inclusion	91.7
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.21
Global Innovation Index ranking, 2015	28.59

CAMEROON

ACI Composite Index	
ACI Composite Index value	47.3
Level of capacity development	Medium
Rank	33

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	63.8
Development cooperation effectiveness	48.8
Gender equality mainstreaming and social inclusion	92.5
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.85
Global Innovation Index ranking, 2015	27.80

CENTRAL AFRICAN REPUBLIC

ACI Composite Index	
ACI Composite Index value	33.1
Level of capacity development	Low
Rank	44

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	35.4
Development cooperation effectiveness	56.3
Gender equality mainstreaming and social inclusion	82.5
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.69
Global Innovation Index ranking, 2015	Not available

CHAD

ACI Composite Index	
ACI Composite Index value	46.4
Level of capacity development	Medium
Rank	34

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	60.5
Development cooperation effectiveness	67.5
Gender equality mainstreaming and social inclusion	60.8
Partnering for capacity development	25.0
Capacity profiling and capacity needs assessment	0.0
Domestic resource mobilization (tax effort index 1996–2013)	0.39
Global Innovation Index ranking, 2015	Not available

COMOROS

ACI Composite Index	
ACI Composite Index value	45.9
Level of capacity development	Medium
Rank	40

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	64.9
Development cooperation effectiveness	66.3
Gender equality mainstreaming and social inclusion	62.5
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	50.0
Domestic resource mobilization (tax effort index 1996–2013)	0.91
Global Innovation Index ranking, 2015	Not available

REPUBLIC OF CONGO

ACI Composite Index	
ACI Composite Index value	43.1
Level of capacity development	Medium
Rank	40

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	66.7
Development cooperation effectiveness	12.5
Gender equality mainstreaming and social inclusion	75.8
Partnering for capacity development	25.0
Capacity profiling and capacity needs assessment	50.0
Domestic resource mobilization (tax effort index 1996–2013)	0.55
Global Innovation Index ranking, 2015	Not available

CÔTE D'IVOIRE

ACI Composite Index	
ACI Composite Index value	43.6
Level of capacity development	Medium
Rank	38

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	58.8
Development cooperation effectiveness	71.3
Gender equality mainstreaming and social inclusion	91.7
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	50.0
Domestic resource mobilization (tax effort index 1996–2013)	1.00
Global Innovation Index ranking, 2015	27.16

DJIBOUTI

ACI Composite Index	
ACI Composite Index value	51.5
Level of capacity development	Medium
Rank	26

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	55.5
Development cooperation effectiveness	86.3
Gender equality mainstreaming and social inclusion	81.7
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.52
Global Innovation Index ranking, 2015	Not available

EGYPT

ACI Composite Index	
ACI Composite Index value	55.8
Level of capacity development	Medium
Rank	16

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	50.5
Development cooperation effectiveness	88.8
Gender equality mainstreaming and social inclusion	81.7
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	50.0
Domestic resource mobilization (tax effort index 1996–2013)	1.08
Global Innovation Index ranking, 2015	28.91

ETHIOPIA

ACI Composite Index	
ACI Composite Index value	56.5
Level of capacity development	Medium
Rank	13

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	60.8
Development cooperation effectiveness	63.8
Gender equality mainstreaming and social inclusion	78.3
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.82
Global Innovation Index ranking, 2015	24.17

GABON

ACI Composite Index	
ACI Composite Index value	52.3
Level of capacity development	Medium
Rank	24

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	55.9
Development cooperation effectiveness	41.3
Gender equality mainstreaming and social inclusion	73.3
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	50.0
Domestic resource mobilization (tax effort index 1996–2013)	0.75
Global Innovation Index ranking, 2015	Not available

GAMBIA

ACI Composite Index	
ACI Composite Index value	61.7
Level of capacity development	High
Rank	7

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	58.5
Development cooperation effectiveness	85.0
Gender equality mainstreaming and social inclusion	84.2
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.95
Global Innovation Index ranking, 2015	27.49

GHANA

ACI Composite Index	
ACI Composite Index value	54.1
Level of capacity development	Medium
Rank	18

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	70.4
Development cooperation effectiveness	73.8
Gender equality mainstreaming and social inclusion	78.3
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.99
Global Innovation Index ranking, 2015	28.04

GUINEA

ACI Composite Index	
ACI Composite Index value	50.1
Level of capacity development	Medium
Rank	31

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	66.2
Development cooperation effectiveness	88.8
Gender equality mainstreaming and social inclusion	83.3
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.13
Global Innovation Index ranking, 2015	18.49

GUINEA-BISSAU

ACI Composite Index	
ACI Composite Index value	41.8
Level of capacity development	Medium
Rank	41

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	32.9
Development cooperation effectiveness	52.5
Gender equality mainstreaming and social inclusion	92.5
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	Not available
Global Innovation Index ranking, 2015	Not available

KENYA

ACI Composite Index	
ACI Composite Index value	55.2
Level of capacity development	Medium
Rank	17

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	60.1
Development cooperation effectiveness	40.0
Gender equality mainstreaming and social inclusion	75.8
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	50.0
Domestic resource mobilization (tax effort index 1996–2013)	1.21
Global Innovation Index ranking, 2015	30.19

LESOTHO

ACI Composite Index	
ACI Composite Index value	56.1
Level of capacity development	Medium
Rank	15

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	68.5
Development cooperation effectiveness	91.3
Gender equality mainstreaming and social inclusion	86.7
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	Not available
Global Innovation Index ranking, 2015	26.97

LIBERIA

ACI Composite Index	
ACI Composite Index value	57.1
Level of capacity development	Medium
Rank	12

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	62.6
Development cooperation effectiveness	85.0
Gender equality mainstreaming and social inclusion	54.2
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.02
Global Innovation Index ranking, 2015	Not available

MADAGASCAR

ACI Composite Index	
ACI Composite Index value	50.7
Level of capacity development	Medium
Rank	29

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	26.7
Development cooperation effectiveness	72.5
Gender equality mainstreaming and social inclusion	87.5
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	50.0
Domestic resource mobilization (tax effort index 1996–2013)	0.73
Global Innovation Index ranking, 2015	24.42

MALAWI

ACI Composite Index	
ACI Composite Index value	60.7
Level of capacity development	High
Rank	9

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	72.6
Development cooperation effectiveness	90.0
Gender equality mainstreaming and social inclusion	81.7
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.21
Global Innovation Index ranking, 2015	29.71

MALI

ACI Composite Index	
ACI Composite Index value	61.0
Level of capacity development	High
Rank	8

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	68.6
Development cooperation effectiveness	76.3
Gender equality mainstreaming and social inclusion	68.3
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.92
Global Innovation Index ranking, 2015	28.37

MAURITANIA

ACI Composite Index	
ACI Composite Index value	40.8
Level of capacity development	Medium
Rank	42

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	41.2
Development cooperation effectiveness	61.3
Gender equality mainstreaming and social inclusion	68.3
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013	1.10
Global Innovation Index ranking, 2015	Not available

MAURITIUS

ACI Composite Index	
ACI Composite Index value	67.3
Level of capacity development	High
Rank	4

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	78.1
Development cooperation effectiveness	81.3
Gender equality mainstreaming and social inclusion	80.8
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.96
Global Innovation Index ranking, 2015	39.23

MOROCCO

ACI Composite Index	
ACI Composite Index value	71.6
Level of capacity development	High
Rank	1

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	68.4
Development cooperation effectiveness	82.5
Gender equality mainstreaming and social inclusion	97.5
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.45
Global Innovation Index ranking, 2015	33.19

MOZAMBIQUE

ACI Composite Index	
ACI Composite Index value	50.8
Level of capacity development	Medium
Rank	28

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	64.1
Development cooperation effectiveness	85.0
Gender equality mainstreaming and social inclusion	91.7
Partnering for capacity development	0.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.99
Global Innovation Index ranking, 2015	30.07

NAMIBIA

ACI Composite Index	
ACI Composite Index value	56.2
Level of capacity development	Medium
Rank	14

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	68.1
Development cooperation effectiveness	73.8
Gender equality mainstreaming and social inclusion	91.7
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.68
Global Innovation Index ranking, 2015	28.15

NIGER

ACI Composite Index	
ACI Composite Index value	57.4
Level of capacity development	Medium
Rank	11

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	66.7
Development cooperation effectiveness	67.5
Gender equality mainstreaming and social inclusion	84.2
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.82
Global Innovation Index ranking, 2015	21.22

NIGERIA

ACI Composite Index	
ACI Composite Index value	43.4
Level of capacity development	Medium
Rank	39

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	62.8
Development cooperation effectiveness	85.0
Gender equality mainstreaming and social inclusion	70.8
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	50.0
Domestic resource mobilization (tax effort index 1996–2013)	0.47
Global Innovation Index ranking, 2015	23.72

RWANDA

ACI Composite Index	
ACI Composite Index value	68.2
Level of capacity development	High
Rank	3

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	71.4
Development cooperation effectiveness	97.5
Gender equality mainstreaming and social inclusion	84.2
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.94
Global Innovation Index ranking, 2015	30.09

SENEGAL

ACI Composite Index	
ACI Composite Index value	49.0
Level of capacity development	Medium
Rank	32

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	51.7
Development cooperation effectiveness	57.5
Gender equality mainstreaming and social inclusion	65.8
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.19
Global Innovation Index ranking, 2015	30.95

SIERRA LEONE

ACI Composite Index	
ACI Composite Index value	53.3
Level of capacity development	Medium
Rank	21

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	67.5
Development cooperation effectiveness	95.0
Gender equality mainstreaming and social inclusion	78.3
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.70
Global Innovation Index ranking, 2015	Not available

SOUTH AFRICA

ACI Composite Index	
ACI Composite Index value	51.1
Level of capacity development	Medium
Rank	27

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	49.1
Development cooperation effectiveness	26.3
Gender equality mainstreaming and social inclusion	75.8
Partnering for capacity development	25.0
Capacity profiling and capacity needs assessment	0.0
Domestic resource mobilization (tax effort index 1996–2013)	1.51
Global Innovation Index ranking, 2015	37.45

SWAZILAND

ACI Composite Index	
ACI Composite Index value	35.3
Level of capacity development	Low
Rank	43

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	47.0
Development cooperation effectiveness	80.0
Gender equality mainstreaming and social inclusion	57.5
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	0.0
Domestic resource mobilization (tax effort index 1996–2013)	1.81
Global Innovation Index ranking, 2015	25.37

TANZANIA

ACI Composite Index	
ACI Composite Index value	68.8
Level of capacity development	High
Rank	2

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	68.3
Development cooperation effectiveness	86.3
Gender equality mainstreaming and social inclusion	87.5
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.86
Global Innovation Index ranking, 2015	27.00

TOGO

ACI Composite Index	
ACI Composite Index value	50.4
Level of capacity development	Medium
Rank	30

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	46.2
Development cooperation effectiveness	82.5
Gender equality mainstreaming and social inclusion	85.0
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	0.0
Domestic resource mobilization (tax effort index 1996–2013)	1.08
Global Innovation Index ranking, 2015	18.43

TUNISIA

ACI Composite Index	
ACI Composite Index value	62.6
Level of capacity development	High
Rank	6

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	54.4
Development cooperation effectiveness	85.0
Gender equality mainstreaming and social inclusion	74.2
Partnering for capacity development	100
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	0.89
Global Innovation Index ranking, 2015	33.48

UGANDA

ACI Composite Index	
ACI Composite Index value	54.0
Level of capacity development	Medium
Rank	19

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	59.4
Development cooperation effectiveness	48.8
Gender equality mainstreaming and social inclusion	80.8
Partnering for capacity development	75.0
Capacity profiling and capacity needs assessment	50.0
Domestic resource mobilization (tax effort index 1996–2013)	0.91
Global Innovation Index ranking, 2015	27.65

ZAMBIA

ACI Composite Index	
ACI Composite Index value	52.3
Level of capacity development	Medium
Rank	25

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	38.3
Development cooperation effectiveness	62.5
Gender equality mainstreaming and social inclusion	84.2
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	100
Domestic resource mobilization (tax effort index 1996–2013)	1.33
Global Innovation Index ranking, 2015	24.64

ZIMBABWE

ACI Composite Index	
ACI Composite Index value	46.3
Level of capacity development	Medium
Rank	35

Assessment of capacity development areas: Component Index values	
Policy choices for capacity development	60.9
Development cooperation effectiveness	61.3
Gender equality mainstreaming and social inclusion	86.7
Partnering for capacity development	50.0
Capacity profiling and capacity needs assessment	0.0
Domestic resource mobilization (tax effort index 1996–2013)	1.59
Global Innovation Index ranking, 2015	22.52

