Africa's Development Dynamics 2023

INVESTING IN SUSTAINABLE DEVELOPMENT

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Foreword

The annual flagship report *Africa's Development Dynamics* is a product of the longstanding partnership between the African Union Commission's Department of Economic Development, Trade, Tourism, Industry and Minerals and the OECD Development Centre. It brings together a team of academic researchers, economists, statisticians and other experts from African and partner countries.

The 2024 edition explores how African stakeholders can increase the continent's supply of quality skills, in line with current and future demand, to support the creation of jobs and growth in productivity, in line with the vision and aspirations of Agenda 2063. The first chapter addresses how skill supply currently meets demand. It also identifies options for developing newly in-demand skills, in response to the digital and green transitions. The second chapter proposes priority policies to bridge gaps in foundational, soft and technical skills, drawing on lessons from across the continent and beyond. The ensuing chapters focus on the five African regions as defined by the Abuja Treaty: Southern, Central, East, North and West Africa. These chapters offer tailored policy recommendations to develop skills in strategic sectors for each region, including mining, digital technologies, renewable energy and agri-food.

This edition draws on a wide range of data sources and included primary data collection through interviews and surveys. The cut-off date for data used in the report was 21 March 2024, except for the statistical annex, which is revised online on an ongoing basis.

For the second chapter, 20 evaluation reports were analysed to assess the implementation of technical and vocational education and training (TVET) projects in Africa. This exercise sought to explain factors that enable or hinder TVET project performance. The analysed reports were selected from a database of 225 TVET evaluations, compiled from 2 publicly available sources: the online repository of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Evaluation Resource Centre (DEReC) of the OECD Development Assistance Committee (DAC). The former gathers project reports led by the German Cooperation Agency; the latter collects evaluation reports from the development agencies of the 32 DAC members, including GIZ, and partners such as the African Development Bank. Additionally, the authors conducted 3 semi-structured interviews with TVET practitioners in Africa-based international organisations to evaluate success factors for and barriers to TVET project implementation. The interviews took place from October to December 2023.

The North Africa chapter provides a comprehensive overview of findings derived from a qualitative survey conducted in January 2024 in the renewable energy sector. Based on semi-structured interviews, the survey asked questions about skills in renewable energy. The study included 18 participants who were engaged in renewable energy activities or used such energy sources. The participants came from different countries in North Africa and represented the public sector, business associations, private enterprises and universities.

The statistical annex contains the latest economic, social and institutional indicators across African countries for which data are comparable. A list of data tables appears in the last pages of the report. The data are presented by country, region, regional economic community and relevant country groupings (e.g. resource endowment, levels of income, socio-economic development and fragility, ocean access, and language). The annex provides comparisons between Africa and different world regions as well as other relevant benchmarks. These data aim to inform decision-makers, advisors, business analysts, private investors, journalists, non-governmental organisations and citizens around the globe who are interested in the development trajectories of African countries.

The full report is published in English, French and Portuguese. Additional figures and tables and the statistical annex are available on the websites of the African Union and the OECD Development Centre.

Acknowledgements

The flagship economic report *Africa's Development Dynamics 2024: Skills, Jobs and Productivity* (AfDD 2024) was jointly prepared by the African Union Commission (AUC) and the OECD Development Centre. It is published under the aegis of H.E. Moussa Faki Mahamat, AUC President, and H.E. Mathias Cormann, OECD Secretary-General. It was guided by H.E. Albert M. Muchanga, Commissioner for Economic Development, Trade, Tourism, Industry and Minerals of the African Union, and by Ragnheiður Elín Árnadóttir, Director of the OECD Development Centre. The report was supervised by Djamel Ghrib, Director, Department of Economic Development, Trade, Tourism, Industry and Minerals, and by Patrick Ndzana Olomo, Head of the Economic Policy and Sustainable Development Division, Department of Economic Development, Trade, Tourism, Industry and Minerals, along with Federico Bonaglia, Deputy Director of the OECD Development Centre, and Arthur Minsat, Head of the OECD Development Centre's Africa Unit and Senior Economist.

The drafting team of the AUC consisted of Patrick Ndzana Olomo, Head of the Economic Policy and Sustainable Development Division, Rumbidzai Treddah Manhando, Economist, Luckystar Miyandazi, Tax and Domestic Revenue Mobilisation Adviser, and Ronnel Inonge Sisamu, Legal Advisor (Department of Economic Development, Trade, Tourism, Industry and Minerals). Regional experts who contributed to the report included Jude Eggoh (University of Abomey-Calavi), Kevin Ibeh (Birkbeck University, University of London), Nabil Jedlane (ENCG Tanger), Nicholas Ngepah (University of Johannesburg) and Bruno Emmanuel Ongo Nkoa (Université de Yaoundé II). The team at the OECD Development Centre, led by Arthur Minsat, Head of the Africa Unit, with Nicolas Friederici, included, Keiko Álvarez, Mélanie Brin, Andrea Cinque, Ginevra Coda Nunziante, Majda Eddaifi, Ismaël Keita, Sébastien Markley, Agnès Moukarzel, Francesco Napolitano, Elisa Saint Martin, Clémentine Tahir, Maha Temre and Bakary Traoré. Anne-Marie Trang (OECD) and Mandy Mauyakufa (AUC) gave valuable support to the research, production, logistics and administrative work on the report.

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Editorial

Investment is key to propel Africa's development, and to attain the African Union's Agenda 2063 and the Sustainable Development Goals. Yet, global crises have widened the African continent's sustainable financing gap. Africa needs an extra USD 1.6 trillion by 2030 – USD 194 billion annually – to achieve the Sustainable Development Goals. The sustainable financing gap can be bridged: it is equivalent to less than 0.2% of the value of global financial assets, or 10.5% of the African-held financial assets.

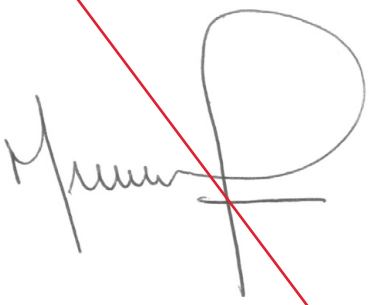
Since the turn of the 21st century, Africa has boasted the world's second-highest rate of economic growth after developing Asia. Yet despite this strong growth, global investment has shifted focus away from the continent. Greenfield foreign direct investment (FDI) has decreased from 12% of the world's total in 2017 to less than 6% in 2021 – compared to 15% for developing Asia and 10% for Latin America and the Caribbean.

Low sustainable investment is a tragic paradox, when so many opportunities exist. The continent boasts unique assets that should attract more investment to boost transformative and sustainable activities. Take the energy sector. Africa is endowed with 60% of the world's best solar resources, but only 1% of installed solar generation capacity. Africa also has the world's youngest population, with a median age of 19 years. By 2050 25% of the global population will reside in Africa. The world must therefore better invest in African youth now to fully realise its significant opportunities.

Low investor confidence and high cost of capital are holding back investment in Africa more than any other world region. In uncertain times, investors are more attentive to macroeconomic and political risks, like policy predictability and regulatory capacity. Scarce skilled labour and quality infrastructure can hinder investment, notably in technology-driven sectors or where large upfront investment is required. Investors' scepticism results in incongruity: the African continent boasts the world's lowest default rates for infrastructure, yet most projects go unfinanced.

Better policies can turn challenges into opportunities. Our analysis highlights three priorities. First, fit-for-purpose data will support informed investment decisions, better aligning risk perceptions to realities. Too many investors withhold decisions because of insufficient or costly information gathering. Second, African-led partnerships can optimise the impacts of sustainable finance on development and better catalyse investments into local sustainable activities. The deepening and integration of domestic capital markets, the development of local currency bonds and the strengthening of ESG compliance are part of the solution. Third, deepening African integration further, notably by implementing the African Continental Free Trade Area (AfCFTA) and its protocol on investment, will harmonise policies among countries and facilitate value chains development.

The growing partnership between the African Union Commission and the OECD, including through its Development Centre, provides an important venue to inform global narratives on Africa and bring the African continent from the frontier to the heart of global investment. Leveraging our policy dialogue platform on investment and productive transformation in Africa, we are committed to working together to monitor trends and identify good practices on the continent that mobilise greater investment for sustainable development and job creation. We are proud that this joint report, now in its fifth edition, contributes to enhanced global partnerships and an effective policy dialogue that benefits African people.



Moussa Faki Mahamat

Chairperson
African Union Commission

Mathias Cormann

Secretary-General
Organisation for Economic Co-operation and Development

Table of contents

Figures

Tables

Boxes

Abbreviations and acronyms

AAP	Alliance for African Partnership
ACET	African Center for Economic Transformation
ACQF	African Continental Qualifications Framework
ADEA	Association for the Development of Education in Africa
AfCFTA	African Continental Free Trade Area
AFD	Agence française de développement (*French Development Agency*)
AfDB	African Development Bank
AfDD	Africa's Development Dynamics
AI	Artificial intelligence
AMLA	African Mining Legislation Atlas
ASM	Artisanal and small-scale mining
ATAF	African Tax Administration Forum
AU	African Union
AUC	African Union Commission
AUDA-NEPAD	African Union Development Agency-New Economic Partnership for Africa's Development
AUF	Agence universitaire de la Francophonie (*The Francophone University Agency*)
BEAR	Better Education for Africa's Rise
BMGF	Bill and Melinda Gates Foundation
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (*Federal Ministry for Economic Co-operation and Development*)
CEDEFOP	European Centre for the Development of Vocational Training
COMESA	Common Market for Eastern and Southern Africa
COMILOG	Compagnie minière de l'Ogooué (*Ogooué Mining Company*)
DHS	Demographic and Health Surveys
EAC	East African Community
EASTRIP	East Africa Skills for Transformation and Regional Integration Project
EC	European Commission
ECA	Economic Commission for Africa
ECOWAS	Economic Community of West African States
EITI	Extractive Industries Transparency Initiative
EU	European Union
ERCE	Regional Comparative and Explanatory Study
ESG	Environmental, social and governance
EV	Electric vehicle
FAO	Food and Agriculture Organization
FDI	Foreign direct investment
FONEA	National Support Fund for Employability and Apprenticeship
GCA	Global Center on Adaptation
GDP	Gross domestic product
GEEAP	Global Education Evidence Advisory Panel
GEF	Global Environment Facility
GIS	Geographic information system
GIZ	Gesellschaft für Internationale Zusammenarbeit (*German Corporation for International Co-operation*)

ICAO	International Civil Aviation Organization
ICEE	International Conference on Environmental Education
ICT	Information and communications technology
IDRC	International Development Research Centre
IEA	International Energy Agency
IFC	International Finance Corporation
IGF	Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development
ILO	International Labour Organization
IISD	International Institute for Sustainable Development
IMF	International Monetary Fund
IPIS	International Peace and Information Service
IRENA	International Renewable Energy Agency
ISCO	International Standard Classification of Occupations
ITC	International Trade Center
JICA	Japan International Cooperation Agency
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KfW	Kreditanstalt für Wiederaufbau (*Credit Institute for Reconstruction*)
LAC	Latin America and the Caribbean
LAYS	Learning-adjusted years
LLECE	Laboratorio Latinoamericano de Evaluación de la Calidad de la Educación (*The Latin-American Laboratory for Assessment of the Quality of Education*)
LMIS	Logistics management information systems
MOOC	Massive open online course
MQA	Mining qualifications authority
NVTC	Nakawa Vocational Training College
OACPS	Organization of African, Caribbean and Pacific States
OECD	Organisation for Economic Co-operation and Development
O*NET	Occupational Information Network
PALOP	Países Africanos de Língua Oficial Portuguesa (*Portuguese-speaking African countries*)
PASEC	Programme for the Analysis of Educational Systems of CONFEMEN
PIRLS	Progress in International Reading Literacy Study
PISA	Programme for International Student Assessment
PPP	Purchasing power parity
PSF	Private Sector Federation
RAFIC	Regional Flagship ICT Centre
RES	Renewable energy sources
RPL	Recognition of prior learning
SACMEQ	The Southern and Eastern Africa Consortium for Monitoring Education Quality
SADC	Southern African Development Community
SAP	Systems, Applications and Products in Data Processing
SIFA	Skills Initiative for Africa
SME	Small and medium-sized enterprise
SMP	Skill mobility partnership
SQL	Structured Query Language

STEM	Science, technology, engineering and mathematics
SWP	Sustainable Water Partnership
TARL	Teaching at the Right Level
TIMSS	Trends in International Mathematics and Science Study
TVET	Technical and vocational education and training
UEMOA	Union Économique et Monétaire Ouest-Africaine (*West African Economic and Monetary Union*)
UIS	UNESCO Institute for Statistics
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNU WIDER	United Nations University World Institute for Development Economics Research
USAID	United States Agency for International Development
WEF	World Economic Forum
WFP	World Food Programme
WHO	World Health Organization
WTO	World Trade Organization
ZMDC	Zimbabwe Mining Development Corporation

Executive summary

Africa can improve the productivity and the quality of its economic growth by investing in a virtuous cycle of better skills for better jobs. Labour markets must rapidly increase the supply of and demand for skilled workers. On the supply side, while education levels have progressed, the quality of education must catch up with other developing regions. Over the last two decades, primary school completion rates have increased from about 55% to 75%. Yet, children in Africa benefit from only 5.1 learning-adjusted years of schooling, compared to 7.2 in developing Asia and 7.8 in Latin America and the Caribbean. On the demand side, labour markets must create quality jobs for skilled workers. Over 80% of Africa's youth in school aspire to work in high-skilled occupations, but only 8% find such jobs. The demand for skilled workers remains low because employment growth has been confined to low-productivity sectors like agriculture, retail trade and services. About 82% of the continent's workers are informal, compared to 56% for Latin America and the Caribbean and 73% for developing Asia. In addition, highly educated workers tend to migrate outside the continent: among tertiary-educated individuals born in Africa, 17% resided abroad in 2020, of which 72% chose high-income countries.

Africa's better-educated and growing population is changing the global workforce. The continent's working-age population (i.e. 15-64 years old) will almost double in the next 26 years, from 849 million in 2024 to 1 556 million in 2050. This growth will account for 85% of the increase in the global working-age population. The number of young Africans having completed an upper-secondary or tertiary education will more than double between 2020 and 2040, from 103 million to 240 million.

Socio-economic returns on better education are higher in Africa than in other world regions. Each additional year of education could boost African learners' earnings by 8.2-11.4%, compared to 7.6-9.1% for countries in Latin America and the Caribbean. In manufacturing, evidence from 27 African countries shows that a 10 percentage point increase in the share of employees with high school and university degrees is associated with an increase in average firm productivity by 4.2% and 4.8%, respectively. If all of Africa's children acquired foundational literacy and numeracy skills, gross domestic product could increase by more than 22-fold (more than any other world region), by about USD 154 trillion.

African labour markets are adapting to new trends, which is redefining skill demand and supply. As the continent's digitalisation advances, the number of jobs requiring digital skills is growing. By 2030, 70% of these jobs will demand basic digital skills and 23% intermediate digital skills, especially in services. Developing renewable energy and sustainable infrastructure could generate over 9 million new jobs by 2030 and a further 3 million jobs by 2050. Many skill shortages in the renewable energy sector are found in vocational roles. Climate adaptation measures, including improved climate literacy and climate-smart agriculture, will increase productivity and provide additional employment opportunities.