COMPENDIUM OF STATISTICS

1

Strategic policy choices for capacity development

No.	Country	Existence of a NDS	Number of NDS since 2002	Year of adoption of latest NDS version	Integration of CD in NDS/national development plan	Specific national program for CD	Level of government commitment to MDGs	Number of targets of MDGs achieved
1	ALGERIA	YES	3	2010	CD mainstreamed, no clear object	YES	High	18
2	BENIN	YES	3	2011	CD mainstreamed, clear objective	NO	High	2
3	BOTSWANA	YES	2	2009	CD mainstreamed, no clear object	NO	Average	13
4	BURKINA FASO	YES	2	2010	CD mainstreamed, clear objective	YES	Average	3
5	BURUNDI	YES	4	2012	CD mainstreamed, clear objective	YES	High	2
6	CABO VERDE	YES	3	2013	CD mainstreamed, clear objective	YES	High	6
7	CAMEROON	YES	na	2013	CD mainstreamed, clear objective	YES	High	1
8	CAR	YES	na	2014	CD mainstreamed, no clear object	NO	Low	0
9	CHAD	YES	3	2013	CD mainstreamed, clear objective	NO	High	1
10	COMOROS	YES	2	2014	CD mainstreamed, clear objective	YES	Average	2
11	CONGO, REP	YES	2	2012	CD mainstreamed, clear objective	NO	High	na
12	CÔTE D'IVOIRE	YES	2	2012	CD mainstreamed, no clear object	YES	High	6
13	DJIBOUTI	YES	3	2014	CD mainstreamed, clear objective	YES	High	5
14	EGYPT	YES	4	2013	CD mainstreamed, clear objective	YES	Average	8
15	ETHIOPIA	YES	3	2011	CD mainstreamed, no clear object	YES	High	4
16	GABON	YES	2	2011	CD mainstreamed, clear objective	YES	Average	10
17	GAMBIA	YES	3	2012	CD mainstreamed, clear objective	YES	High	5
18	GHANA	YES	3	2000	CD mainstreamed, clear objective	YES	High	3
19	GUINEA	YES	3	2013	CD mainstreamed, clear objective	YES	High	3
20	GUINEA-BISSAU	YES	2	2011	CD mainstreamed, clear objective	NO	High	0

No.	Country	Existence of a NDS	Number of NDS since 2002	Year of adoption of latest NDS version	Integration of CD in NDS/national development plan	Specific national program for CD	Level of government commitment to MDGs	Number of targets of MDGs achieved
21	KENYA	YES	3	2013	CD mainstreamed, clear objective	YES	High	9
22	LESOTHO	YES	3	2012	CD mainstreamed, clear objective	YES	High	0
23	LIBERIA	YES	9	2012	CD mainstreamed, clear objective	YES	Average	0
24	MADAGASCAR	YES	3	2014	CD not mainstreamed	NO	High	5
25	MALAWI	YES	5	2012	CD mainstreamed, clear objective	YES	High	8
26	MALI	YES	4	2011	CD mainstreamed, clear objective	YES	High	10
27	MAURITANIA	YES	3	2011	CD mainstreamed, clear objective	NO	High	0
28	MAURITIUS	YES	5		CD mainstreamed, clear objective	YES	High	11
29	MOROCCO	YES	6	2011	CD mainstreamed, clear objective	YES	Average	8
30	MOZAMBIQUE	YES	3	2011	CD mainstreamed, no clear object	YES	High	1
31	NAMIBIA	YES	3	2012	CD mainstreamed, clear objective	YES	High	16
32	NIGER	YES	3	2012	CD mainstreamed, clear objective	YES	High	0
33	NIGERIA	YES	4	2010	CD mainstreamed, clear objective	YES	High	7
34	RWANDA	YES	3	2013	CD mainstreamed, clear objective	YES	High	17
35	SENEGAL	YES	4	2013	CD mainstreamed, no clear object	YES	Low	
36	SIERRA LEONE	YES	3	2005	CD mainstreamed, clear objective	YES	High	0
37	SOUTH AFRICA	YES	8	2012	CD mainstreamed, no clear object	YES	High	9
38	SWAZILAND	YES	1		CD mainstreamed, no clear object	YES	High	
39	TANZANIA	YES	5	2013	CD mainstreamed, clear objective	YES	Average	14
40	TOGO	YES	3	2013	CD mainstreamed, clear objective	YES	High	1
41	TUNISIA	YES	3	2010	CD mainstreamed, no clear object	YES	High	16
42	UGANDA	YES	2	2013	CD mainstreamed, no clear object	NO	Average	10
43	ZAMBIA	YES	5	2014	CD not mainstreamed	YES	High	4
44	ZIMBABWE	YES	9	2013	CD mainstreamed, no clear object	NO	High	4

Note: na = not available; CD = Capacity Development; MDGs = Millennium Development Goals; and NDS = National Development Strategy/ National Development Plan.

2

Policy environment/Efficiency of instrument

No.	Country	Level of legitimacy of the National Development Strategy	Levels of incentives for compliance provided by the National Development Strategy	Level of flexibility of the National Development Strategy
1	ALGERIA	High	Average	Average
2	BENIN	High	High	Low
3	BOTSWANA	High	Average	Average
4	BURKINA FASO	High	High	High
5	BURUNDI	High	High	High
6	CABO VERDE	Average	Average	High
7	CAMEROON	High	High	High
8	CAR	High	High	Average
9	CHAD	High	High	High
10	COMOROS	High	High	Average
11	CONGO, REP	High	High	High
12	CÔTE D'IVOIRE	High	High	High
13	DJIBOUTI	Average	Average	Average
14	EGYPT	Average	Average	Average
15	ETHIOPIA	High	Average	Average
16	GABON	Average	Average	Average
17	GAMBIA	High	High	High
18	GHANA	High	High	Average
19	GUINEA	High	Average	High
20	GUINEA-BISSAU	High	Low	Average
21	KENYA	High	High	High
22	LESOTHO	High	High	High
23	LIBERIA	High	High	High
24	MADAGASCAR	Low	Low	Low
25	MALAWI	High	High	High
26	MALI	High	High	High
27	MAURITANIA	High	High	Average
28	MAURITIUS	High	High	High
29	MOROCCO	Average	Average	Average
30	MOZAMBIQUE	High	Average	High
31	NAMIBIA	High	High	Average
32	NIGER	High	High	High

No.	Country	Level of legitimacy of the National Development Strategy	Levels of incentives for compliance provided by the National Development Strategy	Level of flexibility of the National Development Strategy
33	NIGERIA	Average	Average	High
34	RWANDA	High	High	High
35	SENEGAL	Average	Average	Average
36	SIERRA LEONE	High	High	High
37	SOUTH AFRICA	Average	Average	Average
38	SWAZILAND	High	Average	Average
39	TANZANIA	Average	Average	High
40	TOGO	High	High	High
41	TUNISIA	Average	Average	Average
42	UGANDA	High	High	Average
43	ZAMBIA	Average	Average	Average
44	ZIMBABWE	High	Average	Average

Note: NDS = national development strategy.

3

Dialogue mechanisms for capacity development

No.	Country	Effective dialog mechanism (and other links as appropriate) among domestic institutions (civil society, private sector) engaged in CD	Level of effectiveness	Effective dialogue mechanism established by Government with development partners relating specifically to CD	Level of effectiveness
1	ALGERIA	Institutionalized dialogue	High	No institutionalized mechanism	na
2	BENIN	Institutionalized dialogue	High	CD discussed within broader dialogue	Low
3	BOTSWANA	Institutionalized dialogue	Average	Institutionalized dialogue	
4	BURKINA FASO	Institutionalized dialogue	High	Institutionalized dialogue	High
5	BURUNDI	Institutionalized dialogue	Average	Institutionalized dialogue	Average
6	CABO VERDE	Informal dialogue	Average	Institutionalized dialogue	High
7	CAMEROON	Institutionalized dialogue	Average	CD discussed within broader dialogue	na
8	CAR	Institutionalized dialogue	Average	CD discussed within broader dialogue	Average
9	CHAD	Institutionalized dialogue	High	CD discussed within broader dialogue	High
10	COMOROS	Institutionalized dialogue	High	Institutionalized dialogue	High
11	CONGO, REP	Institutionalized dialogue	Average	Institutionalized dialogue	Average
12	CÔTE D'IVOIRE	Institutionalized dialogue	Average	CD discussed within broader dialogue	na
13	DJIBOUTI	Institutionalized dialogue	Average	CD discussed within broader dialogue	Average
14	EGYPT	Institutionalized dialogue	Average	Institutionalized dialogue	High
15	ETHIOPIA	Informal dialogue	Average	CD discussed within broader dialogue	High
16	GABON	Institutionalized dialogue	Average	CD discussed within broader dialogue	Average
17	GAMBIA	Institutionalized dialogue	High	CD discussed within broader dialogue	Average
18	GHANA	Institutionalized dialogue	Average	Institutionalized dialogue	Average
19	GUINEA	Institutionalized dialogue	High	Institutionalized dialogue	High
20	GUINEA-BISSAU	No institutionalized mechanism	na	No institutionalized mechanism	na
21	KENYA	Institutionalized dialogue	Average	Institutionalized dialogue	Average
22	LESOTHO	Institutionalized dialogue	High	Institutionalized dialogue	Very High
23	LIBERIA	Institutionalized dialogue	High	Institutionalized dialogue	High
24	MADAGASCAR	No institutionalized mechanism	na	No institutionalized mechanism	na

No.	Country	Effective dialog mechanism (and other links as appropriate) among domestic institutions (civil society, private sector) engaged in CD	Level of effectiveness	Effective dialogue mechanism established by Government with development partners relating specifically to CD	Level of effectiveness
25	MALAWI	Institutionalized dialogue	Average	Institutionalized dialogue	High
26	MALI	Institutionalized dialogue	Average	CD discussed within broader dialogue	Very Low
27	MAURITANIA	No institutionalized mechanism	na	No institutionalized mechanism	na
28	MAURITIUS	Institutionalized dialogue	Very High	Institutionalized dialogue	Very High
29	MOROCCO	Institutionalized dialogue	High	Institutionalized dialogue	na
30	MOZAMBIQUE	Institutionalized dialogue	Very High	CD discussed within broader dialogue	High
31	NAMIBIA	Institutionalized dialogue	Average	Institutionalized dialogue	High
32	NIGER	Informal dialogue	High	CD discussed within broader dialogue	High
33	NIGERIA	Informal dialogue	Average	Institutionalized dialogue	Average
34	RWANDA	Institutionalized dialogue	Very High	Institutionalized dialogue	Very High
35	SENEGAL	Institutionalized dialogue	Average	Institutionalized dialogue	Average
36	SIERRA LEONE	Informal dialogue	High	Institutionalized dialogue	Very High
37	SOUTH AFRICA	Institutionalized dialogue	Average	CD discussed within broader dialogue	na
38	SWAZILAND	Institutionalized dialogue	High	Institutionalized dialogue	High
39	TANZANIA	Informal dialogue	Very High	Institutionalized dialogue	High
40	TOGO	Informal dialogue	Low	Institutionalized dialogue	Average
41	TUNISIA	Institutionalized dialogue	High	CD discussed within broader dialogue	High
42	UGANDA	Informal dialogue	Average	CD discussed within broader dialogue	Average
43	ZAMBIA	No institutionalized mechanism	na	CD discussed within broader dialogue	High
44	ZIMBABWE	Institutionalized dialogue	Average	Institutionalized dialogue	Very High

na = Information not available

CD: Capacity Development

4

Dialogue mechanisms for capacity development (Cont'd)

No.	Country	During 2014 calendar year, how frequently did the Head of State, the Head of government and/or other high officials speak publicly and favorably about capacity development efforts?	Level of civil society participation in priority setting related to capacity development agenda	Level of transparency of information to civil society about the capacity development agenda
1	ALGERIA	Once or twice	Average	Average
2	BENIN	At least 3 times	Average	Low
3	BOTSWANA	na	na	na
4	BURKINA FASO	At least 3 times	Average	Average
5	BURUNDI	At least 3 times	na	na
6	CABO VERDE	At least 3 times	Low	Average
7	CAMEROON	Once or twice	Average	Average
8	CAR	Once or twice	Low	Low
9	CHAD	At least 3 times	High	Average
10	COMOROS	At least 3 times	Average	Low
11	CONGO, REP	At least 3 times	Low	Low
12	CÔTE D'IVOIRE	na	na	na
13	DJIBOUTI	na	na	na
14	EGYPT	At least 3 times	Average	High
15	ETHIOPIA	At least 3 times	Average	Average
16	GABON	na	na	na
17	GAMBIA	At least 3 times	Average	Average
18	GHANA	At least 3 times	High	High
19	GUINEA	At least 3 times	Average	Average
20	GUINEA-BISSAU	Once or twice	Low	Low
21	KENYA	At least 3 times	Average	Average
22	LESOTHO	At least 3 times	High	High
23	LIBERIA	At least 3 times	High	High
24	MADAGASCAR	At least 3 times	Average	Average
25	MALAWI	At least 3 times	Average	Average
26	MALI	At least 3 times	Average	Average
27	MAURITANIA	Once or twice	Low	Low
28	MAURITIUS	At least 3 times	High	High
29	MOROCCO	Once or twice	High	Low
30	MOZAMBIQUE	na	na	na

No.	Country	During 2014 calendar year, how frequently did the Head of State, the Head of government and/or other high officials speak publicly and favorably about capacity development efforts?	Level of civil society participation in priority setting related to capacity development agenda	Level of transparency of information to civil society about the capacity development agenda
31	NAMIBIA	At least 3 times	na	High
32	NIGER	At least 3 times	Low	Low
33	NIGERIA	At least 3 times	Low	Low
34	RWANDA	At least 3 times	Average	Average
35	SENEGAL	At least 3 times	Average	Average
36	SIERRA LEONE	At least 3 times	Low	Low
37	SOUTH AFRICA	At least 3 times	Low	Average
38	SWAZILAND	na	na	na
39	TANZANIA	At least 3 times	Average	Average
40	TOGO	Once or twice	Average	Low
41	TUNISIA	Once or twice	Average	Average
42	UGANDA	At least 3 times	Average	Average
43	ZAMBIA	At least 3 times	Average	Average
44	ZIMBABWE	At least 3 times	Average	Low

na = Information not available

5

Strategic policy choices for improving the statistical system

No.	Country	Existence of an NSDS	Year of adoption of NSDS	NSDS is fully operational	Statistics taught at any of the higher training institutions	National Statistics Office operate an in-service training center	Signing of the African Charter on Statistics (adopted on 3rd February 2009)
1	ALGERIA	YES	2009	YES	YES	NO	YES
2	BENIN	YES	2008	YES	YES	YES	YES
3	BOTSWANA	YES	2012	YES	YES	NO	NO
4	BURKINA FASO	YES	2003	YES	NO	YES	YES
5	BURUNDI	YES	2011	YES	NO	NO	YES
6	CABO VERDE	YES	2006	YES	YES	NO	YES
7	CAMEROON	YES	2009	YES	YES	YES	NO
8	CAR	NO	na	na	YES	NO	NO
9	CHAD	YES	2011	YES	NO	NO	YES
10	COMOROS	YES	2009	YES	YES	NO	YES
11	CONGO, REP	YES	na	NO	YES	NO	YES
12	CÔTE D'IVOIRE	YES	2012	YES	NO	NO	YES
13	DJIBOUTI	YES	2010	YES	YES	YES	NO
14	EGYPT	NO	na	na	YES	YES	NO
15	ETHIOPIA	YES	2009	YES	YES	YES	YES
16	GABON	YES	2010	NO	YES	NO	YES
17	GAMBIA	YES	2007	YES	na	NO	YES
18	GHANA	YES	2008	YES	YES	YES	YES
19	GUINEA	YES	2008	YES	NO	YES	YES
20	GUINEA-BISSAU	NO	na	na	NO	YES	YES
21	KENYA	NO	na	na	NO	YES	YES
22	LESOTHO	YES	2011	YES	YES	NO	YES
23	LIBERIA	YES	2008	YES	NO	YES	YES
24	MADAGASCAR	YES	2008	NO	YES	YES	NO
25	MALAWI	YES	2013	YES	YES	YES	YES
26	MALI	YES	2006	YES	NO	NO	YES
27	MAURITANIA	YES	2011	YES	YES	NO	NO
28	MAURITIUS	YES	2007	YES	YES	YES	YES
29	MOROCCO	YES	2004	YES	YES	YES	YES
30	MOZAMBIQUE	YES	2012	YES	YES	YES	YES

No.	Country	Existence of an NSDS	Year of adoption of NSDS	NSDS is fully operational	Statistics taught at any of the higher training institutions	National Statistics Office operate an in-service training center	Signing of the African Charter on Statistics (adopted on 3rd February 2009)
31	NAMIBIA	YES	2011	YES	YES	YES	NO
32	NIGER	YES	2008	YES	YES	YES	YES
33	NIGERIA	YES	2010	YES	YES	YES	NO
34	RWANDA	YES	2014	YES	YES	NO	YES
35	SENEGAL	YES	2007	YES	YES	YES	YES
36	SIERRA LEONE	YES	2008	YES	YES	NO	YES
37	SOUTH AFRICA	YES	2015	NO	YES	NO	YES
38	SWAZILAND	NO	na	na	YES	NO	NO
39	TANZANIA	YES	2012	YES	YES	YES	YES
40	TOGO	YES	2009	YES	YES	NO	YES
41	TUNISIA	NO	na	na	YES	YES	YES
42	UGANDA	YES	2006	YES	NO	YES	YES
43	ZAMBIA	YES	2014	NO	YES	NO	YES
44	ZIMBABWE	YES	2011	YES	YES	YES	NO

Note: na = not available (or not applicable; NSDS = national strategy for the development of statistics.

6

Development cooperation effectiveness related to capacity development activities

No.	Country	Endorsement of the Busan Global Partnership	The country has an aid policy	Existence of an aid coordination mechanism	Mutual accountability framework in place	Assessment of coordination of support to capacity in the country Scale 1 = Very weak to 6 = Very strong
1	ALGERIA	NO	NO	NO	NO	1
2	BENIN	YES	YES	YES	YES	3
3	BOTSWANA	NO	YES	YES	na	2
4	BURKINA FASO	YES	YES	YES	YES	4
5	BURUNDI	YES	YES	YES	YES	3
6	CABO VERDE	YES	YES	YES	YES	5
7	CAMEROON	YES	NO	NO	NO	3
8	CAR	YES	YES	YES	NO	1
9	CHAD	YES	NO	YES	YES	3
10	COMOROS	YES	NO	YES	NO	5
11	CONGO, REP	YES	NO	NO	NO	2
12	CÔTE D'IVOIRE	YES	NO	YES	YES	2
13	DJIBOUTI	YES	YES	YES	YES	3
14	EGYPT	YES	YES	YES	YES	4
15	ETHIOPIA	YES	NO	YES	YES	4
16	GABON	NO	NO	NO	NO	4
17	GAMBIA	YES	YES	YES	YES	5
18	GHANA	YES	YES	YES	YES	3
19	GUINEA	YES	NO	NO	NO	2
20	GUINEA-BISSAU	YES	YES	NO	NO	2
21	KENYA	YES	NO	NO	NO	2
22	LESOTHO	YES	NO	YES	NO	5
23	LIBERIA	YES	YES	YES	YES	5
24	MADAGASCAR	YES	NO	YES	YES	5
25	MALAWI	YES	YES	YES	YES	3
26	MALI	YES	NO	YES	YES	4
27	MAURITANIA	YES	YES	YES	NO	3
28	MAURITIUS	NO	YES	YES	YES	6
29	MOROCCO	YES	YES	YES	YES	4
30	MOZAMBIQUE	YES	YES	YES	YES	5

No.	Country	Endorsement of the Busan Global Partnership	The country has an aid policy	Existence of an aid coordination mechanism	Mutual accountability framework in place	Assessment of coordination of support to capacity in the country Scale 1 = Very weak to 6 = Very strong
31	NAMIBIA	YES	YES	YES	NO	3
32	NIGER	YES	NO	YES	YES	3
33	NIGERIA	YES	YES	YES	YES	5
34	RWANDA	YES	YES	YES	YES	5
35	SENEGAL	YES	NO	YES	YES	4
36	SIERRA LEONE	YES	YES	YES	YES	4
37	SOUTH AFRICA	NO	YES	NO	NO	4
38	SWAZILAND	YES	YES	YES	YES	3
39	TANZANIA	YES	NO	YES	YES	3
40	TOGO	YES	YES	YES	YES	3
41	TUNISIA	YES	YES	YES	NO	5
42	UGANDA	YES	NO	YES	NO	3
43	ZAMBIA	YES	YES	YES	YES	2
44	ZIMBABWE	YES	YES	YES	NO	4

Note: na = not available.

7

Development cooperation effectiveness related to capacity development activities (additional)

No.	Country	M&E framework to assess progress against NDS developed	Mutual assessment of progress in implementing agreed commitments between the government and the community of donors conducted	Tracking system on CD allocations for gender equality and women's empowerment	Transparency of information on bilateral cooperation on capacity development
1	ALGERIA	M&E tools, but not adequate	YES	YES	NO
2	BENIN	Adequate M&E	YES	NO	NO
3	BOTSWANA	M&E tools, but not adequate	YES	na	na
4	BURKINA FASO	M&E tools, but not adequate	YES	YES	YES
5	BURUNDI	M&E tools, but not adequate	YES	NO	NO
6	CABO VERDE	Adequate M&E	YES	YES	YES
7	CAMEROON	M&E tools, but not adequate	YES	NO	NO
8	CAR	M&E tools, but not adequate	NO	NO	NO
9	CHAD	M&E tools, but not adequate	YES	NO	YES
10	COMOROS	Adequate M&E		NO	YES
11	CONGO, REP	No M&E mechanism in place	NO	NO	YES
12	CÔTE D'IVOIRE	M&E tools, but not adequate	NO	NO	YES
13	DJIBOUTI	Adequate M&E	YES	YES	na
14	EGYPT	M&E tools, but not adequate	YES	YES	YES
15	ETHIOPIA	Adequate M&E	YES	YES	YES
16	GABON	M&E tools, but not adequate	YES	NO	NO
17	GAMBIA	Adequate M&E	YES	NO	YES
18	GHANA	M&E tools, but not adequate	NO	NO	YES
19	GUINEA	No M&E mechanism in place	NO	YES	NO
20	GUINEA-BISSAU	M&E tools, but not adequate	NO	NO	NO

No.	Country	M&E framework to assess progress against NDS developed	Mutual assessment of progress in implementing agreed commitments between the government and the community of donors conducted	Tracking system on CD allocations for gender equality and women's empowerment	Transparency of information on bilateral cooperation on capacity development
21	KENYA	M&E tools, but not adequate	NO	NO	NO
22	LESOTHO	Adequate M&E	YES	NO	YES
23	LIBERIA	Adequate M&E	YES	NO	NO
24	MADAGASCAR	Adequate M&E	YES	YES	YES
25	MALAWI	Adequate M&E	YES	YES	YES
26	MALI	M&E tools, but not adequate	YES	NO	YES
27	MAURITANIA	M&E tools, but not adequate	na	na	YES
28	MAURITIUS	Adequate M&E	YES	YES	YES
29	MOROCCO	Adequate M&E	YES	YES	YES
30	MOZAMBIQUE	Adequate M&E	YES	YES	YES
31	NAMIBIA	Adequate M&E	YES	NO	YES
32	NIGER	Adequate M&E	YES	NO	NO
33	NIGERIA	Adequate M&E	NO	NO	YES
34	RWANDA	Adequate M&E	YES	YES	YES
35	SENEGAL	M&E tools, but not adequate	YES	NO	YES
36	SIERRA LEONE	Adequate M&E	YES	NO	YES
37	SOUTH AFRICA	M&E tools, but not adequate	na	YES	YES
38	SWAZILAND	Adequate M&E	YES	na	na
39	TANZANIA	M&E tools, but not adequate	YES	YES	NO
40	TOGO	Adequate M&E	YES	NO	NO
41	TUNISIA	Adequate M&E	YES	NO	YES
42	UGANDA	M&E tools, but not adequate	YES	YES	YES
43	ZAMBIA	Adequate M&E	NO	na	YES
44	ZIMBABWE	M&E tools, but not adequate	na	YES	NO

Note: na = not available (or not applicable); CD = capacity development [pls confirm]; M&E = monitoring and evaluation; NDS = national development strategy.

8

Gender equality mainstreaming

No.	Country	Ratification of CEDAW	Year of ratification	Report to the Committee	Institutional mechanisms implement the CEDAW
1	ALGERIA	CEDAW ratified with reservations	1996	Reporting is up to date	Focal point at appropriate level
2	BENIN	CEDAW ratified without reservations	1992	Reporting is up to date	Focal person without special mandate
3	BOTSWANA	CEDAW ratified with reservations	1996	Some reporting done	Focal person without special mandate
4	BURKINA FASO	CEDAW ratified without reservations	1984	Reporting is up to date	Focal point at appropriate level
5	BURUNDI	CEDAW ratified without reservations	1991	Reporting is up to date	Focal point at appropriate level
6	CABO VERDE	CEDAW ratified without reservations	na	Reporting is up to date	Focal point at appropriate level
7	CAMEROON	CEDAW ratified without reservations	1994	Reporting is up to date	Focal point at appropriate level
8	CAR	CEDAW ratified without reservations	1991	Some reporting done	Focal point at appropriate level
9	CHAD	CEDAW ratified without reservations	1993	Reporting is up to date	Focal person without special mandate
10	COMOROS	CEDAW ratified without reservations	1994	Reporting is up to date	Focal point at appropriate level
11	CONGO, REP	CEDAW ratified without reservations	1982	Some reporting done	Focal point at appropriate level
12	CÔTE D'IVOIRE	CEDAW ratified without reservations	1995	Some reporting done	Focal point at appropriate level
13	DJIBOUTI	CEDAW ratified with reservations	1998	Some reporting done	Focal point at appropriate level
14	EGYPT	CEDAW ratified without reservations	1996	Some reporting done	Focal point at appropriate level
15	ETHIOPIA	CEDAW ratified without reservations	1981	Reporting is up to date	Focal point at appropriate level
16	GABON	CEDAW ratified without reservations	1983	Reporting is up to date	Focal point at appropriate level
17	GAMBIA	CEDAW ratified without reservations	1992	Reporting is up to date	Focal person without special mandate
18	GHANA	CEDAW ratified without reservations	1986	Reporting is up to date	Focal point at appropriate level
19	GUINEA	CEDAW ratified without reservations	1982	Reporting is up to date	Focal point at appropriate level
20	GUINEA BISSAU	CEDAW ratified without reservations	2008	Some reporting done	Focal point at appropriate level

No.	Country	Ratification of CEDAW	Year of ratification	Report to the Committee	Institutional mechanisms implement the CEDAW
21	KENYA	CEDAW ratified without reservations	1984	Reporting is up to date	Focal point at appropriate level
22	LESOTHO	CEDAW ratified with reservations	1995	Reporting is up to date	Focal person without special mandate
23	LIBERIA	CEDAW ratified without reservations	2009	Reporting is up to date	Focal person without special mandate
24	MADAGASCAR	CEDAW ratified without reservations	1998	Reporting is up to date	Focal point at appropriate level
25	MALAWI	CEDAW ratified without reservations	2000	Reporting is up to date	Focal point at appropriate level
26	MALI	CEDAW ratified with reservations	1985	Reporting is up to date	Focal person without special mandate
27	MAURITANIA	CEDAW ratified with reservations	2000	Reporting is up to date	Focal point at appropriate level
28	MAURITIUS	CEDAW ratified without reservations	1984	Reporting is up to date	Focal point at appropriate level
29	MOROCCO	CEDAW ratified without reservations	2012	Some reporting done	Focal point at appropriate level
30	MOZAMBIQUE	CEDAW ratified without reservations	1993	Reporting is up to date	Focal point at appropriate level
31	NAMIBIA	CEDAW ratified without reservations	1995	Reporting is up to date	Focal point at appropriate level
32	NIGER	CEDAW ratified with reservations	1999	Some reporting done	Focal point at appropriate level
33	NIGERIA	CEDAW ratified without reservations	1985	Reporting is up to date	Focal point at appropriate level
34	RWANDA	CEDAW ratified without reservations	1981	Reporting is up to date	Focal person without special mandate
35	SENEGAL	CEDAW ratified without reservations	1985	Some reporting done	Focal person without special mandate
36	SIERRA LEONE	CEDAW ratified without reservations	1988	Reporting is up to date	Focal point at appropriate level
37	SOUTH AFRICA	CEDAW not ratified	na	No reporting	Focal point at appropriate level
38	SWAZILAND	CEDAW ratified without reservations	2004	Reporting is up to date	Focal person without special mandate
39	TANZANIA	CEDAW ratified without reservations	2004	Reporting is up to date	Focal person without special mandate
40	TOGO	CEDAW ratified without reservations	1983	Some reporting done	Focal point at appropriate level
41	TUNISIA	CEDAW ratified without reservations	1985	Reporting is up to date	Focal person without special mandate
42	UGANDA	CEDAW ratified without reservations	1985	Reporting is up to date	Focal point at appropriate level
43	ZAMBIA	CEDAW ratified without reservations	1985	Reporting is up to date	Focal point at appropriate level
44	ZIMBABWE	CEDAW ratified without reservations	1991	Reporting is up to date	Focal point at appropriate level

Note: na = not available; CEDAW = Convention of the Elimination of all Forms of Discrimination Against Women.