African countries would benefit from skills development policies that balance multiple trade-offs, including between high productivity, employment potential and inclusivity. Policies must take into account each country's comparative advantages, capacities and financial resources. *Africa's Development Dynamics 2024* proposes five policy options to bridge Africa's skill gaps:

1. **To be effective, skill strategies must be based on detailed analysis of data pertaining to each national context.** Countries face different situations: African economies that are diversifying (e.g. Egypt, Eswatini, Mauritius, Senegal and Tunisia) rely on occupations requiring more foundational and soft skills as well as more skills in science, technology, engineering and mathematics (STEM) than agrarian countries (e.g. Burundi, Democratic Republic of the Congo, Mozambique, Tanzania and Uganda), which depend on agricultural employment. Only Algeria, Mauritius, Morocco and Tunisia show STEM graduation rates of above 20%, coupled with large tertiary enrolment. To align the supply of skills with future demand, national strategies can use granular and big data (like from job boards) to identify skill gaps in targeted sectors. Improving labour market information systems, increasing the frequency of surveys and collaborating more closely with the private sector are ways to better assess skill supply and demand.

2. **African countries can increase education spending and improve its efficiency through cost-effective interventions and learning assessments.** Cost-effective interventions include structured pedagogy and targeted teaching by learning level. Comparable national, regional (e.g. PASEC and SACMEQ) and international (e.g. PISA, TIMSS and PIRLS) learning assessments can serve to monitor education outcomes and policy impacts, providing evidence for policy making.

3. **Training and skill recognition can improve informal and female workers' productivity.** Entrepreneurial, managerial and soft skills training are widespread. Training formats vary in effectiveness, and they need to be chosen with care to increase productivity and inclusivity. Recognition of prior learning validates knowledge that informal workers have acquired without formal training and can help them find more productive jobs. Cabo Verde, Ghana, Nigeria, Tanzania, Togo and Tunisia, among others, have developed such programmes.

4. **Technical and vocational education and training (TVET) institutions can better adapt their training offers to Africa's emerging skill needs.** TVET institutions can become more attractive to students and employers by designing more relevant curricula, including on digital skills, and by developing stronger linkages with the private sector. Only 30% of surveyed TVET trainers in Africa have recent experience in companies related to the sectors they teach. Many good practices can be emulated, including Morocco's ten Delegated Management Institutes located within special economic zones to provide tailor-made training courses. National funding for TVET can be made more accountable and can rely less on development partners.

5. **Regional frameworks and broader international partnerships can accelerate skills development.** Harmonising policies across countries can permit skill mobility, free trade and the free movement of people across borders, creating benefits from their interplay. The East Africa Skills for Transformation and Regional Integration Project (EASTRIP) brings a regional approach to specialised TVET skills. Across Africa, AUDA-NEPAD's regional Centres of Excellence help anticipate sectoral skill needs. International partnerships and university exchanges, for example programmes like ERASMUS+, are crucial for skills development and retention.

Policy recommendations to improve skills, jobs and productivity in African regions

Region	Case study	Policy recommendations
Southern Africa	Mining	• Monitor skills development in alignment with regional standards and global best practices. • Incorporate country-specific technical mining and complementary skill sets into mining education and training. • Target education and training programmes directly towards women and workers in artisanal and small-scale mining.
Central Africa	Mining	• Encourage the development of regional and national strategies and improve data collection. • Promote public-private partnerships to improve TVET quality and offer training that responds to skill demand. • Enhance the mining sector's sustainability and inclusiveness through upskilling artisanal and small-scale miners. • Strengthen transparency, accountability and multi-level governance for a better allocation of resources.
East Africa	Digital skills	• Expand Internet access and integrate digital skills into education. • Target intermediate and advanced digital skill provision towards country-specific needs and global demand. • Enhance regional integration of digital markets, infrastructure and regional co-operation for skills development.
North Africa	Renewable energies	• Develop national strategies for renewable energy that account for upcoming skill demand. • Enhance skill supply by promoting on-the-job training, research and development, and centres of excellence. • Support skills development through co-operation with public and private partners at all levels.
West Africa	Agri-food	• Reinforce professionalisation through public-private partnerships and local initiatives. • Reduce the skill gap through increased co-operation between research institutions and the private sector. • Mobilise investment towards upskilling workers to respond to global challenges, particularly climate change.

Source: Authors' compilation.

Overview

Skills development can increase the productivity of Africa's talent pool and create jobs

To improve productivity and the quality of its economic growth, Africa must invest in a virtuous cycle of better skills for better jobs. In 2025, Africa's real growth is projected at 4%, outpacing Latin America and the Caribbean (2.5%) and close behind developing Asia (4.8%). And yet the continent's economic growth continues to generate too few quality jobs, for the growth does not translate into sufficient productivity gains (AUC/OECD, 2019[1]; AUC/OECD, 2018[2]). Skill gaps are one central reason. Partly because of shortages in skilled labour – notably in sectors such as agrifood and renewable energies – private investment remains below the continent's potential (AUC/OECD, 2023[3]). Africa has a higher share of informal employment than any other world region, as a result of slow productive transformation; an estimated 82% of all the continent's workers are in informal employment, compared to 56% in Latin America and the Caribbean and 73% in developing Asia. In South Africa, a country with a low share of informality, 76% of employers report difficulty finding the talent they need (ManpowerGroup, 2022[4]). Skilled workers are necessary to strengthen Africa's fledgling productive transformation and to deliver quality jobs at scale. The 2024 edition of the *Africa's Development Dynamics* report therefore addresses skills, jobs and productivity, coinciding with the African Union's choice of "education" as its theme of the year.

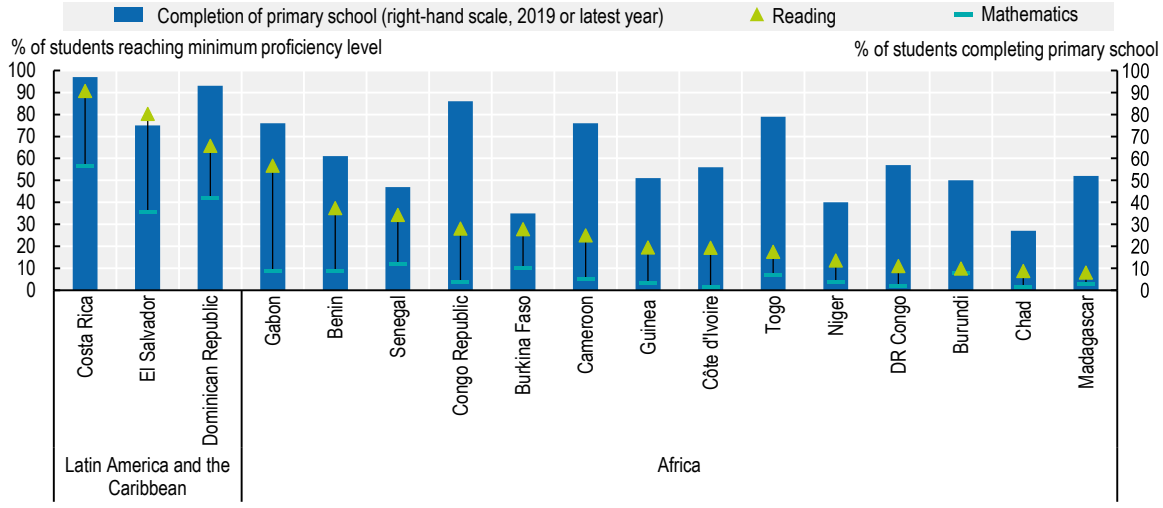
Continuing to expand quality education generates larger returns in Africa than in other world regions.

- Children in Africa benefit from only 5.1 learning-adjusted years of schooling (a metric combining quantity and quality of schooling),[1] compared to 7.2 in developing Asia, 7.8 in Latin America and the Caribbean and 10.5 in high-income countries. Math and reading proficiency is lower in Africa than in other world regions (Figure 1).
- Returns to education are higher in Africa than elsewhere in the world. Each additional year of education could increase African learners' earnings by 8.2% to 11.4%, compared to 7.6% to 9.1% for Latin American and Caribbean countries (Peet, Fink and Fawzi, 2015[5]).
- Africa's gross domestic product (GDP) could increase by about USD 154 trillion before the end of the century – a more than 22-fold increase, greater than any other world region – if all African children attained foundational skill levels (Gust, Hanushek and Woessmann, 2024[6]).[2]
- Firms benefit from better-educated workers as well. In manufacturing, evidence from over 7 600 firms across 27 African countries shows that a 10 percentage point increase in the share of employees with high school and university degrees is associated with an increase in average firm productivity by 4.2% and 4.8%, respectively (Okumu and Mawejje, 2020[7]).

Workers lack the specific skill sets required for existing jobs (limited supply), while not enough quality jobs are available to further build their skills (limited demand). In a survey of six African countries, many secondary school graduates did not meet employers' expectations in terms of technical skills (almost 50%), digital, business and managerial skills (25%) and soft skills (10-40%) (ACET, 2022[8]). In Ghana, about 14% of surveyed companies reported recruiting employees with digital skills internationally, because they could not find skilled local talent (IFC, 2019[9]). Over 80% of African youth in school aspire to work in high-skilled occupations, but only 8% find such jobs (OECD, 2017[10]).[3]

Skill gaps vary between countries. African economies that are diversifying (e.g. Egypt, Eswatini, Mauritius, Senegal and Tunisia) rely on occupations that require 3.8 percentage points more foundational and soft skills than countries that depend on agricultural employment (e.g. Burundi, the Democratic Republic of the Congo, Mozambique, Tanzania and Uganda).

Figure 1. **Minimum proficiency in mathematics and reading and primary school completion in selected countries in Latin America and the Caribbean and Africa, 2019**



Note: Regional discrepancies in the proportion of children in sixth grade achieving minimum proficiency levels could be partly due to differences in assessment frameworks, contexts and measured constructs. All African countries are displayed for which data are available. Data for Latin America and the Caribbean only include the top, middle and bottom performers out of all countries that were part of the assessment.

Source: Authors' compilation based on UNESCO/PASEC/LLECE/IEA (2022[11]), "Establishing a concordance between regional (ERCE and PASEC) and international (TIMSS/PIRLS) assessments", https://www.researchgate.net/publication/361903612_Rosetta-Stone_Policy-Brief_2022.

StatLink https://stat.link/82pdai

Gender and rural-urban divides in skills development cause significant disparities in employment and remuneration. Girls and women face more significant barriers to skills development than boys and men, as discriminatory gender norms often restrict their school or training attendance and job opportunities (ACET, 2022[12]; OECD, 2022[13]). The rate of out-of-school primary-aged children is 4.2 percentage points higher for girls than for boys (UNESCO, 2022[14]). The gender pay gap is around 30% in most African countries (UN Women, 2022[15]). The share of workers in skilled occupations is around 27% among men versus 15% among women, and 30% among urban inhabitants versus 13% among rural inhabitants. These inequalities intersect, with less than 10% of rural women found in skilled occupations compared to almost 45% of urban men. Hourly wages for all workers in rural areas are only half of those in large cities (OECD/UNECA/AfDB, 2022[16]).

Highly skilled workers tend to move out of Africa. Low-skilled migrants from African countries mostly remain within the continent, with skills development figuring as one of a range of factors underlying migration decisions. For highly skilled migrants, skill-based employment opportunities represent a more important factor. In 2020, 74% of highly educated migrant workers opted to move to another continent; the vast majority (98%) chose high-income countries as a destination. Almost half (47%) of tertiary-educated individuals born in East Africa resided abroad in 2020.[4]

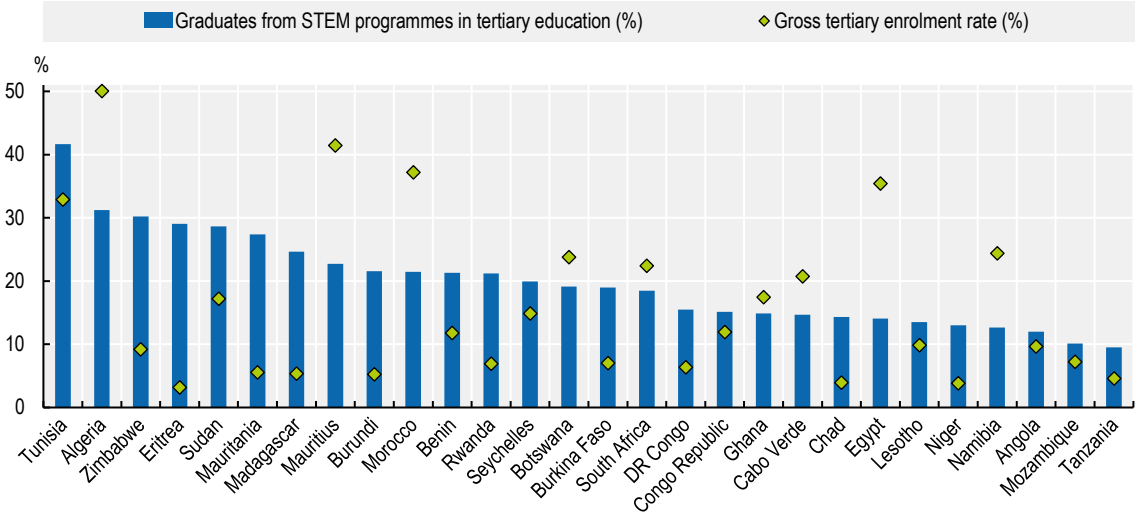
Africa's talent pool is growing fast, and targeted investment in education and training promises to fuel productivity

As Africa's growing population is becoming better educated, the continent is developing an unprecedented pool of talent and improving its age structure for a demographic dividend. Africa's working-age population (i.e. 15-64 years old) will almost double by 2050, from 849 million in 2024 to 1 556 million in 2050. This growth will account for 85% of the total increase in the global working-age population. Projecting constant enrolment ratios, the number of young Africans having completed an upper-secondary or tertiary education will more than double between 2020 and 2040, from 103 million to 240 million. In the past 20 years, mean years of schooling have increased by over 2 years for 28 African countries with available data. Continuing progress, particularly in girls' education, will also shape Africa's demographics favourably by postponing the age of child pregnancy. This will raise Africa's demographic dividend, by increasing the active population compared to the dependency-age population. Better quality education for millions of Africans can result in impressive progress throughout society.

Skills development that effectively reaches informal workers, especially in agriculture and trade, can increase productivity for millions of workers. The share of youth not in employment, education or training across 12 African countries averages 7 percentage points higher for young people from households that rely solely on informal employment (OECD, 2024[17]). Vulnerable workers[5] account for 93% of the labour force in agriculture, forestry and fishing and 84% in wholesale and retail trade. Together, these two sectors account for about half of the jobs created over the last two decades, and they have the lowest share of occupations with a high complexity and range of tasks and duties. "By 2040, own account and family workers in Africa will represent 65% of employment under current trends", rising from 325 million to 529 million, according to AUC/OECD (2021[18]).