9

Gender equality mainstreaming (additional)

No.	Country	Ratification of the Optional Protocol	Embodiment of the principle of equality of men and women in national constitution or other appropriate legislation	Consistency of family laws with the principles of equality between the sexes as under provision of Article 16 of the CEDAW	The country has put in place (enacted) a gender policy
1	ALGERIA	YES	Law approved by Parliament	Law approved by Parliament	NO
2	BENIN	YES	Law approved by Parliament	Law approved by Parliament	YES
3	BOTSWANA	YES	Draft law in place	Draft law in place	YES
4	BURKINA FASO	YES	Law approved by Parliament	Law approved by Parliament	YES
5	BURUNDI	NO	Law approved by Parliament	Law approved by Parliament	YES
6	CABO VERDE	YES	Law approved by Parliament	Law approved by Parliament	YES
7	CAMEROON	YES	Law approved by Parliament	Draft law in place	YES
8	CAR	NO	Law approved by Parliament	Draft law in place	YES
9	CHAD	NO	Law approved by Parliament	Draft law in place	NO
10	COMOROS	NO	Law approved by Parliament	Law approved by Parliament	YES
11	CONGO, REP	YES	Law approved by Parliament	Law approved by Parliament	YES
12	CÔTE D'IVOIRE	YES	Law approved by Parliament	Law approved by Parliament	YES
13	DJIBOUTI	YES	Law approved by Parliament	Law approved by Parliament	YES
14	EGYPT	NO	Law approved by Parliament	Law approved by Parliament	YES
15	ETHIOPIA	NO	Law approved by Parliament	Law approved by Parliament	YES
16	GABON	NO	Law approved by Parliament	Law approved by Parliament	YES
17	GAMBIA	NO	Law approved by Parliament	Law approved by Parliament	YES
18	GHANA	YES	Law approved by Parliament	Law approved by Parliament	YES
19	GUINEA	YES	Law approved by Parliament	Law approved by Parliament	YES
20	GUINEA BISSAU	YES	Law approved by Parliament	Law approved by Parliament	YES
21	KENYA	NO	Law approved by Parliament	Law approved by Parliament	YES
22	LESOTHO	YES	Law approved by Parliament	Law approved by Parliament	YES
23	LIBERIA	NO	No law or legal measure	Law approved by Parliament	YES
24	MADAGASCAR	NO	Law approved by Parliament	Law approved by Parliament	YES
25	MALAWI	NO	Law approved by Parliament	Law approved by Parliament	YES
26	MALI	YES	Law approved by Parliament	Draft law in place	YES
27	MAURITANIA	NO	Law approved by Parliament	Law approved by Parliament	YES
28	MAURITIUS	YES	Law approved by Parliament	Law approved by Parliament	YES
29	MOROCCO	YES	Law approved by Parliament	Law approved by Parliament	YES
30	MOZAMBIQUE	YES	Law approved by Parliament	Law approved by Parliament	YES

No.	Country	Ratification of the Optional Protocol	Embodiment of the principle of equality of men and women in national constitution or other appropriate legislation	Consistency of family laws with the principles of equality between the sexes as under provision of Article 16 of the CEDAW	The country has put in place (enacted) a gender policy
31	NAMIBIA	YES	Law approved by Parliament	Law approved by Parliament	YES
32	NIGER	YES	Law approved by Parliament	Law approved by Parliament	YES
33	NIGERIA	YES	Draft law in place	Draft law in place	YES
34	RWANDA	NO	Law approved by Parliament	Law approved by Parliament	YES
35	SENEGAL	YES	Law approved by Parliament	Law approved by Parliament	YES
36	SIERRA LEONE	NO	Law approved by Parliament	Law approved by Parliament	YES
37	SOUTH AFRICA	NO	Law approved by Parliament	Law approved by Parliament	YES
38	SWAZILAND	NO	Draft law in place	Draft law in place	YES
39	TANZANIA	YES	Law approved by Parliament	Law approved by Parliament	YES
40	TOGO	NO	Law approved by Parliament	Law approved by Parliament	NO
41	TUNISIA	YES	Draft law in place	Draft law in place	YES
42	UGANDA	YES	Law approved by Parliament	Draft law in place	YES
43	ZAMBIA	NO	Law approved by Parliament	Draft law in place	YES
44	ZIMBABWE	NO	Law approved by Parliament	Law approved by Parliament	YES

Note: CEDAW = Convention of the Elimination of all Forms of Discrimination Against Women.

10

Gender equality mainstreaming (additional)

No.	Country	Gender equality policy is integrated in the country's Poverty Reduction Strategy	Government allocated financial resources to gender related activities	Mainstreaming gender in statistics
1	ALGERIA	Gender mainstreamed, no clear objectives	No budget line allocated	Clear guide
2	BENIN	Clear objectives and targets set	Sufficient budget allocated	No clear guide
3	BOTSWANA	Gender mainstreamed, no clear objectives	Unclear kind of budget allocated	No clear guide
4	BURKINA FASO	Clear objectives and targets set	Sufficient budget allocated	Clear guide
5	BURUNDI	Clear objectives and targets set	Unclear kind of budget allocated	No clear guide
6	CABO VERDE	Clear objectives and targets set	Sufficient budget allocated	Clear guide
7	CAMEROON	Clear objectives and targets set	Sufficient budget allocated	No clear guide
8	CAR	Clear objectives and targets set	Sufficient budget allocated	No clear guide
9	CHAD	Clear objectives and targets set	Unclear kind of budget allocated	No clear guide
10	COMOROS	Clear objectives and targets set	Unclear kind of budget allocated	No clear guide
11	CONGO, REP	Clear objectives and targets set	Sufficient budget allocated	No clear guide
12	CÔTE D'IVOIRE	Clear objectives and targets set	Sufficient budget allocated	No clear guide
13	DJIBOUTI	Clear objectives and targets set	Unclear kind of budget allocated	Clear guide
14	EGYPT	Clear objectives and targets set	Unclear kind of budget allocated	Clear guide
15	ETHIOPIA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
16	GABON	Gender mainstreamed, no clear objectives	Unclear kind of budget allocated	No clear guide
17	GAMBIA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
18	GHANA	Clear objectives and targets set	Unclear kind of budget allocated	No clear guide
19	GUINEA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
20	GUINEA BISSAU	Clear objectives and targets set	No budget line allocated	No clear guide
21	KENYA	Clear objectives and targets set	Unclear kind of budget allocated	Clear guide
22	LESOTHO	Clear objectives and targets set	Sufficient budget allocated	Clear guide
23	LIBERIA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
24	MADAGASCAR	Clear objectives and targets set	Unclear kind of budget allocated	No clear guide
25	MALAWI	Clear objectives and targets set	Sufficient budget allocated	No clear guide
26	MALI	Gender mainstreamed, no clear objectives	Unclear kind of budget allocated	No clear guide
27	MAURITANIA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
28	MAURITIUS	Gender mainstreamed, no clear objectives	Sufficient budget allocated	Clear guide
29	MOROCCO	Clear objectives and targets set	Sufficient budget allocated	Clear guide
30	MOZAMBIQUE	Clear objectives and targets set	Sufficient budget allocated	Clear guide

No.	Country	Gender equality policy is integrated in the country's Poverty Reduction Strategy	Government allocated financial resources to gender related activities	Mainstreaming gender in statistics
31	NAMIBIA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
32	NIGER	Clear objectives and targets set	Unclear kind of budget allocated	Clear guide
33	NIGERIA	Gender mainstreamed, no clear objectives	Unclear kind of budget allocated	No clear guide
34	RWANDA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
35	SENEGAL	Clear objectives and targets set	Unclear kind of budget allocated	No clear guide
36	SIERRA LEONE	Clear objectives and targets set	Sufficient budget allocated	Clear guide
37	SOUTH AFRICA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
38	SWAZILAND	Clear objectives and targets set	Sufficient budget allocated	No clear guide
39	TANZANIA	Gender mainstreamed, no clear objectives	Unclear kind of budget allocated	No clear guide
40	TOGO	Clear objectives and targets set	Unclear kind of budget allocated	No clear guide
41	TUNISIA	Gender mainstreamed, no clear objectives	Unclear kind of budget allocated	No clear guide
42	UGANDA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
43	ZAMBIA	Clear objectives and targets set	Sufficient budget allocated	Clear guide
44	ZIMBABWE	Clear objectives and targets set	Sufficient budget allocated	Clear guide

11

Social inclusion

No.	Country	Provisions in the country's Constitution allowing the President / Head of State to appoint some representatives to Parliament in addition to the elected representatives	Instances where some nationals in the country require special permission/ qualification to enjoy certain privileges	Social services accessible to nationals in the country on equal terms	Equal employment opportunities for all nationals	Policy or law that provides equal opportunity for all	Policy or law that protects the vulnerable in the society
1	ALGERIA	YES	NO	YES	NO	NO	YES
2	BENIN	NO	NO	YES	YES	YES	YES
3	BOTSWANA	YES	NO	YES	YES	NO	YES
4	BURKINA FASO	NO	NO	YES	YES	YES	YES
5	BURUNDI	NO	YES	YES	YES	YES	YES
6	CABO VERDE	NO	NO	YES	YES	YES	YES
7	CAMEROON	YES	YES	YES	YES	YES	YES
8	CAR	NO	NO	YES	YES	YES	YES
9	CHAD	NO	NO	YES	YES	YES	YES
10	COMOROS	NO	NO	YES	YES	YES	NO
11	CONGO, REP	NO	NO	YES	YES	YES	YES
12	CÔTE D'IVOIRE	NO	YES	YES	NO	YES	YES
13	DJIBOUTI	YES	YES	YES	YES	YES	YES
14	EGYPT	YES	YES	YES	NO	YES	YES
15	ETHIOPIA	NO	NO	YES	YES	YES	YES
16	GABON	NO	NO	YES	YES	YES	YES
17	GAMBIA	YES	NO	YES	YES	YES	YES
18	GHANA	NO	NO	YES	YES	YES	NO
19	GUINEA	NO	NO	YES	YES	YES	YES
20	GUINEA BISSAU	YES	YES	YES	YES	YES	YES
21	KENYA	NO	NO	YES	YES	YES	YES
22	LESOTHO	YES	NO	YES	YES	YES	YES
23	LIBERIA	NO	NO	NO	YES	YES	NO
24	MADAGASCAR	YES	NO	YES	YES	YES	YES
25	MALAWI	YES	NO	YES	YES	YES	YES
26	MALI	NO	NO	YES	YES	YES	YES
27	MAURITANIA	NO	NO	YES	YES	YES	YES
28	MAURITIUS	NO	NO	YES	YES	YES	YES

No.	Country	Provisions in the country's Constitution allowing the President / Head of State to appoint some representatives to Parliament in addition to the elected representatives	Instances where some nationals in the country require special permission / qualification to enjoy certain privileges	Social services accessible to nationals in the country on equal terms	Equal employment opportunities for all nationals	Policy or law that provides equal opportunity for all	Policy or law that protects the vulnerable in the society
29	MOROCCO	YES	YES	YES	YES	YES	YES
30	MOZAMBIQUE	NO	YES	YES	YES	YES	YES
31	NAMIBIA	YES	NO	YES	YES	YES	YES
32	NIGER	NO	YES	YES	YES	YES	YES
33	NIGERIA	NO	NO	YES	YES	YES	YES
34	RWANDA	YES	NO	YES	YES	YES	YES
35	SENEGAL	NO	NO	YES	YES	YES	YES
36	SIERRA LEONE	NO	NO	YES	YES	YES	YES
37	SOUTH AFRICA	YES	NO	YES	NO	YES	YES
38	SWAZILAND	YES	na	na	YES	YES	YES
39	TANZANIA	YES	YES	YES	YES	YES	YES
40	TOGO	YES	YES	YES	YES	YES	YES
41	TUNISIA	NO	YES	YES	YES	YES	YES
42	UGANDA	NO	NO	YES	YES	YES	YES
43	ZAMBIA	YES	NO	YES	YES	YES	YES
44	ZIMBABWE	YES	NO	YES	YES	YES	YES

Note: na = not available.

12

Partnering for capacity development

No.	Country	Establishment of a national assistance coordinating unit for CD by the Government	Main partners from multilateral cooperation have developed a country assistance strategy/ program relating to the country
1	ALGERIA	Coordination, not formally instituted	Not all
2	BENIN	Clear Unit established	Not all
3	BOTSWANA	Clear Unit established	All
4	BURKINA FASO	Clear Unit established	Not all
5	BURUNDI	Coordination, not formally instituted	Not all
6	CABO VERDE	Clear Unit established	Not all
7	CAMEROON	Coordination, not formally instituted	All
8	CAR	Clear Unit established	Not all
9	CHAD	No institutional Unit	Not all
10	COMOROS	Clear Unit established	Not all
11	CONGO, REP	No institutional Unit	Not all
12	CÔTE D'IVOIRE	Clear Unit established	Not all
13	DJIBOUTI	Clear Unit established	Not all
14	EGYPT	Coordination, not formally instituted	Not all
15	ETHIOPIA	Clear Unit established	Not all
16	GABON	Clear Unit established	Not all
17	GAMBIA	Clear Unit established	All
18	GHANA	Clear Unit established	All
19	GUINEA	Clear Unit established	Not all
20	GUINEA BISSAU	Clear Unit established	None
21	KENYA	Coordination, not formally instituted	Not all
22	LESOTHO	Clear Unit established	All
23	LIBERIA	Clear Unit established	All
24	MADAGASCAR	Clear Unit established	Not all
25	MALAWI	Clear Unit established	All
26	MALI	Coordination, not formally instituted	Not all
27	MAURITANIA	Coordination, not formally instituted	Not all
28	MAURITIUS	Clear Unit established	All
29	MOROCCO	Coordination, not formally instituted	Not all
30	MOZAMBIQUE	Coordination, not formally instituted	Not all
31	NAMIBIA	Coordination, not formally instituted	Not all
32	NIGER	Clear Unit established	All
33	NIGERIA	Coordination, not formally instituted	Not all

No.	Country	Establishment of a national assistance coordinating unit for CD by the Government	Main partners from multilateral cooperation have developed a country assistance strategy/ program relating to the country
34	RWANDA	Clear Unit established	All
35	SENEGAL	Clear Unit established	All
36	SIERRA LEONE	Clear Unit established	Not all
37	SOUTH AFRICA	Coordination, not formally instituted	na
38	SWAZILAND	Coordination, not formally instituted	Not all
39	TANZANIA	Coordination, not formally instituted	Not all
40	TOGO	Clear Unit established	Not all
41	TUNISIA	Clear Unit established	All
42	UGANDA	Coordination, not formally instituted	All
43	ZAMBIA	Coordination, not formally instituted	na
44	ZIMBABWE	No institutional Unit	na

Note: CD = capacity development; na = not available.

13

Capacity profiling and assessments of needs

No.	Country	Capacity profile conducted in the country since 2008	Date last capacity profile conducted	Who commissioned the capacity profiling?	Capacity needs assessment conducted in the country since 2008	Who commissioned the capacity needs assessment?
1	ALGERIA	NO	na	na	NO	na
2	BENIN	YES	2011	Government Body	YES	Government Body
3	BOTSWANA	YES	2010	Government Body	YES	Government Body
4	BURKINA FASO	YES	2008	Government Body	YES	Government Body
5	BURUNDI	YES	2012	Development partner	YES	Government Body
6	CABO VERDE	YES	2009	Development partner	YES	Development partner
7	CAMEROON	YES	2008	Government Body	YES	Government Body
8	CAR	YES	2008	Government Body	YES	Development partner
9	CHAD	NO	na	na	NO	na
10	COMOROS	NO	na	na	YES	Development partner
11	CONGO, REP	NO	na	na	YES	Government Body
12	CÔTE D'IVOIRE	NO	na	na	YES	Government Body
13	DJIBOUTI	YES	2012	na	YES	na
14	EGYPT	Don't know	na	na	YES	na
15	ETHIOPIA	YES	na	na	YES	na
16	GABON	Don't know	na	na	YES	na
17	GAMBIA	YES	2009	Government Body	YES	Government Body
18	GHANA	YES	2011	Development partner	YES	DP & Other
19	GUINEA	YES	2010	Development partner	YES	Development partner
20	GUINEA BISSAU	YES	2007	Government Body	YES	Development partner
21	KENYA	YES	2011	Government Body	NO	na
22	LESOTHO	YES	2012	Gvnt & Dev. Partner	YES	Development partner
23	LIBERIA	YES	2012	Development partner	YES	Gvnt & Dev. Partner
24	MADAGASCAR	NO	na	na	YES	Government Body
25	MALAWI	YES	2013	na	YES	na
26	MALI	YES	2011	Development partner	YES	Government Body
27	MAURITANIA	YES	2009	Government Body	YES	Government Body
28	MAURITIUS	YES	2010	Government Body	YES	na
29	MOROCCO	YES	2011	Development partner	YES	Development partner
30	MOZAMBIQUE	YES	2011	Government Body	YES	Government Body

No.	Country	Capacity profile conducted in the country since 2008	Date last capacity profile conducted	Who commissioned the capacity profiling?	Capacity needs assessment conducted in the country since 2008	Who commissioned the capacity needs assessment?
31	NAMIBIA	YES	2012	na	YES	Government Body
32	NIGER	YES	2013	Government Body	YES	Government Body
33	NIGERIA	NO	1	na	YES	Development partner
34	RWANDA	YES	2014	Government Body	YES	Government Body
35	SENEGAL	YES	na	na	YES	Government Body
36	SIERRA LEONE	YES	2013	na	YES	na
37	SOUTH AFRICA	na	na	na	na	na
38	SWAZILAND	NO	na	na	NO	na
39	TANZANIA	YES	2010	na	YES	Gvnt & Dev. Partner
40	TOGO	NO	na	na	NO	na
41	TUNISIA	YES	2010	Government Body	YES	Government Body
42	UGANDA	NO	na	na	YES	Gvnt & Dev. Partner
43	ZAMBIA	YES	2009	na	YES	Government Body
44	ZIMBABWE	Don't know	na	na	Don't know	na

Note: Gvnt & Dev: Partner = Government and Development Partner; na = not available.

14

Regional integration: Geography and membership

No.	Country	Number of border countries	Country landlocked	Country membership to:				
				APPA	OPEC	Commonwealth	OIF	ICO
1	ALGERIA	6	NO	YES	YES	NO	NO	YES
2	BENIN	4	NO	YES	NO	NO	YES	YES
3	BOTSWANA	4	YES	NO		YES	NO	NO
5	BURKINA FASO	6	YES	NO	NO	NO	YES	NO
4	BURUNDI	3	YES	NO	NO	NO	YES	NO
6	CABO VERDE	0	NO	NO	NO	NO	YES	NO
7	CAMEROON	6	NO	YES	NO	YES	YES	YES
8	CAR	6	YES	NO	NO	NO	YES	YES
9	CHAD	6	YES	YES	NO	NO	YES	YES
10	COMOROS	0	NO	NO	NO	NO	YES	YES
11	CONGO, REP	5	NO	YES	NO	NO	YES	NO
12	CÔTE D'IVOIRE	5	NO	YES	YES	NO	YES	YES
13	DJIBOUTI	3	NO	NO	NO	NO	YES	YES
14	EGYPT	4	NO	YES	YES	NO	YES	YES
15	ETHIOPIA	6	YES	NO	NO	NO	NO	NO
16	GABON	3	NO	YES	NO	NO	YES	YES
17	GAMBIA	1	NO	NO	NO	NO	NO	YES
18	GHANA	3	NO	YES	NO	YES	YES	NO
19	GUINEA	6	NO	NO	NO	NO	YES	YES
20	GUINEA-BISSAU	2	NO	NO	NO	NO	YES	YES
21	KENYA	5	NO	NO	NO	YES	NO	NO
22	LESOTHO	1	YES	NO	NO	YES	NO	NO
23	LIBERIA	3	NO	NO	NO	NO	NO	NO
24	MADAGASCAR	0	NO	NO	NO	NO	YES	NO
25	MALAWI	3	YES	NO	NO	YES	NO	NO
26	MALI	7	YES	NO	NO	NO	YES	YES
27	MAURITANIA	4	NO	NO	NO	NO	YES	YES
28	MAURITIUS	0		NO	NO	YES	YES	NO
29	MOROCCO	2	NO	NO	NO	NO	YES	YES
30	MOZAMBIQUE	6	NO	NO	NO	YES	NO	YES
31	NAMIBIA	5	NO	YES	YES	YES	NO	NO
32	NIGER	7	YES	YES	YES	NO	YES	YES

No.	Country	Number of border countries	Country landlocked	Country membership to:				
				APPA	OPEC	Commonwealth	OIF	ICO
33	NIGERIA	4	NO	YES	YES	YES	NO	NO
34	RWANDA	4	YES	NO	NO	YES	YES	NO
35	SENEGAL	5	NO	NO	NO	NO	YES	YES
36	SIERRA LEONE	2	NO	YES	NO	YES	NO	YES
37	SOUTH AFRICA	6	NO	NO	NO	YES	NO	NO
38	SWAZILAND	2	YES	NO	NO	YES	NO	NO
39	TANZANIA	8	NO	NO	NO	YES	NO	NO
40	TOGO	3	NO	NO	NO	NO	YES	YES
41	TUNISIA	2	NO	NO	NO	NO	YES	YES
42	UGANDA	5	YES	NO	YES	YES	NO	YES
43	ZAMBIA	8	YES	NO	NO	YES	NO	NO
44	ZIMBABWE	5	YES	NO	NO	NO	NO	NO

APPA = African Petroleum Producers Association; OIF = Organisation internationale de la Francophonie; OPEC = Organization of the Petroleum Exporting Countries.

15

Regional integration: Membership AU-recognized RECs

No.	Country	CEN-SAD	EAC	ECCAS	ECOWAS	COMESA	IGAD	SADC	UMA
1	ALGERIA	NO	NO	NO	NO	NO	NO	NO	**YES**
2	BENIN	**YES**	NO	NO	**YES**	NO	NO	NO	NO
3	BOTSWANA	NO	NO	NO	NO	NO	NO	**YES**	NO
5	BURKINA FASO	**YES**	NO	NO	**YES**	NO	NO	NO	NO
4	BURUNDI	NO	**YES**	**YES**	NO	**YES**	NO	NO	NO
6	CABO VERDE	NO	NO	NO	**YES**	NO	NO	NO	NO
7	CAMEROON	NO	NO	**YES**	NO	NO	NO	NO	NO
8	CAR	**YES**	NO	**YES**	NO	NO	NO	NO	NO
9	CHAD	**YES**	NO	**YES**	NO	NO	NO	NO	NO
10	COMOROS	**YES**	NO	NO	NO	**YES**	NO	NO	NO
11	CONGO, REP	NO	NO	**YES**	NO	NO	NO	NO	NO
12	CÔTE D'IVOIRE	**YES**	NO	NO	**YES**	NO	NO	NO	NO
13	DJIBOUTI	**YES**	NO	NO	NO	**YES**	**YES**	NO	NO
14	EGYPT	**YES**	NO	NO	NO	**YES**	NO	NO	NO
15	ETHIOPIA	NO	NO	NO	NO	**YES**	**YES**	NO	NO
16	GABON	NO	NO	**YES**	NO	NO	NO	NO	NO
17	GAMBIA	**YES**	NO	NO	**YES**	NO	NO	NO	NO
18	GHANA	**YES**	NO	NO	**YES**	NO	NO	NO	NO
19	GUINEA	**YES**	NO	NO	**YES**	NO	NO	NO	NO
20	GUINEA-BISSAU	**YES**	NO	NO	**YES**	NO	NO	NO	NO
21	KENYA	**YES**	**YES**	NO	NO	**YES**	**YES**	NO	NO
22	LESOTHO	NO	NO	NO	NO	NO	NO	**YES**	NO
23	LIBERIA	**YES**	NO	NO	**YES**	NO	NO	NO	NO
24	MADAGASCAR	NO	NO	NO	NO	**YES**	NO	**YES**	NO
25	MALAWI	NO	NO	NO	NO	**YES**	NO	**YES**	NO
26	MALI	**YES**	NO	NO	**YES**	NO	NO	NO	NO
27	MAURITANIA	**YES**	NO	NO	NO	NO	NO	NO	**YES**
28	MAURITIUS	NO	NO	NO	NO	**YES**	NO	**YES**	NO
29	MOROCCO	**YES**	NO	NO	NO	NO	NO	NO	**YES**
30	MOZAMBIQUE	NO	NO	NO	NO	NO	NO	**YES**	NO
31	NAMIBIA	NO	NO	NO	NO	NO	NO	**YES**	NO
32	NIGER	**YES**	NO	NO	**YES**	NO	NO	NO	NO
33	NIGERIA	**YES**	NO	NO	**YES**	NO	NO	NO	NO