Greater investment in technical skills such as science, technology, engineering and mathematics (STEM) increases labour productivity. Workers with STEM skills can support the development of technology-intensive value chains such as automotive, electronics, solar panels, pharmaceuticals and medical devices, and mining (UNCTAD, 2023[19]; Dugbazah et al., 2021[20]). Yet, when investing in technical disciplines, African policy makers and educational institutions often have to choose between inclusion or selective excellence. Across Africa, only Algeria, Mauritius, Morocco and Tunisia show STEM graduation rates of above 20%, coupled with large overall tertiary enrolment (Figure 2). Consequently, African countries have a limited number of engineering professionals per capita: they range from 540 per 100 000 inhabitants in Seychelles to less than 45 in the DR Congo, Madagascar, Malawi and Mozambique. This compares to 1 160 engineering professionals in the United Kingdom and 850 in the United States (UNESCO/ICEE, 2021[21]; SADC, 2018[22]).

Figure 2. **Percentage of tertiary education graduates from programmes in science, technology, engineering and mathematics (STEM) and gross enrolment rates in African countries, average 2015-23**



Note: Gross enrolment rates represent total enrolment in tertiary education (ISCED 5 to 8), expressed as a percentage of the total population of the five-year age group following on from secondary school leaving.

Source: UNESCO Institute for Statistics (2023[23]), *UIS Stat* (database), http://data.uis.unesco.org/.

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Digital skills are in demand across the continent, while the need for green skills is increasing with climate challenges

The digital revolution is redefining the demand for and the supply of skills in the African labour market. As the continent's digitalisation advances, the demand for basic digital skills (e.g. Internet navigation, mobile communication) and intermediate digital skills (e.g. use of spreadsheet and presentation software) is growing fast, and the demand for advanced skills (e.g. programming) is also emerging. By 2030, it is projected that 70% of the demand for digital skills will be for basic skills and 23% for intermediate skills. Most of the demand will be in services (Figure 3). While the supply of basic digital skills is growing, intermediate and advanced digital skills remain scarce (Table 1).

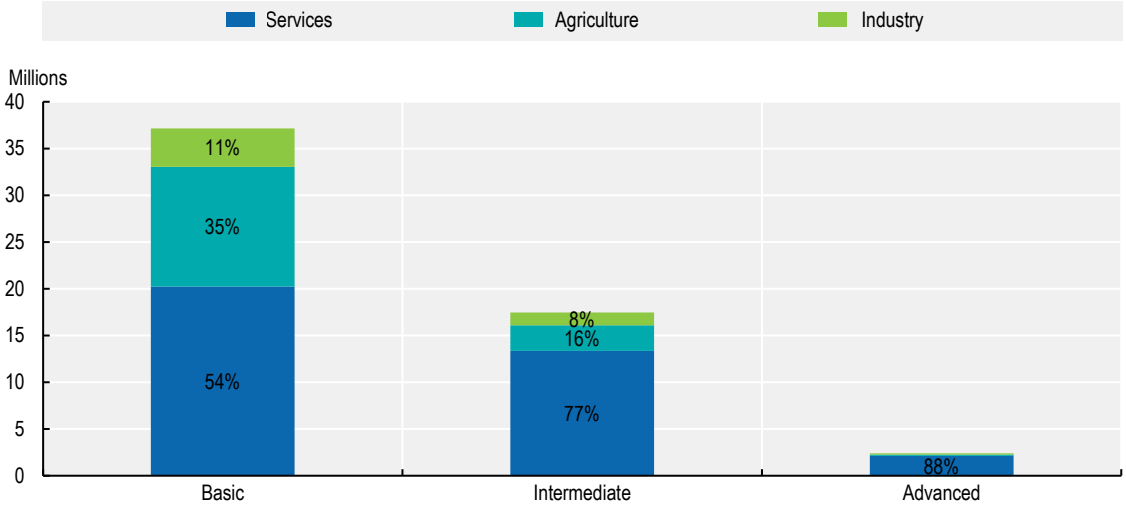
Table 1. **Demand for and supply of digital skills across Africa**

	Basic digital skills (e.g. smartphone use, e-mail, basic file management, web browsing, mobile communication)	**Intermediate digital skills** (e.g. use of multiple devices, e-commerce and financial software, professional social media, data entry and management)	**Advanced digital skills** (e.g. web design, programming, AI development, data science)
Demand	*Very large demand* 70% of demand for digital skills is expected to be for basic digital skills by 2030 (World Bank, 2021[24]).	*Large demand* 23% of demand for digital skills is expected to be for intermediate skills by 2030 (World Bank, 2021[24]).	*Emerging demand* While AI markets are more mature in high-income economies, some African countries are emerging as regional AI leaders (World Bank, 2021[24]).
Supply	*Growing supply* 26.4% of the African population knows how to use a mobile money account. Across 15 African countries, 9% of the workforce possesses basic digital skills (Authors' calculations based on World Bank (2021[25]); and UNICEF (2022[26]).	*Limited supply* 5% of the workforce possesses intermediate digital skills across 15 African countries (Authors' calculation based on UNICEF (2022[26]).	*Scarce supply* Africa comprises only 1.3% of global users of GitHub – a widely used platform for programme developers (OECD et al., 2021[27]).

Note: AI – artificial intelligence.

Source: Authors' compilation.

Figure 3. **Jobs requiring digital skills by 2030 in five African countries, by skill level**



Note: Data cover Côte d'Ivoire, Kenya, Mozambique, Nigeria and Rwanda.

Source: Authors' calculations based on World Bank (2021[24]), *Demand for Digital Skills in Sub-Saharan Africa*, https://www.datocms-assets.com/37703/1623797656-demand-for-digital-skills-in-sub-saharan-africa.pdf.

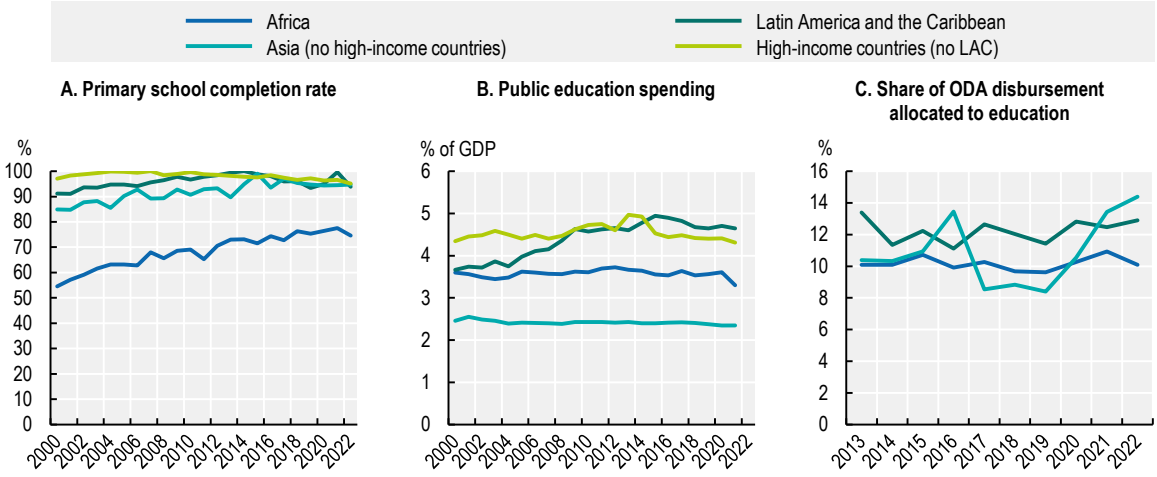
StatLink https://stat.link/jgkp16

Addressing climate change can create jobs and raise Africa's productivity in key sectors, but more green skills are needed. Producing less than 3% of global greenhouse gas emissions created by human activity, Africa is the world region that contributes the least to climate change; yet it is the most vulnerable and most exposed to the consequences of climate change (IPCC, 2022[28]). Notwithstanding, a green transition could create job and growth opportunities in Africa: renewable energy and sustainable infrastructure could generate over 9 million jobs from 2019 to 2030 and a further 3 million jobs by 2050 (IRENA/AfDB, 2022[29]). Specific skills are needed, and many skill shortages in the renewable energy sector are found in vocational roles (Chapter 6). These mid-skilled roles often require specialised training beyond that needed for typical energy-related jobs (IEA, 2023[30]). Measures for adapting to climate change, including improved climate literacy and climate-smart agriculture, can increase productivity and provide additional employment opportunities (Chapter 7) (IPCC, 2022[28]; Williams et al., 2021[31]).

Better policies contribute to productive and inclusive skills development in Africa

African countries and their development partners can expand efforts to deliver education for all Africans. With rising primary school completion rates, from about 55% in 2000 to 75% in 2022, millions more children receive an education today than at the turn of the century (Figure 4, Panel A). However, to bring the rate closer to that of other world regions, more investment in skills remains a priority, despite constrained budgets (IMF, 2024[32]). On average, in 2021, African governments spent 3.7% of GDP on education, accounting for 14.5% of total public expenditure. These shares are slightly below the international benchmarks set by UNESCO of at least 4% of GDP and 15% of total public expenditure (UNESCO, 2015[33]). Public spending on education has stagnated since 2000 (Figure 4, Panel B), due to important fiscal constraints (OECD/AUC/ATAF, 2023[34]) and debt concerns (AUC/OECD, 2023[3]). Donors' disbursements in education have also flatlined in Africa, at around 10% of overall official development assistance disbursements since 2013 (Figure 4, Panel C).

Figure 4. **Primary school completion, public education spending and share of official development assistance allocated to education, by world region, 2000-22**



Note: Primary school completion rate is the number of new entrants (enrolments minus repeaters) in the last grade of primary education, regardless of age, divided by the population at the entrance age for the last grade of primary education. The earliest available year in the *Creditor Reporting System (CRS)* database in Panel C is 2013. The category "High-income countries (no LAC)" is omitted from Panel C. ODA = official development assistance. LAC = Latin America and the Caribbean.

Source: Panel A: UNESCO Institute for Statistics (2023[23]), *UIS Stat* (database), http://data.uis.unesco.org/; Panel B: IMF (2023[35]), *World Economic Outlook* (database), https://www.imf.org/en/Publications/WEO; Panel C: OECD.Stat (2024[36]), *Creditor Reporting System (CRS)* (database), https://stats.oecd.org/Index.aspx?DataSetCode=crs1.

StatLink https://stat.link/4gto6b

To be effective, skills development policies must balance high productivity, employment potential and inclusiveness and consider each country's comparative advantages, capacities and financial resources. In this respect, this report proposes policy actions to tackle five challenges related to Africa's skill gaps that are preventing greater employment creation and productivity (Table 2).

Table 2. **Challenges and policy actions to boost skills, jobs and productivity**

Challenges	Policy agenda	Policy actions
Population growth that is outpacing formal job growth; significant country differences in the selection of skill supply and demand, especially for digital and green skills	Nationally specific strategies identifying priority sectors, based on granular data, to tackle emerging skill needs	• Target skill strategies through harmonised, up-to-date and comparable data on skill mismatches • Select priority sectors with high productivity and employment potential, based on national comparative advantages • Integrate digital and green skills into strategies, addressing country-specific skill gaps
Significant foundational skill shortages; gender and rural-urban divides	Learning assessments and cost-effective interventions to expand quality education	• Assess weaknesses in national education systems that result in foundational skill gaps • Target investments towards the most cost-effective measures • Monitor progress against international benchmarks to inform reforms
Employment growth confined to low-productivity/high-informality sectors; gender and rural-urban divides	Innovative on- and off-the-job training and skill recognition to improve the labour productivity of informal and female workers	• Expand entrepreneurial and soft skills training to impart transferable skills that increase worker productivity • Offer certified apprenticeships in co-operation with the private sector to provide practical experience and documented technical skills • Establish frameworks for the recognition of prior learning and professional certificates

Table 2. **Challenges and policy actions to boost skills, jobs and productivity *(continued)***

Challenges	Policy agenda	Policy actions
Varying technical skill needs across African countries; basic and intermediate digital skill gaps	Technical and vocational education and training (TVET) institutions to embrace innovative approaches that better respond to emerging skill needs	• Involve the private sector, including small and medium-sized enterprises, in programme delivery to ensure effectiveness and employability • Increase the appeal of TVET to students by upgrading institutions' curricula, governance and reputation • Increase female and rural participation through local outreach and private sector involvement • Make TVET levies more accountable and improve the co-ordination of partner finance
Limited high-skilled migration within Africa; large high-skilled emigration to high-income countries	Regional integration of African skills development policies	• Identify skill needs within cross-border labour pools and regional value chains • Address skill shortages and gaps along regional value chains • Improve cross-border skill recognition and portability • Reduce talent outflow and encourage the international circulation of skills via partnerships

Source: Authors' compilation.

Significant country differences require nationally specific skill strategies based on more comprehensive data analysis. To align the supply of skills with current and future demand, national strategies can use granular data analysis to focus skills development on priority sectors and specific digital and green skill gaps. By strengthening the quality of labour market information systems, increasing the frequency of surveys and fostering collaboration with the private sector, African countries can better assess skill supply and demand. Using big data, especially from online job boards, can facilitate real-time, detailed analysis of skill demand and help anticipate future needs.

> In East Africa, Mauritius has established a comprehensive digital policy that encourages firms to attract employees with skills and incites workers to acquire skills, particularly in research and development and innovation related to artificial intelligence (AI) (ANDP, 2019[37]; Republic of Mauritius, 2018[38]). Ethiopia, Rwanda and Uganda are also formulating policies specifically on AI skills development (Diplo, 2022[39]).

Efficient education spending, cost-effective interventions and learning assessments can help expand quality education. Africa's spending inefficiencies in education remain high: between 2000 and 2017, they were equivalent to over USD 40 billion annually (IMF, 2021[40]). To achieve better learning outcomes with limited funds, cost-effective interventions, such as support for teachers with structured pedagogy and targeted teaching by learning level, could be expanded (Angrist et al., 2023[41]). Applying these types of interventions to reach 90% of primary school pupils in African countries would cost the equivalent of just 2.3% of the continent's 2021 spending on education while generating a return of 1.2 learning-adjusted years of schooling.[6] Comparable national, regional and international learning assessments can serve to monitor education outcomes and policy impacts.

> In North Africa, Morocco's Ministry of Education rolled out a roadmap for reforming the education system in 2022, designed to respond to the country's low results in 2018 in PISA, the OECD's Programme for International Student Assessment. The roadmap focuses on improving learning impact, student well-being and foundational learning results (Madrastna, 2022[42]; Madrastna, 2022[43]).

Training and skill recognition can increase informal and female workers' productivity. Training in entrepreneurial, managerial and soft skills is widespread, but training formats vary in effectiveness and need to be chosen with care to increase productivity. For African enterprises in manufacturing and services that provide training to employees, sales per worker are around 20% higher than for those that do not. Yet less than 30% of firms registered in Africa provide formal training to employees, compared to almost 50% in Latin America (AfDB, 2020[44]).[7] Seventy-five per cent of informal apprentices find a job less than

six months after finishing their apprenticeships, most of them becoming self-employed or being employed by the businesses that hosted their apprenticeships (ILO, 2022[45]). Training programmes can also help reduce the gender pay gap: socio-emotional skills training can yield higher earnings for female workers and ensure a greater likelihood of success in their entrepreneurial endeavours (Baliamoune-Lutz, Brixiova and Ncube, 2014[46]). Recognition of prior learning can create win-win scenarios for informal workers and employers, but the available support often remains unknown to both.