No.	Country	CEN-SAD	EAC	ECCAS	ECOWAS	COMESA	IGAD	SADC	UMA
34	RWANDA	NO	**YES**	YES	NO	**YES**	NO	NO	NO
35	SENEGAL	**YES**	NO	NO	**YES**	NO	NO	NO	NO
36	SIERRA LEONE	**YES**	NO	NO	**YES**	NO	NO	NO	NO
37	SOUTH AFRICA	NO	NO	NO	NO	NO	**NO**	YES	NO
38	SWAZILAND	NO	NO	NO	NO	**YES**	NO	**YES**	NO
39	TANZANIA	NO	**YES**	NO	NO	NO	NO	**YES**	NO
40	TOGO	**YES**	NO	NO	**YES**	NO	NO	NO	NO
41	TUNISIA	**YES**	NO	NO	NO	NO	NO	NO	**YES**
42	UGANDA	NO	**YES**	NO	NO	**YES**	**YES**	NO	NO
43	ZAMBIA	NO	NO	NO	NO	**YES**	NO	**YES**	NO
44	ZIMBABWE	NO	NO	NO	NO	**YES**	NO	**YES**	NO

16

Regional integration: Membership other RECs

No.	Country	CEMAC	CEPGL	IOC	MRU	UEMOA	SACU
1	ALGERIA	NO	NO	NO	NO	NO	NO
2	BENIN	NO	NO	NO	NO	YES	NO
3	BOTSWANA	NO	NO	NO	NO	NO	YES
5	BURKINA FASO	NO	NO	NO	NO	YES	NO
4	BURUNDI	NO	YES	NO	NO	NO	NO
6	CABO VERDE	NO	NO	NO	NO	NO	NO
7	CAMEROON	YES	NO	NO	NO	NO	NO
8	CAR	YES	NO	NO	NO	NO	NO
9	CHAD	YES	NO	NO	NO	NO	NO
10	COMOROS	NO	NO	YES	NO	NO	NO
11	CONGO, REP	YES	NO	NO	NO	NO	NO
12	CÔTE D'IVOIRE	NO	NO	NO	YES	YES	NO
13	DJIBOUTI	NO	NO	NO	NO	NO	NO
14	EGYPT	NO	NO	NO	NO	NO	NO
15	ETHIOPIA	NO	NO	NO	NO	NO	NO
16	GABON	YES	NO	NO	NO	NO	NO
17	GAMBIA	NO	NO	NO	NO	NO	NO
18	GHANA	NO	NO	NO	NO	NO	NO
19	GUINEA	NO	NO	NO	YES	NO	NO
20	GUINEA-BISSAU	NO	NO	NO	NO	YES	NO
21	KENYA	NO	NO	NO	NO	NO	NO
22	LESOTHO	NO	NO	NO	NO	NO	YES
23	LIBERIA	NO	NO	NO	YES	NO	NO
24	MADAGASCAR	NO	NO	YES	NO	NO	NO
25	MALAWI	NO	NO	NO	NO	NO	NO
26	MALI	NO	NO	NO	NO	YES	NO
27	MAURITANIA	NO	NO	NO	NO	NO	NO
28	MAURITIUS	NO	NO	YES	NO	NO	NO
29	MOROCCO	NO	NO	NO	NO	NO	NO
30	MOZAMBIQUE	NO	NO	NO	NO	NO	NO
31	NAMIBIA	NO	NO	NO	NO	NO	YES

No.	Country	CEMAC	CEPGL	IOC	MRU	UEMOA	SACU
32	NIGER	NO	NO	NO	NO	YES	NO
33	NIGERIA	NO	NO	NO	NO	NO	NO
34	RWANDA	NO	YES	NO	NO	NO	NO
35	SENEGAL	NO	NO	NO	NO	YES	NO
36	SIERRA LEONE	NO	NO	NO	YES	NO	NO
37	SOUTH AFRICA	NO	NO	NO	NO	NO	YES
38	SWAZILAND	NO	NO	NO	NO	NO	YES
39	TANZANIA	NO	NO	NO	NO	NO	NO
40	TOGO	NO	NO	NO	NO	YES	NO
41	TUNISIA	NO	NO	NO	NO	NO	NO
42	UGANDA	NO	NO	NO	NO	NO	NO
43	ZAMBIA	NO	NO	NO	NO	NO	NO
44	ZIMBABWE	NO	NO	NO	NO	NO	NO

17

Regional integration: Main Treaties/Protocols relating to regional integration signed/ratified

No	Country	Abuja Treaty		Constitutive Act of the African Union		Constitution of the Association of African Trade Promotion Organizations	
		Signed	Ratified	Signed	Ratified	Signed	Ratified
1	ALGERIA	NO	NO	YES	NO	YES	NO
2	BENIN	YES	YES	YES	YES	YES	YES
3	BOTSWANA	YES	YES	YES	YES	NO	NO
5	BURKINA FASO	YES	YES	YES	YES	YES	NO
4	BURUNDI	YES	YES	YES	YES	YES	NO
6	CABO VERDE	NO	NO	YES	YES	NO	NO
7	CAMEROON	YES	YES	YES	YES	YES	NO
8	CAR	YES	YES	YES	YES	YES	NO
9	CHAD	YES	YES	YES	YES	YES	NO
10	COMOROS	YES	YES	YES	YES	YES	NO
11	CONGO, REP	YES	YES	YES	YES	YES	YES
12	CÔTE D'IVOIRE	YES	YES	YES	YES	YES	
13	DJIBOUTI	YES	NO	YES	NO	NO	NO
14	EGYPT	YES	YES	NO	NO	YES	YES
15	ETHIOPIA	YES	YES	YES	YES	YES	YES
16	GABON	YES	YES	YES	YES	YES	NO
17	GAMBIA	YES	YES	YES	YES	NO	NO
18	GHANA	YES	YES	YES	YES	YES	YES
19	GUINEA	YES	YES	YES	YES	YES	YES
20	GUINEA-BISSAU	YES	YES	YES	YES	NO	NO
21	KENYA	YES	NO	YES	YES	NO	NO
22	LESOTHO	YES	YES	YES	YES	NO	NO
23	LIBERIA	YES	YES	YES	YES	YES	YES
24	MADAGASCAR	YES	NO	YES	YES	YES	NO
25	MALAWI	YES	YES	YES	YES	NO	NO
26	MALI	YES	YES	YES	YES	YES	YES
27	MAURITANIA	YES	YES	YES	YES	YES	NO
28	MAURITIUS	YES	YES	YES	YES	NO	NO
29	MOROCCO	NO	NO	NO	NO	NO	NO

No	Country	Abuja Treaty		Constitutive Act of the African Union		Constitution of the Association of African Trade Promotion Organizations	
		Signed	Ratified	Signed	Ratified	Signed	Ratified
30	MOZAMBIQUE	YES	YES	YES	YES	NO	NO
31	NAMIBIA	YES	YES	YES	YES	YES	YES
32	NIGER	YES	YES	YES	YES	YES	YES
33	NIGERIA	YES	YES	YES	YES	YES	YES
34	RWANDA	YES	YES	YES	NO	YES	YES
35	SENEGAL	YES	YES	YES	YES	YES	NO
36	SIERRA LEONE	YES	YES	YES	YES	YES	YES
37	SOUTH AFRICA	YES	YES	YES	YES	YES	YES
38	SWAZILAND			YES	YES		
39	TANZANIA	YES	YES	YES	YES	YES	YES
40	TOGO	YES	YES	YES	YES	YES	YES
41	TUNISIA	NO	NO	YES	YES	NO	NO
42	UGANDA	YES	YES	YES	YES	YES	NO
43	ZAMBIA	YES	YES	YES	YES		
44	ZIMBABWE	YES	YES	YES	YES	NO	NO

18

Regional integration: Main Treaties/Protocols relating to regional integration signed/ratified

No	Country	Protocol to the Treaty establishing the African Economic Community relating to the Pan-African Parliament		Protocol on the African Investment Bank	
		Signed	Ratified	Signed	Ratified
1	ALGERIA	YES	NO	YES	NO
2	BENIN	YES	YES	YES	YES
3	BOTSWANA	NO	YES	NO	NO
5	BURKINA FASO	YES	YES	YES	NO
4	BURUNDI	YES	YES	NO	NO
6	CABO VERDE	NO	NO	NO	NO
7	CAMEROON	YES	YES	NO	NO
8	CAR	YES	NO	YES	NO
9	CHAD	YES	YES	NO	NO
10	COMOROS	YES	YES	YES	NO
11	CONGO, REP	YES	YES	YES	YES
12	CÔTE D'IVOIRE	YES	YES	YES	YES
13	DJIBOUTI	YES	YES	YES	NO
14	EGYPT	YES	YES	NO	NO
15	ETHIOPIA	YES	YES	NO	NO
16	GABON	YES	YES	NO	NO
17	GAMBIA	YES	YES	YES	YES
18	GHANA	YES	YES	YES	YES
19	GUINEA	YES	YES	YES	YES
20	GUINEA-BISSAU	YES	YES	YES	YES
21	KENYA	YES	YES	NO	NO
22	LESOTHO	YES	YES	NO	NO
23	LIBERIA	YES	YES	NO	NO
24	MADAGASCAR	YES	YES	NO	NO
25	MALAWI	YES	YES	NO	NO
26	MALI	YES	YES	NO	NO
27	MAURITANIA	YES	YES	YES	YES
28	MAURITIUS	YES	YES	NO	NO
29	MOROCCO	NO	NO	NO	NO

No	Country	Protocol to the Treaty establishing the African Economic Community relating to the Pan-African Parliament		Protocol on the African Investment Bank	
		Signed	Ratified	Signed	Ratified
30	MOZAMBIQUE	YES	YES	NO	NO
31	NAMIBIA	YES	YES	NO	NO
32	NIGER	YES	YES	YES	YES
33	NIGERIA	YES	YES	NO	NO
34	RWANDA	YES	YES	NO	NO
35	SENEGAL	YES	YES	YES	NO
36	SIERRA LEONE	YES	YES	YES	YES
37	SOUTH AFRICA	YES	YES		
38	SWAZILAND	YES			
39	TANZANIA	YES	YES	YES	YES
40	TOGO	YES	YES	YES	YES
41	TUNISIA	YES	YES	NO	NO
42	UGANDA	YES	YES	NO	NO
43	ZAMBIA	YES	YES	YES	NO
44	ZIMBABWE	YES	YES	NO	NO

19

Policies, strategies, and initiatives for domestic resource mobilization

No.	Country	Existence of a National Development Strategy	Country is member of the African Tax Administration Forum (ATAF)	Country is member of the Collaborative African Budget Reform Initiatives (CABRI)	Yaoundé Declaration on Combatting Illicit Financial Flows from Africa (7th June 2014) signed	Country has put in place an Agency to fight illicit financial flows	The Yaoundé Declaration on Tax and Development (9th September 2010) signed
1	ALGERIA	YES	NO	NO	NO	YES	NO
2	BENIN	YES	YES	NO	NO	YES	NO
3	BOTSWANA	NO	YES	YES	YES	YES	NO
5	BURKINA FASO	YES	YES	YES	NO	NO	na
4	BURUNDI	YES	YES	NO	NO	NO	NO
6	CABO VERDE	NO	NO	NO	NO	YES	NO
7	CAMEROON	NO	YES	NO	YES	YES	YES
8	CAR	IN PROCESS	NO	YES	YES	YES	YES
9	CHAD	YES	YES	NO	NO	YES	
10	COMOROS	YES	YES	NO	NO	YES	NO
11	CONGO, REP	YES	NO	NO	YES	YES	YES
12	CÔTE D'IVOIRE	IN PROCESS	YES	NO	na	na	NO
13	DJIBOUTI	NO	na	na	na	YES	na
14	EGYPT	YES	YES	NO	NO	YES	NO
15	ETHIOPIA	IN PROCESS	NO	NO	NO	YES	NO
16	GABON	NO	YES	NO	NO	YES	NO
17	GAMBIA	YES	YES	YES	NO	YES	NO
18	GHANA	YES	YES	YES	YES	YES	YES
19	GUINEA	IN PROCESS	NO	NO	YES	NO	NO
20	GUINEA-BISSAU	NO	YES	NO	NO	YES	NO
21	KENYA	YES	YES	YES	NO	YES	NO
22	LESOTHO	YES	YES	NO	NO	YES	NO
23	LIBERIA	YES	YES	YES	YES	YES	YES
24	MADAGASCAR	YES	YES	NO	NO	YES	NO
25	MALAWI	YES	YES	NO	NO	NO	NO
26	MALI	YES	NO	YES	NO	YES	NO
27	MAURITANIA	NO	YES	YES	YES	YES	YES