TVET institutions can better respond to Africa's emerging skill needs. In the next 20 years, the number of secondary TVET students is expected to more than quadruple in agrarian economies like Burundi, Mali and Uganda and to increase ten-fold in Niger (ILO/World Bank/UNESCO, 2023[47]). TVET institutions would benefit from an improved reputation and more relevant curricula, including on digital skills. Stronger linkages with the private sector can enhance the professionalisation of TVET trainers and help align skill supply with demand. Only 30% of TVET trainers in Africa have recent experience in companies related to the sectors they teach (IIEP-UNESCO, 2023[48]). National funding for TVET can be more accountable since levy funds for training are often retained by the central government and diverted to other purposes. Of funds analysed in 29 African countries, the only country in which 100% of the training levies collected go to TVET is Senegal, compared to 60% in Niger, 17% in Zambia and 5% in Burkina Faso (UNESCO, 2022[49]).

> In West Africa, Benin's National Strategy for Technical and Vocational Education and Training (SN-EFTP 2020-2030) envisages an increase in technical agricultural vocational institutions from around 10 to 30 by 2025 (Marie, 2022[50]).

The regional integration of African skills development depends on harmonised policies and partnerships. Aligning relevant policies across countries can help close skill gaps, allowing African countries to reap the benefits of the interplay of skill mobility, free trade – notably while developing the African Continental Free Trade Area (AfCFTA) – and the free movement of people across borders. AUDA-NEPAD's five regional Centres of Excellence can help anticipate sectoral skills needed across Africa. Partnerships with international and private actors can help address challenges for skills development in regional value chains (OECD/AUC/EU/AUDA-NEPAD, 2023[51]). University exchange programmes and skill mobility partnerships, within and beyond Africa, are crucial to retaining highly educated students and increasing the circulation of skills.

> In Central and Southern Africa, the Centre of Excellence for Advanced Battery Research between the Democratic Republic of the Congo and Zambia supports public-private co-operation for training and research along different segments of value chains for electric vehicle batteries.

African regions can better leverage their comparative advantages to accelerate productive transformation and job creation. The report's five regional chapters (Chapters 3-7) summarise some of the most salient characteristics of skills development in each region and highlight how each can accelerate skills development in strategic sectors. Case studies in those chapters propose ways to carry out the report's five continental policy recommendations (Table 3) in specific sectors. Examples are below:

- Southern Africa's mining sector would benefit from developing downstream industries where value addition per worker is higher than in extraction, like diamond cutting (e.g. in Botswana), steel production (e.g. in Zimbabwe), cobalt refining (e.g. in Zambia) and electric vehicle manufacturing (e.g. in Namibia and South Africa). Currently, technical skill shortages and predominantly informal employment prevent productivity increases. More than half of the region's mining workers, mainly informal and low-skilled, are in artisanal and small-scale mining (ASM).

- Central Africa has significant reserves of strategic minerals, accounting for almost 70% of global cobalt production, 30% of tantalum production and 20% of manganese production, but it does not transform these resources within the region (e.g. the DR Congo produces 69% of the world's cobalt but transforms less than 1% of it). Improving technical skills can help develop local mineral processing and transformation, increase the productivity of ASM workers, and meet the growing global demand.
- East Africa's progress in digital skills development is highly uneven: the share of the population over 15 years old who possesses basic digital skills ranges from 33% in Mauritius to 4% in South Sudan. Country-specific expansion of digital skill provision, especially through TVET institutions, can be an effective response to the rising demand for digital skills in the region.
- North Africa has the greatest potential among African regions for developing solar and wind energy, and it is set to become the leading exporter of green hydrogen, with potential exports forecasted at USD 110 billion per year by 2050. Egypt, Morocco and Algeria have contributed to the expansion of solar energy in the region, ranking second, third and fourth for solar power generation on the continent. Egypt and Morocco also dominate African wind energy production, after South Africa (IRENA, 2023[52]). Developing specific technical skills (e.g. in construction and installation) and managerial skills (e.g. in project management) in the renewable energy sector could create at least 2.7 million additional jobs, improve energy security, reduce air pollution and contribute to the global efforts to reduce greenhouse emissions.
- Between 5 and 9 West African countries usually rank among the world's top 20 producers of a dozen agri-food products, such as fonio, shea nuts, yams and cocoa beans. Yet almost 24% of the region's products are lost after harvest. Improving technical skills and conservation techniques can reduce this waste. Boosting research and development and green skills in the agri-food sector can support the development of higher-value products and enhance regional food security and resilience to climate change.

Table 3. **Skills, jobs and productivity: Policy recommendations by region**

Region	Case study	Policy recommendations
Southern Africa	Mining	• Monitor skills development in alignment with regional standards and global best practices. • Incorporate country-specific technical mining and complementary skill sets into mining education and training. • Target education and training programmes directly towards women and workers in artisanal and small-scale mining.
Central Africa	Mining	• Encourage the development of regional and national strategies and improve data collection. • Promote public-private partnerships to improve TVET quality and offer training that responds to skill demand. • Enhance the mining sector's sustainability and inclusiveness through upskilling artisanal and small-scale miners. • Strengthen transparency, accountability and multi-level governance for a better allocation of resources.
East Africa	Digital skills	• Expand Internet access and integrate digital skills into education. • Target intermediate and advanced digital skill provision towards country-specific needs and global demand. • Enhance regional integration of digital markets, infrastructure and regional co-operation for skills development.
North Africa	Renewable energies	• Develop national strategies for renewable energy that account for upcoming skill demand. • Enhance skill supply by promoting on-the-job training, research and development, and centres of excellence. • Support skills development through co-operation with public and private partners at all levels.
West Africa	Agri-food	• Reinforce professionalisation through public-private partnerships and local initiatives. • Reduce the skill gap through increased co-operation between research institutions and the private sector. • Mobilise investment towards upskilling workers to respond to global challenges, particularly climate change.

Source: Authors' compilation.

Notes

1. Learning-adjusted years of schooling merge the quantity and quality of education into one metric, reflecting that similar durations of schooling can yield different learning outcomes. See Filmer et al. (2020[53]) for the detailed methodology.
2. The model by Gust, Hanushek and Woessmann assumes constant labour demand for foundational skills, meaning that an increase in skill supply directly results in economic growth.
3. These numbers are drawn from a survey that covers 11 African countries among 32 low- and middle-income countries.
4. Authors' calculations based on World Bank (2023[56]).
5. For a definition of vulnerable workers, see Chapter 1.
6. An additional 1.2 years of schooling would translate into around an 11% increase in earnings [authors' calculation based on estimated returns to education in Africa in Peet, Fink and Fawzi (2015[5])].
7. In 2013-22, 83% of firms in Africa formally registered when they started operations in their country, against 87% in Latin America and the Caribbean [authors' calculation based on (World Bank, 2024[55])].

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Chapter 1

Skills development for Africa's productive transformation

This chapter explains why developing the skills of Africa's workforce lies at the core of the continent's productive transformation and the African Union's Agenda 2063. It first outlines the barriers to the continent's skill supply and demand, namely limited quality education, gender and rural-urban divides, a high rate of informal employment, and Africa's slow structural transformation. Second, the chapter analyses differences in foundational, soft and technical skill gaps across the continent. Third, it highlights the emerging skill demands brought about by the digital and green transitions.

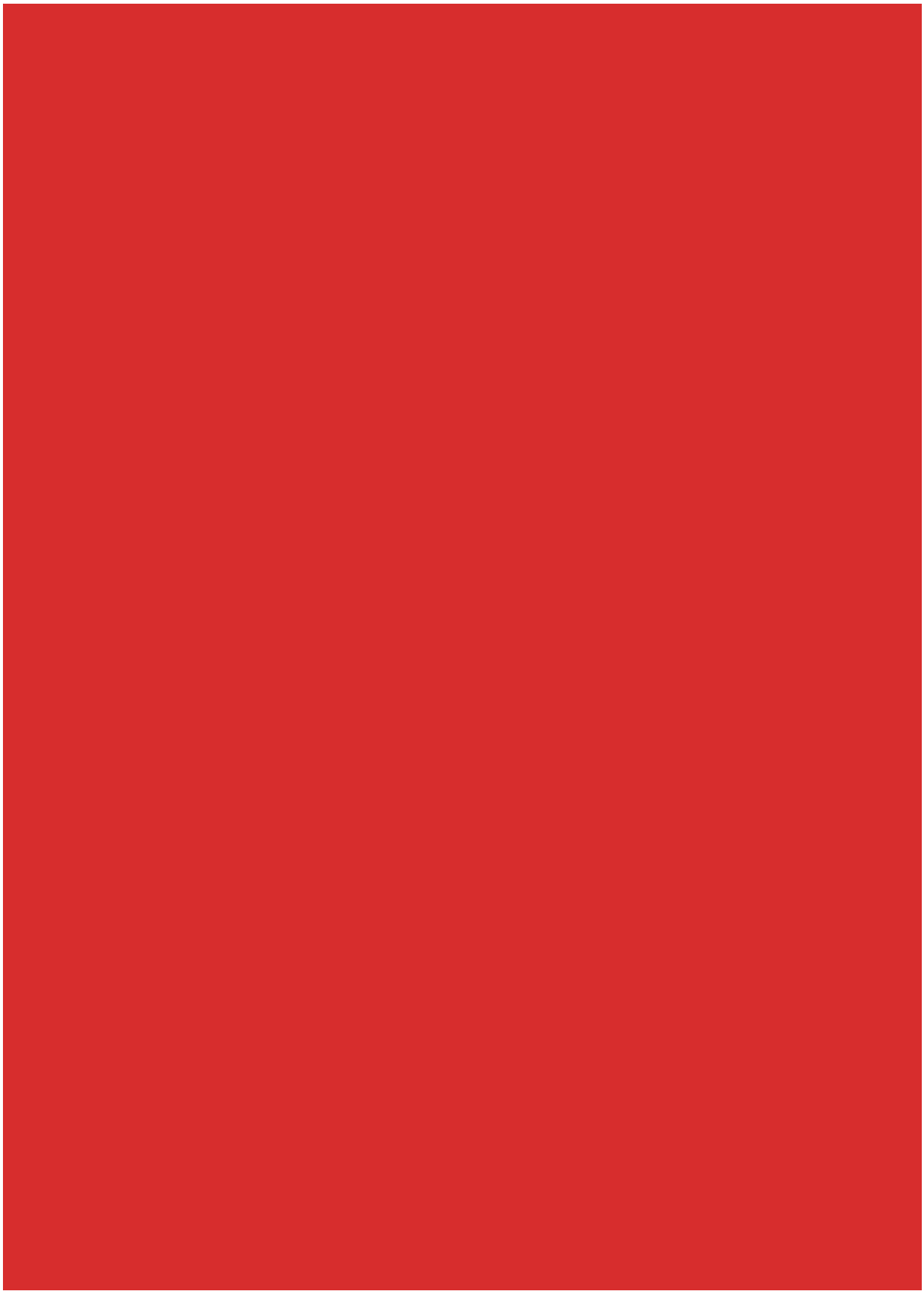
IN BRIEF

Equipping workers with quality skills is essential for Africa's productive transformation. The number of young Africans with an upper-secondary or higher education will rise from 103 million to 240 million between 2020 and 2040. Opportunities for productive employment will be required to match the resulting supply of skills with new demand.

African countries face important barriers regarding the supply of and demand for quality skills. Supply is hampered by the population's limited access to quality education and significant gender, rural-urban and informal-formal employment divides. Despite increases in school enrolment, the number of learning-adjusted years of schooling is more than two years lower than in any other world region. The demand for skilled workers is mostly restricted by employment growth having been confined to low-productivity sectors like agriculture, retail trade and services. Highly educated African workers tend to migrate outside the continent; 72% of tertiary-educated migrants move to high-income countries.

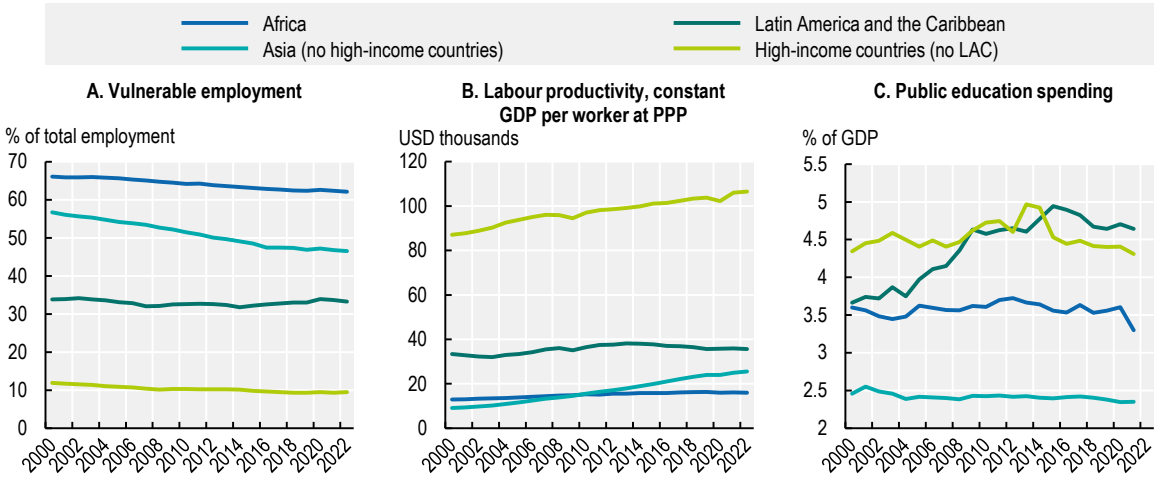
Skill requirements and gaps vary depending on the diversity of occupations and tasks in a country. Foundational and soft skills prove more important in the most diversified African economies than in those where agricultural employment dominates. Technical skills are key to support growth in nationally strategic sectors, but supply often does not align with specific local demand. If workers acquire superior business skills, firms across the continent will be able to improve their productivity, while informal entrepreneurs will more easily master the wide range of skills that running a business entails.

The digital revolution has created a large demand for digital skills, and climate change is now beginning to generate demand for green skills. In most African countries, skill gaps remain widest for intermediate digital skills. Green skills will be necessary to support climate adaptation and mitigation and to drive productive transformation in sectors such as renewable energies and construction.



Continental profile

Figure 1.1. **Vulnerable employment, labour productivity and education spending by world region, 2000-22**



Note: LAC = Latin America and the Caribbean. Vulnerable employment includes formal and informal self-employed (own-account) workers and contributing family members but excludes informal salaried employees. As an approximation of informal employment, it is used here to show long-term trends, as time series data on informal employment is missing for most African countries. Labour productivity is measured as the constant gross domestic product (GDP) in 2017 international USD at purchasing power parity (PPP) prices, divided by the population of employed people in thousands.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org/fr/; World Bank (2023[2]), *World Development Indicators* (database), https://databank.worldbank.org/source/world-development-indicators; and IMF (2023[3]), *World Economic Outlook* (database), https://www.imf.org/en/Publications/WEO.

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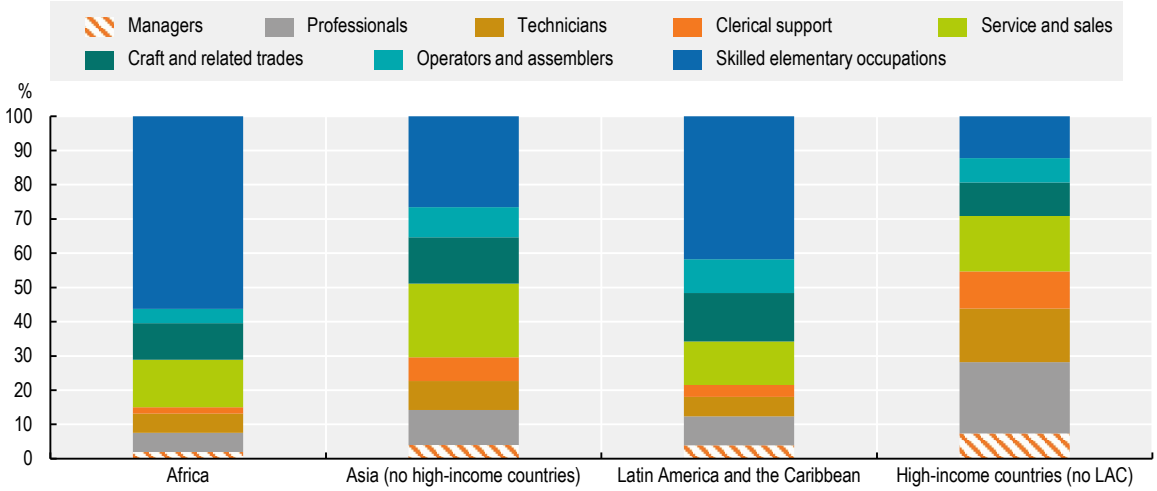
Figure 1.2. **Breakdown of working population by type of occupation by world region, 2021**



Note: LAC = Latin America and the Caribbean. "Technicians" include associate professionals, "Skilled elementary occupations" include skilled agricultural, forestry and fishery workers, and elementary occupations, and "Operators and assemblers" include plant and machine operators and assemblers.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org/fr/.

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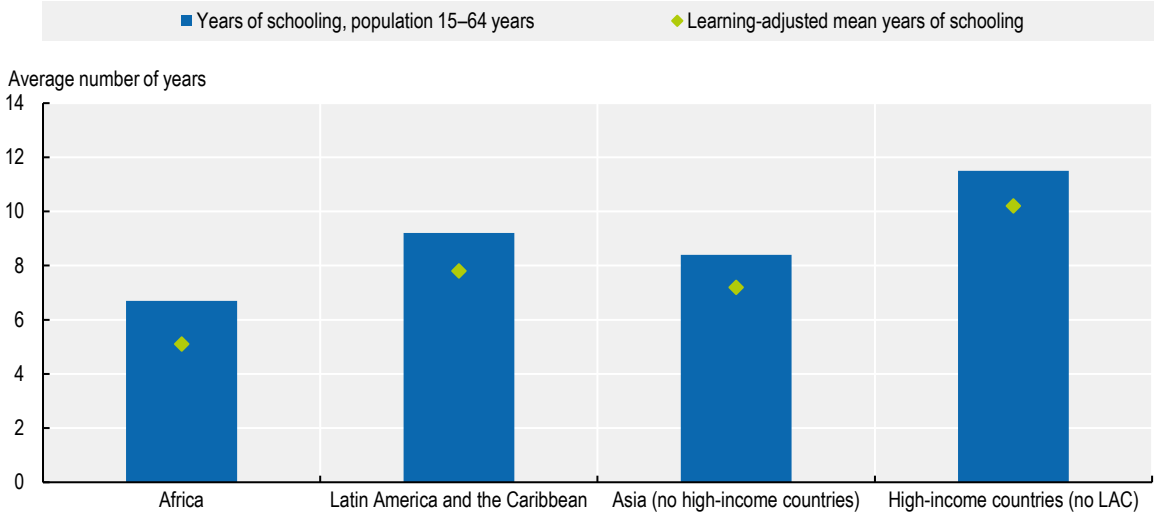
Africa's growing talent pool is seeking better opportunities for productive employment

As Africa's growing population is becoming better educated, the continent is developing an unprecedented pool of talent. Africa's working-age population (i.e. 15-64 years old) will double by 2050, with this growth accounting for 86% of the total increase in the global working-age population.[1] The number of young Africans (i.e. 15-29 years old) who have completed an upper-secondary or tertiary education will more than double between 2020 and 2040, from 103 million to 240 million. Better education for millions of Africans represents impressive progress.

Improving young Africans' educational proficiency is essential. Basic proficiency levels in Africa are lower than in other developing regions. In 2020, the learning-adjusted number of years of schooling was 5.1 in Africa, compared to 7.2 years in developing Asia and 7.8 years in Latin America and the Caribbean (Figure 1.3). In 2019, across 18 countries in Latin America and the Caribbean, the percentage of students who reached basic proficiency levels at the end of primary school was 78.3% for reading and 44.2% for mathematics. In contrast, across 14 African countries, 22.6% of students reached similar levels for reading and 5.6% for mathematics (Figure 1.4).

Figure 1.3. **Average years of schooling and learning-adjusted years of schooling by world region, 2020**



Note: LAC = Latin America and the Caribbean. Learning-adjusted years of schooling merge the quantity and quality of education into one metric, reflecting that similar durations of schooling can yield different learning outcomes. See Filmer et al. (2020[4]) for the detailed methodology.

Source: Authors' calculations based on World Bank (2023[5]), *Education Statistics – All Indicators* (database), https://databank.worldbank.org/source/education-statistics-%5E-all-indicators.

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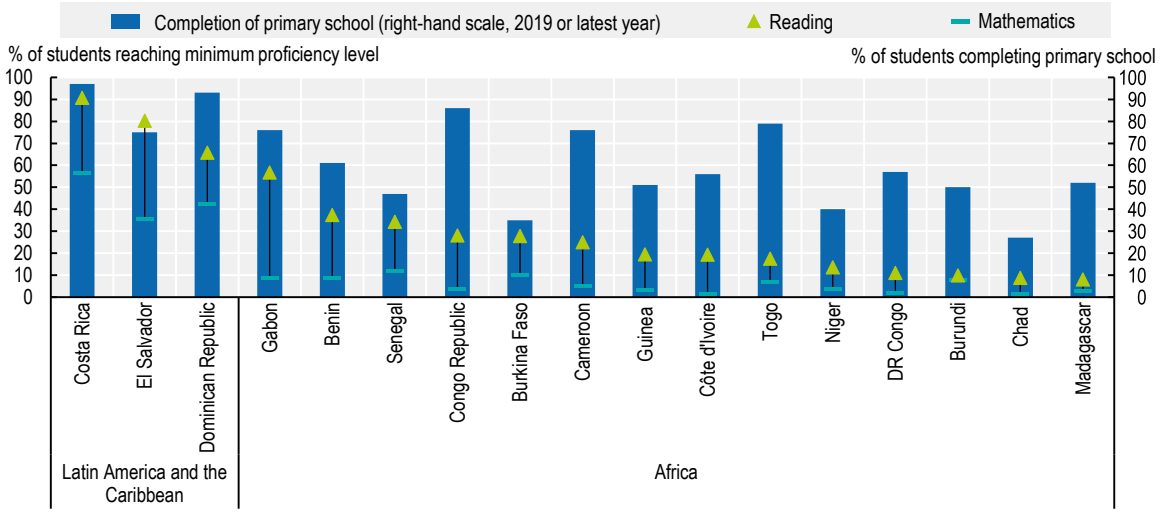
Figure 1.4. **Minimum proficiency in mathematics and reading and primary school completion in selected countries in Latin America and the Caribbean and Africa, 2019**



Note: Regional discrepancies in the proportion of children in sixth grade achieving minimum proficiency levels could be partly due to differences in assessment frameworks, contexts and measured constructs. All African countries are displayed for which data are available. Data for Latin America and the Caribbean only include the top, middle and bottom performers out of all countries that were part of the assessment.

Source: Authors' compilation based on UNESCO/PASEC/LLECE/IEA (2022[6]), "Establishing a concordance between regional (ERCE and PASEC) and international (TIMSS/PIRLS) assessments", https://www.researchgate.net/publication/361903612_Rosetta-Stone_Policy-Brief_2022.

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Important gaps exist between the skills of Africa's secondary school graduates and those needed for employment. While better education outcomes increase the supply of foundational skills, the supply of and demand for specific combinations of skills in a particular location are sometimes poorly matched (Box 1.1). In 2016, across ten African countries,[2] 45% of young people who had recently graduated from secondary school felt that their skills were inappropriate for their work (17% felt over-skilled and 28% under-skilled), while 38% indicated that their education was not useful in finding jobs (AUC/OECD, 2021[7]; Morsy and Mukasa, 2019[8]). Studies across six African countries[3] show that a large share of students graduating from secondary school would need to be retrained to match employers' expectations in terms of technical skills (almost 50%), digital, business and managerial skills (25%) and soft skills (10-40%) (ACET, 2022[9]).

Box 1.1. **Defining and assessing skills in this report**

The *Africa's Development Dynamics 2024* report assesses skill gaps, including changing skill demand across African countries, in light of the specifics of African labour markets. Bridging skill gaps is essential to productive and sustainable transformations (OECD, 2023[10]; Aleksynska and Kolev, 2021[11]; Fox and Ghandi, 2021[12]). Both adjusting existing skills and building new skills will be required to adapt to rapid technological and climate change. Using data mainly from labour force and household surveys, the report analyses skill gaps across African countries by examining the prevalence of skills as well as qualification gaps and mismatches. Case studies in the report's regional chapters highlight the needs and current policy approaches in response to changing skill demands unique to specific sectors (mining in Southern and Central Africa, digital skills in East Africa, renewable energies in North Africa and agri-food in West Africa).

Box 1.1. **Defining and assessing skills in this report *(continued)***

Skill gaps refer to the mismatch between the skills offered by working-age individuals and those demanded within labour markets, both for formal and informal employment (OECD, 2017[13]). Skill gaps thereby imply a lack of employability: once workers offer skills that are in demand, they are more likely to find employment.

Several types of skills are relevant for productive employment:

- **Foundational skills** refer to the ability to process information. They include literacy and numeracy, as well as basic proficiency in mathematics, reading comprehension, speaking and writing (Gust, Hanushek and Woessmann, 2024[14]; OECD, 2019[15]).
- **Soft skills** encompass (OECD, 2019[15]):
  - socio-emotional skills (e.g. self-awareness, communication, leadership and teamwork)
  - transversal cognitive skills (e.g. critical and creative thinking, complex problem-solving).
- **Technical skills** are the specialised knowledge and capabilities necessary to perform job-specific tasks (e.g. science, technology, engineering and mathematics (STEM) skills, repairs, maintenance, graphic design, drawing, food production).

Three domain-specific skill sets that combine elements of soft and technical skills are core to the productive transformation (ILO, 2021[16]; AfDB, 2020[17]; OECD, 2016[18]):

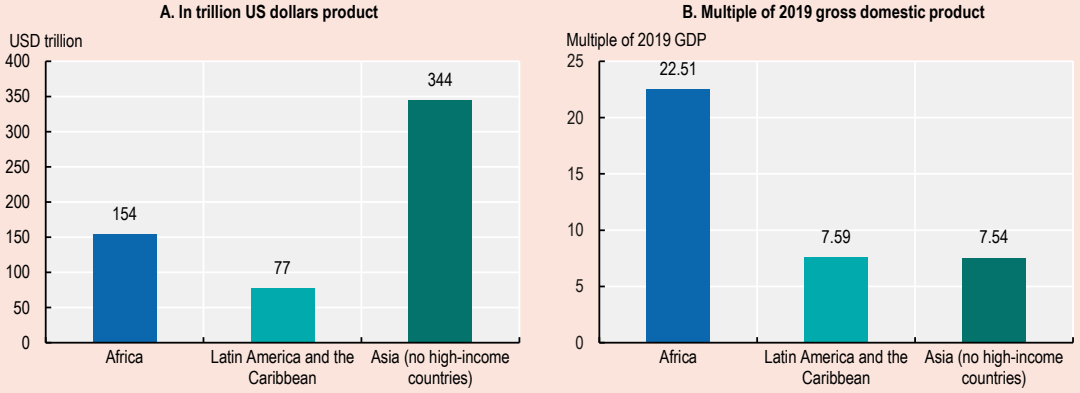
- **Business and managerial skills** are the competencies required to productively operate functions within a firm (e.g. marketing, finance), while **entrepreneurial skills** further include the ability to start and grow a business (e.g. business model design, fundraising) (Conney, 2012[19]).
- **Digital skills** encompass skills that enable workers to use digital technologies productively. They range from basic (e.g. Internet navigation, mobile communication) to intermediate (e.g. use of spreadsheet and presentation software) and advanced (e.g. programming).
- **Green skills** refer to skills to develop or modify products, services or operations in response to climate change (OECD/Cedefop, 2014[20]).

Africa's youth seek high-skilled occupations in the formal sector, but most employment remains informal with limited potential for skills development and productivity. Human capital and skills are foundational to economic development, provided labour markets create quality jobs at scale (Box 1.2). While the number of African workers in high-skilled occupations has grown at an average annual rate of 3% over the last 20 years, enrolment in tertiary education has grown by 5% annually. In addition, over 80% of African youth in school aspire to work in high-skilled occupations, while only 8% are able to find such jobs (OECD, 2017[21]). Skill premiums (i.e. positive pay-offs from investing time and money into skills development) are generally more substantial in the formal sector and urban areas, but only a limited number of such jobs are available. However, informal workers – representing 82% of Africa's workforce – often have fewer incentives to develop their skills and are more likely to remain in low-productivity, experience-based jobs (Dimova, Nordman and Roubaud, 2010[22]). In 2022, over one in four African youth were not in employment, education or training (ILO, 2023[23]).

Box 1.2. **Supply of and demand for skills for productive employment in Africa**

Skill supply is foundational to economic development. The value that labour adds to economic production depends in large part on workers' skills (i.e. task-relevant abilities, knowledge and competencies). Macroeconomic analysis reveals that foundational skills, which are relevant for any employment and mostly attained in primary and secondary education, are highly correlated with economic growth (Hanushek and Woessmann, 2015[24]). Africa's gross domestic product could increase more than 22-fold, by about USD 154 trillion, before the end of the century – more than any other world region – if all African children attained foundational skill levels (Gust, Hanushek and Woessmann, 2024[14]). However, such macroeconomic modelling assumes that the demand for foundational skills remains constant, meaning that an increase in skill supply directly results in economic growth.