No.	Country	Existence of a National Development Strategy	Country is member of the African Tax Administration Forum (ATAF)	Country is member of the Collaborative African Budget Reform Initiatives (CABRI)	Yaoundé Declaration on Combatting Illicit Financial Flows from Africa (7th June 2014) signed	Country has put in place an Agency to fight illicit financial flows	The Yaoundé Declaration on Tax and Development (9th September 2010) signed
28	MAURITIUS	YES	YES	YES	NO	YES	NO
29	MOROCCO	YES	YES	NO	NO	NO	NO
30	MOZAMBIQUE	YES	YES	NO	na	NO	na
31	NAMIBIA	YES	YES	NO	na	YES	NO
32	NIGER	YES	YES	NO	NO	YES	NO
33	NIGERIA	YES	YES	NO	na	YES	na
34	RWANDA	NO	YES	YES	NO	NO	na
35	SENEGAL	YES	YES	YES	YES	YES	NO
36	SIERRA LEONE	YES	YES	NO	YES	YES	NO
37	SOUTH AFRICA	YES	YES	YES	NO	YES	NO
38	SWAZILAND	YES	YES	NO	NO	YES	NO
39	TANZANIA	NO	YES	NO	YES	YES	YES
40	TOGO	NO	YES	NO	YES	YES	NO
41	TUNISIA	IN PROCESS	NO	NO	NO	NO	NO
42	UGANDA	YES	YES	NO	NO	YES	NO
43	ZAMBIA	NO	YES	NO	YES	YES	na
44	ZIMBABWE	YES	YES	YES	NO	YES	NO

na = Information not available

20

Policies, strategies, and initiatives for domestic resource mobilization

No.	Country	The AU Convention on Preventing and Combating Corruption (Maputo, 11 July 2003)	Country has tax exemptions dedicated to investors	Country has developed a specific policy to/strategic to collect taxes from natural resources	Country has put in place strategies to collect taxes from the informal sector	Country has a public training institution dedicated to public revenue collection	Country has a microfinance policy
1	ALGERIA	YES	YES	YES	YES	YES	YES
2	BENIN	YES	YES	NO	YES	YES	YES
3	BOTSWANA	NO	YES	YES	NO	NO	YES
5	BURKINA FASO	YES	YES	YES	YES	YES	YES
4	BURUNDI	NO	YES	NO	YES	YES	YES
6	CABO VERDE	NO	YES	NO	YES	YES	YES
7	CAMEROON	YES	YES		NO	YES	YES
8	CAR	YES	YES	YES	YES	NO	YES
9	CHAD	YES	YES	YES	YES	YES	YES
10	COMOROS	YES	YES	Not applicable	YES	NO	YES
11	CONGO, REP	YES	YES	YES	YES	YES	YES
12	CÔTE D'IVOIRE	YES	YES	YES	YES	YES	YES
13	DJIBOUTI	YES	YES	NO	YES	YES	YES
14	EGYPT	NO	YES	Not applicable	YES		YES
15	ETHIOPIA	YES	YES	NO	YES	YES	NO
16	GABON	YES	YES	Not applicable	YES	YES	YES
17	GAMBIA	YES	YES	Not applicable	YES	NO	YES
18	GHANA	YES	YES	YES	YES	YES	YES
19	GUINEA	YES	YES	NO	NO	NO	YES
20	GUINEA-BISSAU	NO	YES	NO	YES	NO	YES
21	KENYA	YES	YES	NO	YES	NO	YES
22	LESOTHO	YES	NO	YES	NO	NO	NO
23	LIBERIA	YES	YES	YES	NO	NO	YES
24	MADAGASCAR	YES	YES	NO	YES	YES	YES
25	MALAWI	YES	YES	NO	NO	YES	YES
26	MALI		YES	YES	YES	YES	YES
27	MAURITANIA	YES	YES	YES	YES	YES	YES
28	MAURITIUS	YES	YES	Not applicable	YES	YES	YES
29	MOROCCO	NO	YES	YES	NO	YES	YES

No.	Country	The AU Convention on Preventing and Combating Corruption (Maputo, 11 July 2003)	Country has tax exemptions dedicated to investors	Country has developed a specific policy to/strategic to collect taxes from natural resources	Country has put in place strategies to collect taxes from the informal sector	Country has a public training institution dedicated to public revenue collection	Country has a microfinance policy
30	MOZAMBIQUE	YES	YES	YES	YES	YES	NO
31	NAMIBIA	YES	YES	YES	NO	NO	YES
32	NIGER	YES	YES	YES	YES	YES	YES
33	NIGERIA	YES	YES	YES	NO	NO	YES
34	RWANDA	YES	YES	YES	YES	YES	YES
35	SENEGAL	YES	YES	NO	YES	YES	YES
36	SIERRA LEONE	YES	YES	YES	YES	NO	YES
37	SOUTH AFRICA	YES	YES	YES	NO	NO	YES
38	SWAZILAND	YES	YES	NO	NO	NO	YES
39	TANZANIA	YES	YES	YES	YES	YES	YES
40	TOGO	YES	YES	NO	YES	YES	YES
41	TUNISIA	YES	YES	Not applicable	YES	YES	YES
42	UGANDA	YES	YES	YES	YES	YES	YES
43	ZAMBIA		YES	YES	YES	NO	
44	ZIMBABWE	YES	YES	YES	YES	NO	YES

21

Policies, strategies, and initiatives for domestic resource mobilization

No.	Country	Country hosts a stock exchange	Country is a member of a regional stock exchange	Country provides incentives related to the remittances from the diaspora	Country has conducted a tax reform over the past 10 years	Country have a one-stop shop office that deals with all business registrations
1	ALGERIA	YES	NO	NO	YES	YES
2	BENIN	NO	YES	NO	YES	YES
3	BOTSWANA	YES	YES	YES	YES	YES
5	BURKINA FASO	NO	YES	NO	YES	YES
4	BURUNDI	NO	NO	NO	YES	YES
6	CABO VERDE	YES	NO	YES	YES	YES
7	CAMEROON	YES	YES	NO	YES	YES
8	CAR	NO	NO	NO	YES	YES
9	CHAD	NO	YES	NO	YES	YES
10	COMOROS	NO	NO	na	YES	YES
11	CONGO, REP	NO	YES	NO	YES	YES
12	CÔTE D'IVOIRE	YES	YES	na	YES	YES
13	DJIBOUTI	NO	NO	NO	YES	YES
14	EGYPT	YES	YES	NO	YES	YES
15	ETHIOPIA	NO	NO	YES	YES	NO
16	GABON	YES	YES	NO	YES	YES
17	GAMBIA	NO	NO	NO	YES	YES
18	GHANA	YES	YES	YES	NO	YES
19	GUINEA	NO	NO	NO	YES	YES
20	GUINEA-BISSAU	NO	YES	NO	YES	YES
21	KENYA	YES	YES	YES	YES	YES
22	LESOTHO	NO	NO	NO	YES	YES
23	LIBERIA	NO	NO	NO	YES	YES
24	MADAGASCAR	NO	NO	NO	YES	YES
25	MALAWI	YES	NO	NO	YES	YES
26	MALI	NO	YES	YES	YES	YES
27	MAURITANIA	NO	NO	YES	YES	YES
28	MAURITIUS	YES	NO	NO	YES	YES
29	MOROCCO	YES	YES	YES	YES	YES

No.	Country	Country hosts a stock exchange	Country is a member of a regional stock exchange	Country provides incentives related to the remittances from the diaspora	Country has conducted a tax reform over the past 10 years	Country have a one-stop shop office that deals with all business registrations
30	MOZAMBIQUE	YES	YES	YES	YES	YES
31	NAMIBIA	YES	YES	NO	YES	NO
32	NIGER	NO	YES	NO	YES	NO
33	NIGERIA	YES	NO	YES	YES	YES
34	RWANDA	YES	YES	YES	YES	YES
35	SENEGAL	YES	YES	NO	YES	YES
36	SIERRA LEONE	YES	NO	NO	YES	YES
37	SOUTH AFRICA	YES	NO	NO	YES	YES
38	SWAZILAND	YES	NO	NO	YES	NO
39	TANZANIA	YES	YES	YES	YES	YES
40	TOGO	NO	YES	NO	YES	YES
41	TUNISIA	YES	NO	YES	YES	YES
42	UGANDA	YES	NO	NO	YES	NO
43	ZAMBIA	YES	YES	NO	YES	YES
44	ZIMBABWE	YES	NO	NO	YES	YES

Note: na = not available.

22

Challenges in raising tax revenues

No.	Country	There has been information / education / communication campaign related to the payments tax during past 3 years	Country has published the regulations law during the latest fiscal year	Existence of a body to fight against tax evasion and avoidance	Special services offered to bring small business into the tax net
1	ALGERIA	NO	YES	YES	NO
2	BENIN	YES	YES	NO	YES
3	BOTSWANA	YES	YES	YES	NO
5	BURKINA FASO	YES	YES	YES	YES
4	BURUNDI	YES	YES	YES	YES
6	CABO VERDE	YES	YES	YES	NO
7	CAMEROON	YES	YES	NO	YES
8	CAR	YES	NO	YES	NO
9	CHAD	YES	NO	YES	YES
10	COMOROS	YES	YES	YES	YES
11	CONGO, REP	YES	YES	YES	YES
12	CÔTE D'IVOIRE	YES	YES	YES	YES
13	DJIBOUTI	YES	YES	NO	YES
14	EGYPT	YES	YES	YES	YES
15	ETHIOPIA	YES	NO	YES	YES
16	GABON	YES	YES	NO	NO
17	GAMBIA	YES	YES	YES	YES
18	GHANA	YES	YES	YES	NO
19	GUINEA	NO	YES	YES	NO
20	GUINEA-BISSAU	YES	NO	NO	NO
21	KENYA	YES	YES	YES	YES
22	LESOTHO	YES	NO	YES	YES
23	LIBERIA	YES	YES	YES	NO
24	MADAGASCAR	YES	NO	YES	YES
25	MALAWI	YES	YES	YES	NO
26	MALI	YES	YES	YES	YES
27	MAURITANIA	NO	NO	NO	NO
28	MAURITIUS	YES	YES	YES	YES
29	MOROCCO	YES	YES	YES	YES
30	MOZAMBIQUE	YES	YES	YES	YES
31	NAMIBIA	YES	NO	YES	NO

No.	Country	There has been information / education / communication campaign related to the payments tax during past 3 years	Country has published the regulations law during the latest fiscal year	Existence of a body to fight against tax evasion and avoidance	Special services offered to bring small business into the tax net
32	NIGER	YES	NO	YES	NO
33	NIGERIA	YES	NO	NO	YES
34	RWANDA	YES	YES	YES	YES
35	SENEGAL	YES	YES	YES	YES
36	SIERRA LEONE	YES	YES	YES	YES
37	SOUTH AFRICA	YES	YES	YES	YES
38	SWAZILAND	YES	YES	YES	YES
39	TANZANIA	YES	YES	NO	YES
40	TOGO	YES	NO	YES	NO
41	TUNISIA	YES	YES	YES	NO
42	UGANDA	YES	YES	YES	YES
43	ZAMBIA	YES	YES	YES	YES
44	ZIMBABWE	YES	YES	YES	YES

23

Capacity building relating to domestic resource mobilization

No.	Country	Over the past 3 years, there has been a capacity building program in the following areas					
		Fighting corruption	Illicit financial flows	Fiscal sustainability	Social security and safety nets	Financial sector strengthening	Revenue collection
1	ALGERIA	YES	YES	YES	YES	YES	YES
2	BENIN	NO	YES	NO	NO	NO	YES
3	BOTSWANA	YES	NO	YES	YES	YES	YES
5	BURKINA FASO	YES	NO	YES	YES	NO	YES
4	BURUNDI	YES	NO	NO	NO	YES	YES
6	CABO VERDE	NO	NO	NO	NO	NO	NO
7	CAMEROON	NO	YES	NO	NO	NO	YES
8	CAR	YES	YES	YES	YES	YES	YES
9	CHAD	YES	YES	YES	YES	YES	YES
10	COMOROS	YES	YES	YES	YES	YES	YES
11	CONGO, REP	YES	YES	YES	YES	YES	YES
12	CÔTE D'IVOIRE	NO	NO	NO	NO	NO	NO
13	DJIBOUTI	YES	YES	YES	YES	YES	YES
14	EGYPT	YES	YES	YES	YES	YES	YES
15	ETHIOPIA	YES	YES	YES	YES	YES	YES
16	GABON	YES	YES	YES	YES	YES	YES
17	GAMBIA	NO	NO	YES	NO	YES	YES
18	GHANA	YES	YES	YES	YES	NO	YES
19	GUINEA	YES	NO	YES	YES	YES	YES
20	GUINEA-BISSAU	YES	YES	NO	NO	YES	YES
21	KENYA	YES	YES	YES	YES	YES	YES
22	LESOTHO	YES	YES	YES	YES	YES	YES
23	LIBERIA	YES	NO	YES	NO	YES	YES
24	MADAGASCAR	YES	NO	YES	YES	NO	YES
25	MALAWI	YES	YES	YES	NO	YES	YES
26	MALI	YES	YES	YES	YES	YES	YES
27	MAURITANIA	YES	NO	NO	YES	YES	YES
28	MAURITIUS	YES	YES	YES	YES	YES	YES
29	MOROCCO	YES	YES	NO	YES	YES	YES

No.	Country	Over the past 3 years, there has been a capacity building program in the following areas					
		Fighting corruption	Illicit financial flows	Fiscal sustainability	Social security and safety nets	Financial sector strengthening	Revenue collection
30	MOZAMBIQUE	YES	YES	YES	YES	YES	YES
31	NAMIBIA	YES	YES	YES	YES	YES	YES
32	NIGER	YES	YES	YES	YES	YES	YES
33	NIGERIA	YES	YES	YES	NO	YES	YES
34	RWANDA	YES	YES	YES	NO	YES	YES
35	SENEGAL	YES	YES	NO	NO	YES	YES
36	SIERRA LEONE	YES	YES	YES	YES	YES	YES
37	SOUTH AFRICA	NO	NO	YES	NO	NO	YES
38	SWAZILAND	YES	YES	YES	na	na	YES
39	TANZANIA	YES	YES	YES	YES	YES	YES
40	TOGO	YES	YES	YES	YES	YES	YES
41	TUNISIA	YES	YES	NO	YES	YES	YES
42	UGANDA	YES	YES	YES	YES	YES	YES
43	ZAMBIA	YES	na	YES	na	YES	YES
44	ZIMBABWE	YES	YES	YES	YES	YES	YES

Note: na = not available.