Figure 1.5. **Potential economic gain from children's achieving at least basic proficiency in foundational skills in world regions by 2100**



Note: A basic proficiency level in foundational skills corresponds to achieving an equivalent of Level 1 in mathematics and science according to the OECD's Programme for International Student Assessment (PISA). At Level 1, students can answer mathematics questions involving familiar contexts where all of the relevant information is present and the questions are clearly defined. They are able to identify information and carry out routine procedures according to direct instructions. They can only perform actions that are obvious and that follow immediately from the given stimuli.

Source: Authors' calculations based on Gust, Hanushek and Woessmann (2024[14]), "Global universal basic skills: Current deficits and implications for world development", https://doi.org/10.1016/j.jdeveco.2023.103205 and OECD (2019[25]), *PISA 2018 Results (Volume I): What Students Know and Can Do*, https://www.oecd.org/education/pisa-2018-results-volume-i-5f07c754-en.htm.

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Matching skill supply with skill demand is an imperfect process. Education levels provide an incomplete approximation of skill supply, given that skill levels result from a combination of education, training, on-the-job learning and other forms of self-learning (McGrath, 2022[26]; AUC/OECD, 2018[27]). Skill supply is relatively inelastic, as skills represent an intangible resource whose production depends on social and cognitive processes. Acquiring skills takes time, and workers continue to obtain them while they perform jobs. Information asymmetries are large, given that the specific skills demanded by a job and supplied by a worker are typically revealed at the time that the work is being conducted. In addition, skills are not traded in isolation but instead represent only one aspect of labour supply. Workers apply their skills within labour relations for the benefit of employers (for employees) or clients (for self-employment); these relations are governed by informal and formal rules and regulations (such as social protection and labour laws). Informal workers, especially, may have significant experience-based skills that are not recognised in the form of degrees (Dimova, Nordman and Roubaud, 2010[22]).

Box 1.2. **Supply of and demand for skills for productive employment in Africa** ***(continued)***

The demand for skills is changing fast and is hard to measure or predict. Sources of new skill demand typically arise from changing task profiles of existing occupations or emerging new occupations. While it is apparent that technological shifts such as the digital revolution create new skill demands, predicting or measuring the precise timing, location and nature of these demands is difficult (ILO, 2021[16]). Particular new skill sets (like in artificial intelligence) may unfold their value in combination with existing or other new skill sets (Stephany and Teutloff, 2024[28]).

The digital and green transitions offer new opportunities to increase productive employment and to upskill workers. The digital revolution and climate change are creating new skill demands in every African country, beyond country- and sector-specific developments. As the continent's digitalisation advances, the demand for basic and intermediate digital skills is growing fast (SAP, 2023[29]). Green skills are in high demand in specific sectors such as renewable energy and construction. Their importance will widen as countries adapt to the consequences of climate change (GCA, 2021[30]).

Skills development is at the core of the African Union's efforts. The African Union's Agenda 2063 strives for "a prosperous continent … where […] well-educated and skilled citizens, underpinned by science, technology and innovation for a knowledge society [are] the norm and no child misses school due to poverty or any form of discrimination" (AUC, 2015[31]). Overarching African Union strategies, such as the Continental Education Strategy for Africa and the Technical and Vocational Education Training Strategy,[4] co-ordinate policies of member states. Aligning education and training programmes with labour market demands and industrialisation processes can help develop regional value chains as part of the implementation of the African Continental Free Trade Area and the continent's overall productive transformation (AUC/OECD, 2022[32]).

The *Africa's Development Dynamics 2024* report addresses the question of how African policy makers can use skills development policies to advance the continent's productive and sustainable transformation. It emphasises the development of skills that are key to improving Africa's productivity and sustainable development within and through employment, both informal and formal. The report assesses current and future skill gaps, explicitly considering not just education and training (as instruments to increase skill supply) but also the changing demand for skills. It emphasises sectors that are core to the productive and sustainable transformation (e.g. renewable energy, the digital economy, mining and agriculture) (Box 1.2).

Limited access to quality education, labour market divides and a slow productive transformation curtail Africa's skill supply and demand

Access to quality education and employment remains unequal between genders, rural and urban populations, and informal and formal workers

Too many African children do not receive an education. Despite higher school enrolment ratios, the total number of children who do not benefit from any formal education has continued to increase due to the continent's significant demographic growth. From 2009 to 2021, the number of out-of-school children aged between 6 and 18 increased by more

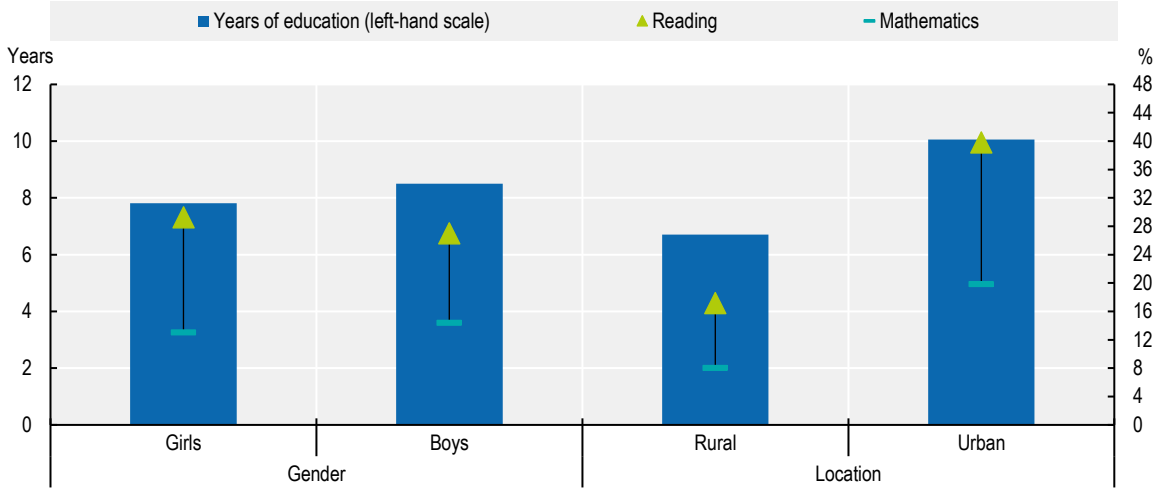
than 20 million, reaching about 100 million. More than 17 million additional teachers are needed to respond to this unmet demand (UNESCO, 2022[33]; UNICEF/AUC, 2021[34]), equivalent to a USD 41 billion funding gap for teacher salaries.[5] Thirty-eight per cent of all youth and 11.5% of employed youth have never attended school, either due to limited financial resources or because of the absence of a school nearby (Morsy and Mukasa, 2019[8]).

Structural challenges and the shock of the COVID-19 pandemic have affected Africa's students, especially learners with low socio-economic status. Prevalent challenges to educational quality include a lack of basic and advanced pedagogical resources, deficits in physical infrastructure, a shortage of qualified teachers and teacher absenteeism, as well as limited access to pre-primary education (Gruijters and Behrman, 2020[35]; PASEC, 2020[36]; OECD, 2017[13]; SACMEQ, 2017[37]). The COVID-19 pandemic has set learning back by about 0.5 to 2 years, hitting students with low socio-economic status the hardest (Moscoviz and Evans, 2022[38]; Kadzamira et al., 2021[39]).

Limited funds have resulted in fewer students attending resource-intensive educational programmes, such as STEM degrees. African policy makers and educational institutions often have to choose between investing in inclusion or in selective excellence in technical disciplines. Over 2015-23, an average of 20% of African students enrolled in tertiary education graduated with STEM degrees, compared to an average of about 25% in developing Asia and high-income countries.

More girls are out of school than boys, and rural children in general have less access to education than those in urban areas. In large parts of Africa, the rate of out-of-school primary-aged children is 4.2 percentage points higher for girls than for boys (UNESCO, 2022[33]). Access to school infrastructure and services is also unequal between rural and urban populations: children in rural areas benefit from, on average, 3.4 years less of education than children in cities (Figure 1.6). The share of the population without any formal education is 13% in urban areas, compared to 42% in rural areas (OECD/UNECA/AfDB, 2022[40]).

Figure 1.6. **Disparities in educational outcomes across genders and rural and urban areas in Africa**



Note: Data are drawn from surveys across 24 African countries for "Years of education" and 11 African countries for "Reading" and "Mathematics" (lower secondary students achieving reading and mathematics assessments of increasing difficulty) collected between 2017 and 2021.

Source: Authors' calculations based on UNESCO (2023[41]), *World Inequality Database on Education* (database), https://www.education-inequalities.org/.

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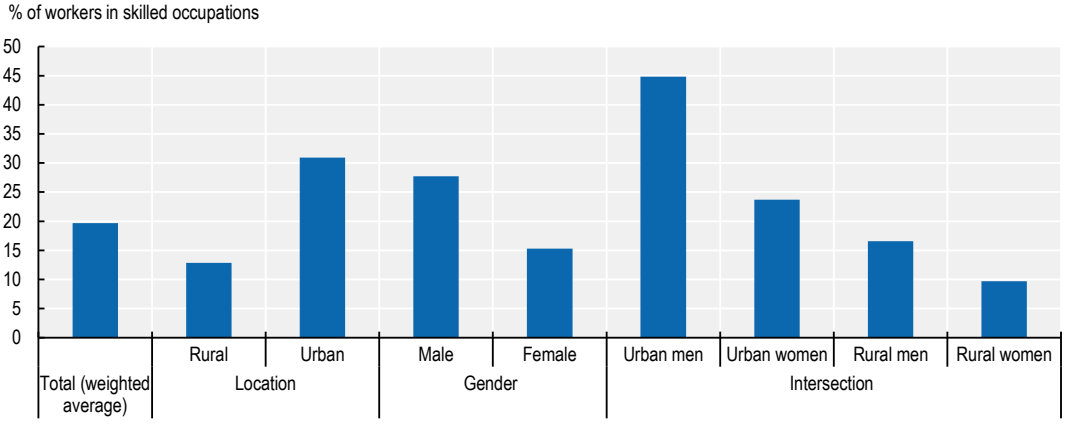
Informal employment dominates in rural agriculture and urban services, and informal female and male workers are concentrated in different sectors. Informal employment – jobs that are not subject to national labour laws, income taxation or social protection – is particularly prevalent in rural areas where it accounts for about 92% of Africa's total employment, compared to some 72% in urban areas. Over half of rural workers (around 57%) are involved in informal agricultural activities, while about 46% of urban workers are informally employed in services (ILO, 2023[42]). Informal female workers tend to concentrate in retail trade, hotels and restaurants, garments, health, education, and social services. In contrast, informal male workers are more likely to work in agriculture, forestry and fishing, construction, transport, manufacturing, or other industries (Carranza, Dhakal and Love, 2018[43]; AfDB/OECD/UNDP, 2017[44]). Labour productivity is lower for women-owned than for male-owned informal firms, due to women's more limited access to resources such as education, managerial experience and capital (Islam and Amin, 2022[45]).

Gender and rural-urban divides cause significant disparities in employment and remuneration (Table 1.1). The share of workers in skilled occupations is around 27% among men versus 15% among women, and 30% among urban inhabitants versus 13% among rural inhabitants. These inequalities intersect, with less than 10% of rural women found in skilled occupations compared to almost 45% of urban men (Figure 1.7). Women face more significant barriers to skills development, as discriminatory gender norms often restrict job opportunities and school or training attendance (ACET, 2022[46]; OECD, 2022[47]). The gender pay gap is around 30% in most African countries (UN Women, 2022[48]). Hourly wages in rural areas are only half of those in large cities (OECD/UNECA/AfDB, 2022[40]).

Figure 1.7. **Disparities in skilled occupations across genders and rural and urban areas in Africa**



Note: Data are drawn from nationally representative demographic and health surveys (DHS) across 35 African countries collected between 2010 and 2019. Occupational categories provided by DHS have been classified into skilled/unskilled following OECD/UNECA/AfDB (2022[40])methodology. Skilled occupations are defined as professional, technical, managerial, clerical and skilled manual work. Unskilled occupations are defined as sales, agriculture, household and domestic work, services, and unskilled manual work.

Source: USAID/DHS (2023[49]), *The Demographic and Health Surveys (DHS) Program* (database), https://dhsprogram.com/.

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Table 1.1. **Three salient labour market divides in Africa**

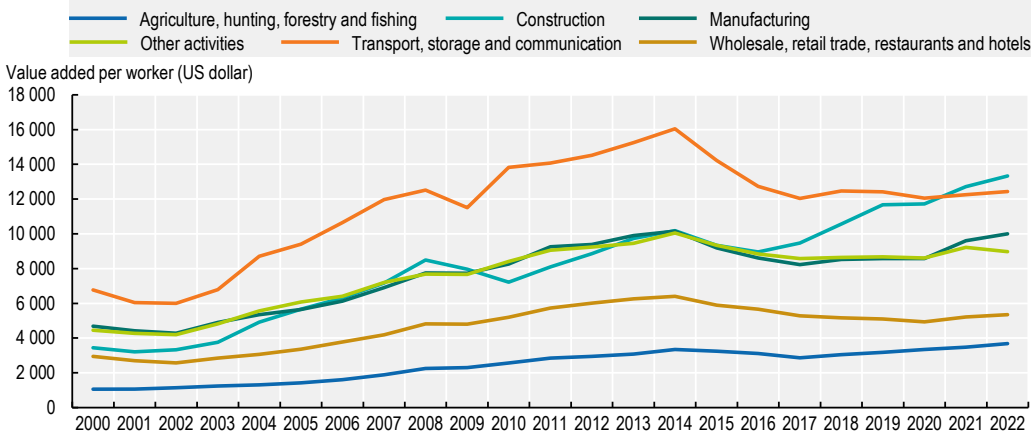
Divide	Effects on skill supply and demand
Gender divide	• Social norms can prevent women from accessing education, employment and training opportunities. For instance, households in Côte d'Ivoire and the United Republic of Tanzania (hereafter, Tanzania) have higher educational aspirations for boys than for girls and, in contexts of limited resources, tend to prioritise the education of the former over that of the latter (OECD, 2022[47]; OECD, 2022[50]). • Gender gaps in completion rates are increasing as children move to higher education levels. At the primary level, eight countries achieve gender parity, while this number drops to five at the lower secondary level and to zero at the upper secondary level (UNESCO/AU, 2023[51]). • African women are 2.5 times more likely than men to contribute primarily to other family members' livelihoods, resulting in women's more limited individual profits and reducing their access to training and apprenticeships (ILO, 2023[42]).
Rural-urban divide	• In most countries, a large gap exists between the participation rates and learning outcomes of children in urban areas and their peers in rural areas. Children living in cities across 24 African countries benefit from about four additional years of education compared to rural children. • Learning outcomes across 11 African countries are also better in urban areas, with around 40% of lower secondary students achieving minimum proficiency in reading compared to less than 20% in rural areas (Figure 1.6). • In rural areas, agriculture accounts for most employment opportunities (69%). The high informality rate (92%) affords limited opportunities for skills development and contributes to low labour productivity. • Urban workers can access a wider set of occupations with higher productivity and earning potential (e.g. in financial services) (OECD/UNECA/AfDB, 2022[40]). While small in most African cities, the urban formal sector is able to absorb highly educated workers and provide high skill premiums (Dimova, Nordman and Roubaud, 2010[22]).
Informal-formal employment divide	• Self-employed informal workers are required to master a wide range of skills associated with running an informal business (such as planning, delegating tasks, budgeting, pricing, handling sales and caring for customers) while lacking access or time to engage in training. • Over 70% of self-employed workers in Côte d'Ivoire and Madagascar (of which over 85% are informal) do not keep written accounts (OECD, 2017[52]).

Source: Authors' compilation.

Africa's slow productive transformation results in a growing informal labour force and limited opportunities for highly skilled workers

As manufacturing is not the basis for most African countries' productive transformation, they could focus on other sectors to increase productivity and employment. Unlike other world regions, Africa's productive transformation – the reallocation of production factors from low to high-productivity economic activities – has not been based on the growth of manufacturing (AUC/OECD, 2019[53]; AUC/OECD, 2018[27]; UNU-WIDER, 2018[54]). Manufacturing growth remains limited, employing about 8% of Africa's workforce in 2022, compared to 12% in developing Asia and as much as 19% in the People's Republic of China (Newfarmer and Heitzig, 2023[55]). In the absence of a significant manufacturing sector, African countries are restricted to identifying sectors to focus on, which, within national contexts, promise to combine productivity potential with employment for many (Rodrik and Stiglitz, 2024[56]).

Figure 1.8. **Value added per worker in major sectors in Africa, 2001-21**



Note: The "Mining and utilities" sector was omitted, due to value added being affected primarily by volatile global commodity prices.

Source: Authors' calculations based on UN (2024[57]), *National Accounts* (database), https://unstats.un.org/unsd/snaama.

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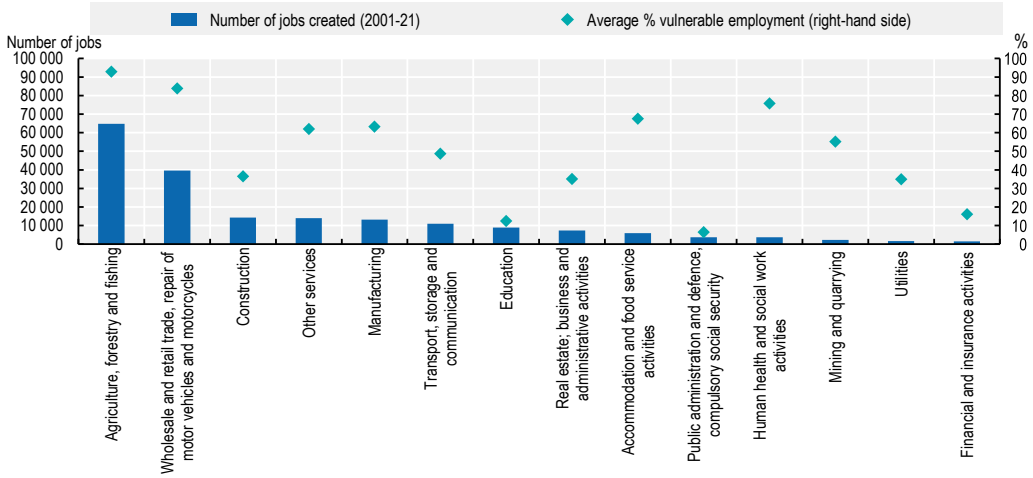
Skills development for agriculture and trade, accounting for half of Africa's employment growth, can increase productivity for millions of workers. The agriculture, forestry and fishing sector remains the largest provider of employment in Africa, despite a decrease in its share of total employment, from 57% to 48% between 2000 and 2021. In contrast, wholesale and retail trade grew from about 19% to 24% of total employment over the same period. Together, these two sectors account for about half of the jobs created over the last two decades (Figure 1.8). Informal employment is prevalent, with vulnerable workers[6] (self-employed, or own-account workers, and contributing family members) accounting for 93% of the workforce in agriculture, forestry and fishing and 84% in wholesale and retail trade (Figure 1.9). The two sectors also have the lowest education requirements (Figure 1.10). While labour productivity is unlikely to rise drastically in these sectors, skills development could achieve marginal productivity increases per worker, for a large labour force.

Figure 1.9. **Evolution of employment by sector in Africa, 2001-21**

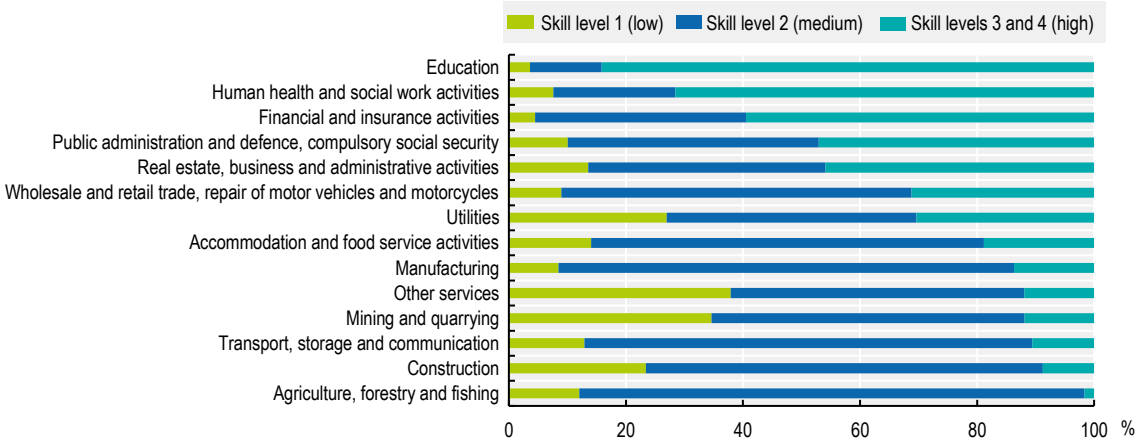


Note: "Number of jobs created" represents the difference in the absolute number of people employed in a sector in 2021 compared to 2000, based on estimates modelled by the International Labour Organization, covering 54 African countries. "Average % vulnerable employment" refers to the percentage of self-employed (own-account) workers and contributing family members in a given sector and is based on labour force statistics across 40 African countries (latest year available).

Source: Authors' compilation based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org/.

StatLink https://stat.link/dua84w

Figure 1.10. **Percentage of workers involved in low-, medium- and high-skilled occupations by economic activity in Africa, 2021 or latest year**



Note: Skill level is defined as a function of the complexity and range of tasks and duties to be performed in an occupation. Skill level 1 (low) covers elementary occupations. Skill level 2 (medium) covers plant and machine operators and assemblers, craft and related trades workers, skilled agricultural, forestry and fishery workers, service and sales workers, and clerical support workers. Skill levels 3 and 4 (high) cover technicians and associate professionals, professionals, and managers. Data are based on labour force statistics across 31 African countries.

Source: ILOSTAT (2023[58]), *ILO Labour Force Statistics* (database), https://ilostat.ilo.org/.

StatLink https://stat.link/5ihb07

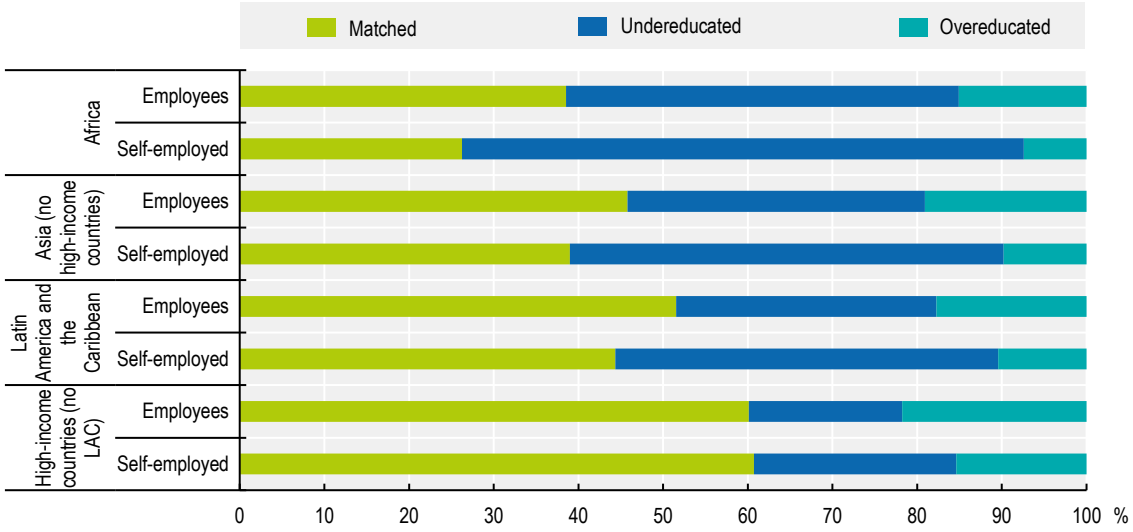
The share of informal employment is likely to remain far larger than the share of formal employment, demanding a dedicated policy focus. The African continent has a higher share of informal employment than any other world region: an estimated 82% of all workers are informal, compared to 56% for Latin America and the Caribbean and 73% for developing Asia. The share of youth not in employment, education or training across 12 African countries[7] averages 7 percentage points higher for young people from fully informal households (i.e. "households where all family members are working informally") than those from fully formal ones (OECD, 2024[59]). Despite wide-ranging policy efforts to increase the share of formal wage employment, the share of vulnerable workers among the working population (used as an approximation of informal employment) has only marginally decreased over the past 20 years (Figure 1.1, Panel A). Under current trends, by 2040, vulnerable workers will continue to make up the majority of employment in Africa (AUC/OECD, 2021[7]). Accordingly, while efforts to upgrade from informal to formal employment remain necessary, addressing skill gaps, low productivity and inter-generational social mobility of informal workers requires dedicated policy responses.

Informal workers face barriers to skills development such as little education, limited resources and inaccessible professional training (OECD, 2024[59]). Acquiring skills seems linked more directly with growth, productivity and innovation in the informal than in the formal sector (Adams, Johansson de Silva and Razmara, 2013[60]). Nevertheless, in practice, informal workers are far less likely to access education and training. In 2019, roughly 68% of informal workers in Africa had completed only primary or no education, compared to 26% of workers in formal employment. The proportion of women in informal employment with no formal education was 14.3 percentage points higher than the corresponding proportion among men (ILO, 2023[42]). Fewer financial resources and lower educational levels limit the propensity to access formal training programmes and acquire additional skills (Aleksynska and Kolev, 2021[11]). Data across ten African countries indicate that 43% to 68% of workers in informal employment earn less than half the median national earnings (OECD, 2024[59]). Evidence across eight African countries shows that less than 5% of surveyed informal workers participate in job-related professional training over the

course of a year. Depending on the country, this rate is 3 to 15 times lower than for formal workers (ILO, 2023[61]). In Ghana and Tanzania, around 90% of vocational training or skills development programme beneficiaries are formal workers (OECD, 2024[59]).

Due to limited formal job opportunities, employees are more likely than self-employed workers to be overeducated and over-skilled. The scarcity of formal job opportunities implies that, in comparison to informal workers, formal workers are more likely to accept positions for which they are overeducated (Aleksynska and Kolev, 2021[11]). Forty-one per cent of African employees hold an occupation matching their education level, compared to 49% in developing Asia and 57% in Latin America and the Caribbean (Figure 1.11). While undereducation remains the prevalent form of mismatch for employees, 16% of them are overeducated for their position, compared to only 7% of self-employed workers. In contrast, about 68% of self-employed workers in Africa (mostly informal) are underqualified for their occupation, compared to 52% in developing Asia and 38% in Latin America and the Caribbean.

Figure 1.11. **Proportion of matched, undereducated and overeducated employees and self-employed workers by world region, 2022 or latest year available**



Note: LAC = Latin America and the Caribbean. (Mis)matches are assessed through the normative approach by comparing educational requirements set out in the International Standard Classification of Occupations (ISCO) for each one-digit ISCO occupational group with the level of education of each person in employment. Calculations are based on data collected in national labour force statistics or other nationally representative household surveys with a module on employment. Coverage includes 39 countries from Africa, 22 countries from developing Asia, 24 countries from Latin America and the Caribbean and 37 high-income countries.

Source: Authors' compilation based on ILOSTAT (2023[62]), *ILO Education and Mismatch Indicators* (database), https://ilostat.ilo.org/.

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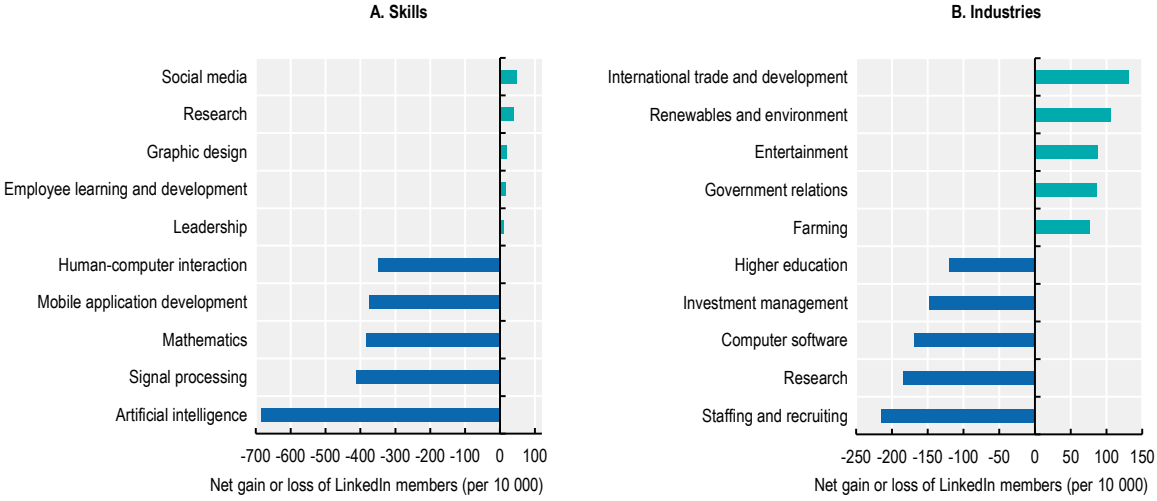
Highly skilled workers and students tend to move out of Africa, suggesting greater professional and educational opportunities abroad. Low-skilled migrants from African countries mostly remain within the continent, with skills development figuring as only one out of a range of factors underlying migration decisions (Annex 1.A). For highly skilled migrants, skill-based employment opportunities represent a more important factor. In 2020, 74% of highly educated migrant workers opted to move to another continent;[8] the vast majority (98%) chose high-income countries as a destination (i.e. a total of 72% of all highly educated migrants). East Africa has experienced the highest outflow of highly educated workers of all African regions. Forty-seven per cent of tertiary-educated individuals born in East Africa resided abroad in 2020, of which 53% had moved to high-income countries and 46% to another African country. Close to 600 000 African students in tertiary education

(3.3% of all tertiary-level students) left to pursue their studies in another country in 2021. This rate is greater than in developing Asia (1.8%) and Latin America and the Caribbean (1%).[9] LinkedIn data reveal that employees with skills in advanced technologies (such as mobile application development or artificial intelligence) and working in globalised professional industries (e.g. higher education, research or computer software) migrate out of the continent, likely due to better pay and career opportunities. Conversely, African employees with managerial or common technological skills are more likely to move to other African countries (World Bank, 2023[63]).