24

Institutional and regulatory framework for science, technology, and innovation

No.	Country	Existence of a Strategy for STI	Capacity development is part of the strategy	Country has indicators tracking R&D	Country has a body in charge of intellectual property protection	Country has joined a REC initiative for the promotion of STI
1	ALGERIA	Part of NDP	CD is part of the Strategy, but without clear objectives	NO	YES	NO
2	BENIN	YES	CD is part of the Strategy, but without clear objectives	NO	YES	YES
3	BOTSWANA	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
5	BURKINA FASO	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
4	BURUNDI	YES	CD is part of the Strategy, with clear objectives	YES	YES	na
6	CABO VERDE	Part of NDP	CD is part of the Strategy, with clear objectives	YES	YES	YES
7	CAMEROON	Part of NDP	CD is part of the Strategy, with clear objectives	YES	NO	YES
8	CAR	na	na	na	na	na
9	CHAD	Part of NDP	CD is part of the Strategy, with clear objectives	NO	YES	NO
10	COMOROS	YES	CD is part of the Strategy, with clear objectives	na	YES	YES
11	CONGO, REP	YES	CD is part of the Strategy, but without clear objectives	YES	YES	YES
12	CÔTE D'IVOIRE	Part of NDP	CD is part of the Strategy, but without clear objectives	na	YES	YES
13	DJIBOUTI	Part of NDP	CD is part of the Strategy, with clear objectives	YES	YES	YES
14	EGYPT	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
15	ETHIOPIA	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
16	GABON	na	na	na	na	na
17	GAMBIA	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
18	GHANA	YES	CD is part of the Strategy, with clear objectives	NO	YES	YES
19	GUINEA	Part of NDP	CD is part of the Strategy, with clear objectives	NO	YES	NO
20	GUINEA-BISSAU	Part of NDP	CD is part of the Strategy, but without clear objectives	NO	YES	YES

No.	Country	Existence of a Strategy for STI	Capacity development is part of the strategy	Country has indicators tracking R&D	Country has a body in charge of intellectual property protection	Country has joined a REC initiative for the promotion of STI
21	KENYA	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
22	LESOTHO	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
23	LIBERIA	Part of NDP	CD is part of the Strategy, but without clear objectives	NO	NO	YES
24	MADAGASCAR	Part of NDP	CD is part of the Strategy, but without clear objectives	YES	YES	NO
25	MALAWI	YES	CD is not at all part of the Strategy	YES	YES	YES
26	MALI	NO	na	NO	YES	YES
27	MAURITANIA	YES	CD is part of the Strategy, with clear objectives	YES	YES	NO
28	MAURITIUS	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
29	MOROCCO	YES	CD is part of the Strategy, but without clear objectives	YES	YES	YES
30	MOZAMBIQUE	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
31	NAMIBIA	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
32	NIGER	YES	CD is not at all part of the Strategy	YES	YES	YES
33	NIGERIA	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
34	RWANDA	YES	CD is part of the Strategy, with clear objectives	YES	YES	NO
35	SENEGAL	NO	CD is part of the Strategy, but without clear objectives	NO	YES	YES
36	SIERRA LEONE	YES	CD is part of the Strategy, with clear objectives	NO	YES	YES
37	SOUTH AFRICA	YES	CD is not at all part of the Strategy	YES	NO	YES
38	SWAZILAND	Part of NDP	CD is part of the Strategy, but without clear objectives	NO	YES	YES
39	TANZANIA	Part of NDP	CD is part of the Strategy, with clear objectives	YES	YES	YES
40	TOGO	NO	CD is part of the Strategy, but without clear objectives	YES	YES	YES
41	TUNISIA	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
42	UGANDA	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
43	ZAMBIA	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES
44	ZIMBABWE	YES	CD is part of the Strategy, with clear objectives	YES	YES	YES

Note: CD = capacity development; na = not available; NDP = National Development Plan; R&D = research and development; REC = regional economic committee; STI = science, technology, and innovation.

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Technology readiness

No	Country	Overall	Availability of latest technologies	Firm-level technology absorption	FDI and technology transfer	Individuals using Internet	Fixed broadband Internet subscriptions per 100 people	International internet bandwidth, kb/s per user	Mobile subscriptions per 100 people
1	Algeria	**3.1**	3.7	3.6	3.6	38.2	5.6	30.1	40.1
2	Benin	2.5	3.6	4.1	3.3	6.8	0.7	3.0	4.2
3	Botswana	**3.6**	4.4	4.4	4.0	27.5	1.8	11.4	67.3
5	BURKINA FASO	na	na	na	na	na	na	na	na
4	BURUNDI	2.0	2.9	2.9	3.2	*4.9*	0.0	5.7	7.6
6	CABO VERDE	3.8	4.5	4.3	4.4	43.0	3.0	17.1	72.9
7	Cameroon	**2.6**	3.8	4.0	3.6	20.7	0.1	1.0	4.3
8	CAR	na	na	na	na	na	na	na	na
9	CHAD	**1.9**	2.7	3.1	2.8	2.7	0.1	2.6	1.4
10	COMOROS	na	na	na	na	na	na	na	na
11	CONGO, REP	na	na	na	na	na	na	na	na
12	CÔTE D'IVOIRE	**3.4**	4.9	4,5	4.5	21.0	0.5	5.2	40.4
13	DJIBOUTI	na	na	na	na	na	na	na	na
14	EGYPT	**3.3**	3.9	3.8	4.4	35.9	4,5	11.3	50.7
15	ETHIOPIA	**2.4**	3.7	3.5	3.9	11.6	0.7	2.0	11.9
16	GABON	**3.1**	4.0	4.1	3.7	23.5	0.6	8.5	33.1
17	GAMBIA	**2.9**	4,3	4.2	4.0	17.1	0.2	13.3	10.0
18	GHANA	**3.4**	3.9	4.2	4.2	23.5	0.3	2.8	66.8
19	GUINEA	na	na	na	na	na	na	na	na
20	GUINEA-BISSAU	na	na	na	na	na	na	na	na
21	KENYA	**3.6**	5.2	5.1	4.6	45.6	0.3	40.1	15.5
22	LESOTHO	**2.7**	3.4	3.5	3.3	16.1	0.1	3.9	37.7
23	LIBERIA	**2.4**	3.0	3.7	3.6	5.9	0.2	7.5	20.5
24	MADAGASCAR	2.5	3.8	4.3	3.8	4.2	0.1	12.4	9.0
25	MALAWI	**2.3**	3.3	3.4	3.3	9.3	0.0	2.4	16.6
26	MALI	2.8	4.0	3.9	3.8	10.3	0.0	1.3	18.8
27	MAURITANIA	**2.3**	3.3	3.4	2.4	15.2	0.2	1.5	23.1
28	MAURITIUS	**4.2**	4.9	4.7	4.5	50.1	15.7	33.9	37.0
29	MOROCCO	**3.7**	5.0	4.6	4.5	57.1	3.4	18.3	39,3
30	MOZAMBIQUE	**2.5**	3.7	3.9	3.9	9.0	0.1	6.1	9.4
31	NAMIBIA	**3.6**	5,0	4.5	4.4	22.3	1.7	22.5	62.1

No	Country	Overall	Availability of latest technologies	Firm-level technology absorption	FDI and technology transfer	Individuals using Internet	Fixed broadband Internet subscriptions per 100 people	International internet bandwidth, kb/s per user	Mobile subscriptions per 100 people
32	NIGER	na	na	na	na	na	na	na	na
33	NIGERIA	**3.1**	4.3	4.3	4.3	47.4	0.0	3.0	21,0
34	RWANDA	**3.2**	5.1	4.7	4.8	18.0	0.2	5.7	25.9
35	SENEGAL	**3.2**	4.8	4.9	3.9	21.7	0.7	6,9	26.4
36	SIERRA LEONE	**2.4**	3.0	3.7	3.4	2.5	n/a	2.0	15.2
37	SOUTH AFRICA	**4.7**	5.4	5.4	4.6	51.9	5.3	147.6	59.5
38	SWAZILAND	na	na	na	na	na	na	na	na
39	TANZANIA	**2.6**	3.7	4.2	4.0	5.4	0.2	4.1	3.2
40	TOGO	na	na	na	na	na	na	na	na
41	TUNISIA	3.7	4.6	4.1	4.2	48.5	4.3	33.8	62.6
42	UGANDA	2.8	4.1	4.1	4.3	19.2	0.3	4.6	18.3
43	ZAMBIA	**2.8**	4.1	4.2	4.3	21.0	0.1	3.2	13.8
44	ZIMBABWE	**2.7**	4.0	3.9	2.8	16.4	1.1	6.4	39.0

Note: FDI = foreign direct investment; kbs = kilobits; na = not available.

26

Innovation

No	Country	Overall	Capacity for innovation	Qualified research institutions	Company spending on R&D	University-Industry collaboration on R&D	Government procurement of advanced technology product	Availability of scientists and engineers	PCT patent and application per million people
1	Algeria	**2.9**	3.7	3.4	2.8	2.7	2.9	3.8	0.2
2	Benin	**3.2**	4.7	3.7	3.0	3.1	3.1	3.5	0.0
3	Botswana	**3.2**	3.9	3.5	3.1	3.4	3.6	3.5	0.2
5	BURKINA FASO	na	na	na	na	na	na	na	na
4	BURUNDI	**2.5**	3.2	2.2	2.6	2.8	2.7	3.2	0.0
6	CABO VERDE	3.1	3.7	3.5	3.1	3.2	3.4	3.5	0.0
7	Cameroon	3.2	4.4	3.6	3.1	3.2	3.0	3.4	0.0
8	CAR	na	na	na	na	na	na	na	na
9	CHAD	**2.5**	3.2	2.6	2.6	2.6	2.6	2.7	0.0
10	COMOROS	na	na	na	na	na	na	na	na
11	CONGO, REP	na	na	na	na	na	na	na	na
12	CÔTE D'IVOIRE	**3.4**	*4.3*	4.2	3.6	3.3	3.2	3.9	0.0
13	DJIBOUTI	na	na	na	na	na	na	na	na
14	EGYPT	**2.7**	3.1	2.6	2.4	2.4	3.2	4.3	0.8
15	ETHIOPIA	**3.4**	3.7	3.8	3.8	3.8	3.5	3.9	0.0
16	GABON	**2.7**	3.6	3.2	2.7	2.6	2.7	2.8	0.4
17	GAMBIA	**3.0**	4.2	3.1	2.9	2.6	3.8	3.0	0.4
18	GHANA	**3.3**	4.1	3.7	3.4	3.3	3.6	3.9	0.0
19	GUINEA	na	na	na	na	na	na	na	na
20	GUINEA-BISSAU	na	na	na	na	na	na	na	na
21	KENYA	**3.8**	4.6	4.2	4.1	4.5	4.0	4.4	0.2
22	LESOTHO	**2.9**	3.4	3.6	3.0	2.8	3.2	3.2	0.0
23	LIBERIA	**3.2**	3.5	3.0	3.7	3.7	3.6	3.3	0.0
24	MADAGASCAR	**3.1**	4.0	3.6	3.2	3.4	2.8	3.7	0.1
25	MALAWI	**2.8**	3.5	3.0	2.8	2.7	2.9	3.6	0.0
26	MALI	**3.2**	3.6	3.7	3.3	3.1	3.4	3.5	0.0
27	MAURITANIA	**2.2**	2.1	2.1	1.9	3.3	2.4	2.3	0.0
28	MAURITIUS	**3.3**	4.3	3.6	3.4	3.2	3.4	3.8	1.6
29	MOROCCO	**3.1**	3.8	3.1	3.0	3.1	3.0	4.0	1.5
30	MOZAMBIQUE	2.8	3.5	2.8	2.9	3.3	3.1	3.1	0.0
31	NAMIBIA	**3.3**	4.1	3.5	3.5	3.3	3.4	3.5	0.2

No	Country	Overall	Capacity for innovation	Qualified research institutions	Company spending on R&D	University-Industry collaboration on R&D	Government procurement of advanced technology product	Availability of scientists and engineers	PCT patent and application per million people
32	NIGER	na	na	na	na	na	na	na	na
33	NIGERIA	**2.9**	4.0	2.7	3.0	2.7	2.9	3.8	0.0
34	RWANDA	**3.6**	4.3	3.7	3.3	3.3	4.4	4.0	0.0
35	SENEGAL	**3.5**	4.4	4.3	3.5	3.6	3.4	3.8	0.0
36	SIERRA LEONE	**2.6**	3.3	2.3	2.5	2.6	3.1	3.0	0.1
37	SOUTH AFRICA	**3.8**	5.0	4.9	4.2	4.4	2.9	3.4	6.5
38	SWAZILAND	na	na	na	na	na	na	na	na
39	TANZANIA	**3.2**	3.7	3.7	3.1	3.5	3.5	3.7	0.0
40	TOGO	na	na	na	na	na	na	na	na
41	TUNISIA	**3.0**	3.8	3.2	2.9	3.0	2.7	4.3	0.7
42	UGANDA	3.3	3.9	3.4	3.1	3.8	3.5	3.9	0.0
43	ZAMBIA	**3.3**	3.9	3.6	3.2	3.5	3.6	4.1	0.0
44	ZIMBABWE	**2.6**	3.3	3.2	2.4	2.5	2.1	3.2	0.1

Note: na = not available; PCT = ???; R&D = research and development.