Figure 1.12. **Net international migration of African LinkedIn users by top five and bottom five skills and industries, 2015-19**



Note: Figures indicate the net gain or loss of LinkedIn members from or to another country who indicated an industry or a skill on their profiles, divided by the number of LinkedIn users indicating the same industry/skill in a given African country, multiplied by 10 000. Average values shown are for 2015-19 as the latest years for which data are available. "Military" was omitted from "Industries" analysis due to data only being available for Nigeria.

Source: Authors' compilation based on World Bank (2023[63]), *Skills | LinkedIn Data* (database), https://datacatalog.worldbank.org/search/dataset/0038027/Skills---LinkedIn-Data-.

StatLink https://stat.link/jp1suw

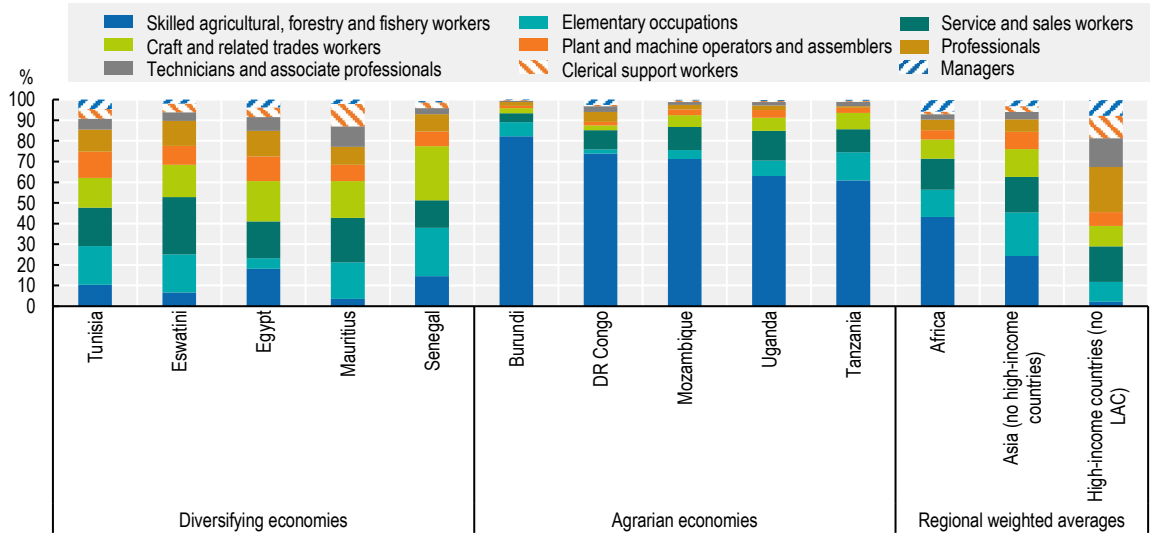
As African economies diversify, workers need more soft, business and sector-specific technical skills to increase productivity and technology adoption

Agrarian and diversifying African economies require different skills. As economies industrialise and diversify, they produce more sophisticated outputs, thus relying on wider sets of skills and higher skill levels (Lo Turco and Maggioni, 2022[65]; WTO/ILO, 2017[66]). The present analysis explains the importance of skills in an economy by mapping occupations onto the skills required to perform them, using O*Net, an occupation-skills database developed in the United States. Despite its limitations, this approach is useful for broad-based comparative analysis of skill requirements across African countries (Annex 1.B). Two groups, each composed of 5 African countries, represent the least and most diversified occupational structures in the dataset of 31 African countries (Figure 1.13):

- **Agrarian economies** include Burundi, the Democratic Republic of the Congo (DR Congo), Mozambique, Tanzania and Uganda. In these countries, over 60% of workers are involved in the agriculture, forestry and fishery sector. These economies are all least developed countries.

- **Diversifying economies** include Egypt, Eswatini, Mauritius, Senegal and Tunisia. These countries have the lowest share of workers involved in elementary occupations[10] or agriculture, forestry and fishery. They demonstrate productive transformation levels that are higher than Africa's average (ACET, 2023[67]), and they have the highest levels of industrial development on the continent (AfDB/AUC/UNIDO, 2022[68]).

Figure 1.13. **Labour force breakdown by occupation in selected African countries, 2021 or latest year available**



Note: LAC = Latin America and the Caribbean. Regional averages are weighted by the number of workers surveyed by country. Thirty-one countries are covered for Africa, 20 countries for developing Asia and 37 high-income countries (no LAC).

Source: ILOSTAT (2023[58]), *ILO Labour Force Statistics* (database), https://ilostat.ilo.org/.

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Foundational and soft skills enable Africans to earn more, be more productive and acquire complementary skills, especially in diversifying economies

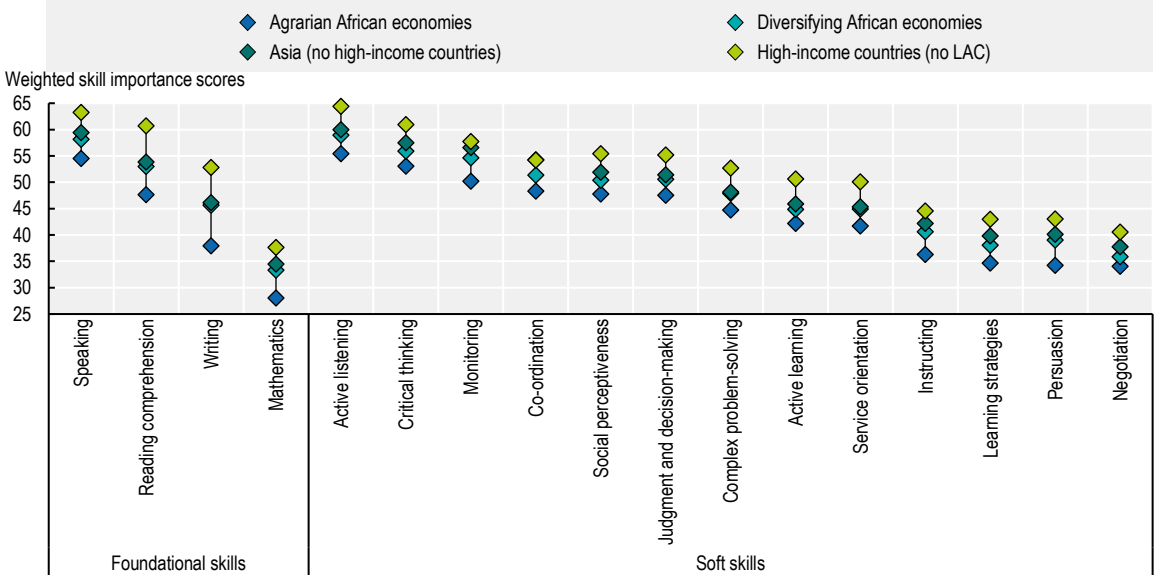
Foundational and soft skills increase in importance as African countries diversify, often matching or surpassing technical skill requirements. Skill requirements and gaps for different types of skills vary across African countries and sectors (Table 1.2). On average, on a 100-point scale, foundational and soft skill requirements are 3.8 points higher in the most diversified African economies than in those relying primarily on agricultural employment (Figure 1.14). Nationally representative surveys of formal and informal firms employing youth in Benin, Liberia, Malawi and Zambia suggest that these skills matter at least as much as technical skills for hiring decisions (Arias, Evans and Santos, 2019[69]; Cunningham and Villasenor, 2014[70]). Similarly, basic digital skills and soft skills like analytical thinking, creativity, curiosity, leadership, resilience and self-awareness rank among the top reskilling and upskilling priorities for 2023-24 across world regions, especially in Africa (WEF, 2023[71]). According to a study of employers across six African countries,[11] almost 40% of students graduating from secondary school would require additional training in communication skills, 15-20% in social and leadership skills and about 11% in analytical and problem-solving skills (ACET, 2023[72]).

Table 1.2. **Policy priorities for reducing skill gaps in Africa**

Priorities	Skill gaps	Evidence
1. Foundational and soft skills	Foundational and soft skills strongly influence a worker's ability to accumulate other types of skills later.	• Weak foundational and soft skills lessen the gains from technical training (Levin et al., 2023[73]). For instance, a study from Tanzania found that science-oriented and problem-solving skills were the most sought-after by employers in agriculture and required students in technical and vocational education and training to have solid foundational and soft skills (Takei, 2016[74]).
2. Managerial and entrepreneurial skills	Missing managerial and entrepreneurial skills impede the growth and productivity of large and small businesses.	• Employers across nine African countries indicated that the need for training for administrative and managerial skills trumped that for technical and digital skills. Administrative and managerial skills were also most commonly identified as lacking by unemployed workers (ILO, 2022[75]).
3. Technical skills based on demand from local industries	Job-specific and technical knowledge is required for competitiveness and productivity.	• Employer surveys across six African countries show that almost 50% of students graduating from secondary school do not possess adequate technical skills and would need to be retrained on the job (ACET, 2023[67]).

Source: Authors' compilation.

Figure 1.14. **Importance of foundational and soft skills in selected agrarian and diversifying African economies and other world regions**



Note: LAC = Latin America and the Caribbean. "Weighted skill importance scores" (from 0 to 100) indicate the average importance of a specific skill to fulfil the tasks and duties across occupations present in the economies considered, weighted by the share of workers employed in each type of occupation at the International Standard Classification of Occupations two-digit level. These scores are matched with occupational data from national labour force statistics from countries for which data are available (see Annex 1.B).

Source: Authors' calculation based on ILOSTAT (2023[58]), *ILO Labour Force Statistics* (database), https://ilostat.ilo.org/ and O*NET OnLine (2023[76]), *O*NET Data* (database), https://www.onetonline.org.

StatLink https://stat.link/k4vyic

African workers with higher foundational and soft skills earn more and are more productive. For instance, in Ghana and Kenya, comparable surveys show that literate workers earn a wage premium of about 30%. In manufacturing, evidence from over 7 600 firms across 27 African countries shows that a 10 percentage point increase in the share of employees with high school and university degrees (a proxy of foundational and soft skills) is associated with an increase in average firm productivity (sales per worker) by 4.2% and 4.8%, respectively (Okumu and Mawejje, 2020[77]).

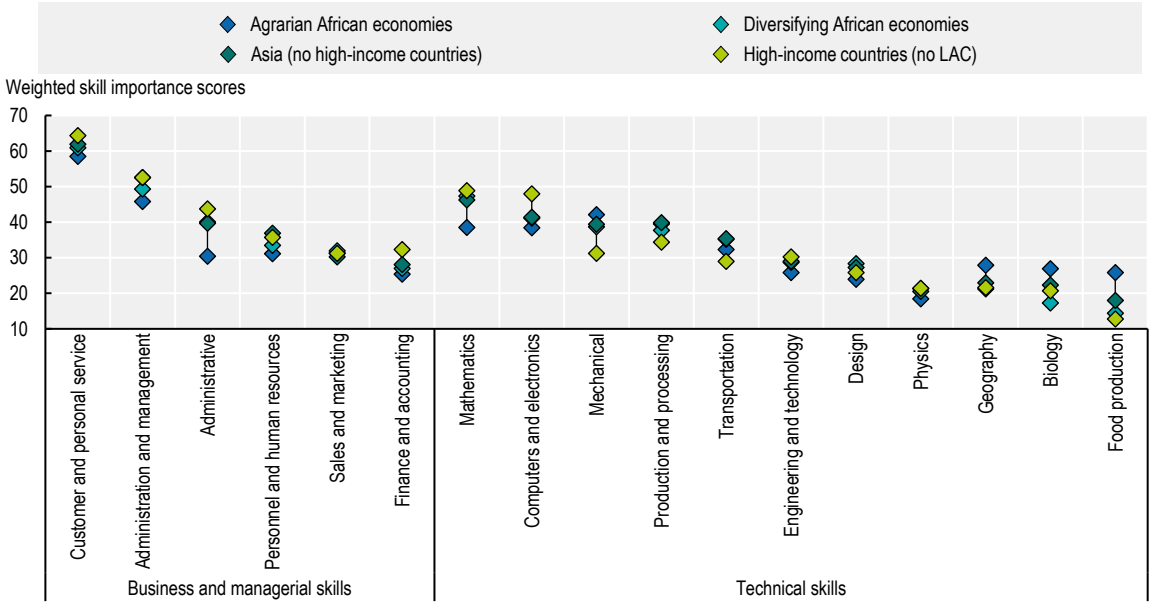
Higher foundational and soft skills also improve workers' capacity to acquire new skills. Farmers' skills explain 12-17% of variation in maize yields in Kenya, with foundational and soft skills strongly influencing their ability to accumulate technical skills (Laajaj and

Macours, 2017[78]). In Malawi, farmers with soft skills (such as perseverance) were more likely to adopt new cash crops and acquire technical knowledge (Montalvao et al., 2017[79]). A cross-country study based on income and educational attainment data of workers across sectors in Ghana, Kenya, South Africa and Tanzania showed that productivity returns to additional education or training were higher when workers had better foundational skills (Fasih et al., 2012[80]).

Technical skills are needed to support growth and productivity in dynamic sectors

STEM skills can help develop technology-intensive value chains, but Africa has low numbers of STEM graduates and engineering professionals. Skills in mathematics, engineering and technology, computer and electronics, and design are on average 4.7 points more important in diversifying African economies than in agrarian ones (Figure 1.15). Workers with STEM skills can support the development of technology-intensive value chains such as automotive, electronics, solar panels, pharmaceuticals and medical devices, and mining (UNCTAD, 2023[81]; Dugbazah et al., 2021[82]). Yet, the rate of STEM tertiary education graduates varies widely across Africa, with only Tunisia, Algeria, Mauritius and Morocco showing STEM graduation rates of above 20%, coupled with large overall tertiary enrolment (Figure 1.16). African countries have a limited number of engineering professionals per capita, ranging from 540 practitioners per 100 000 inhabitants in the Seychelles to less than 45 in the DR Congo, Madagascar, Malawi and Mozambique. This compares to 1 160 engineering professionals in the United Kingdom and 850 in the United States (UNESCO/ICEE, 2021[83]; SADC, 2018[84]).

Figure 1.15. **Importance of business and managerial skills and technical skills in selected agrarian and diversifying African economies and other world regions**



Note: LAC = Latin America and the Caribbean. Weighted skill importance scores (from 0 to 100) indicate the average importance of a specific skill to fulfil the tasks and duties across occupations present in the economies considered, weighted by the share of workers employed in each type of occupation at the International Standard Classification of Occupations two-digit level. These scores are matched with occupational data from national labour force statistics from countries for which data are available (see Annex 1.A).

Source: Authors' calculation based on ILOSTAT (2023[58]), *ILO Labour Force Statistics* (database), https://ilostat.ilo.org/ and O*NET OnLine (2023[76]), *O*NET Data* (database), https://www.onetonline.org.

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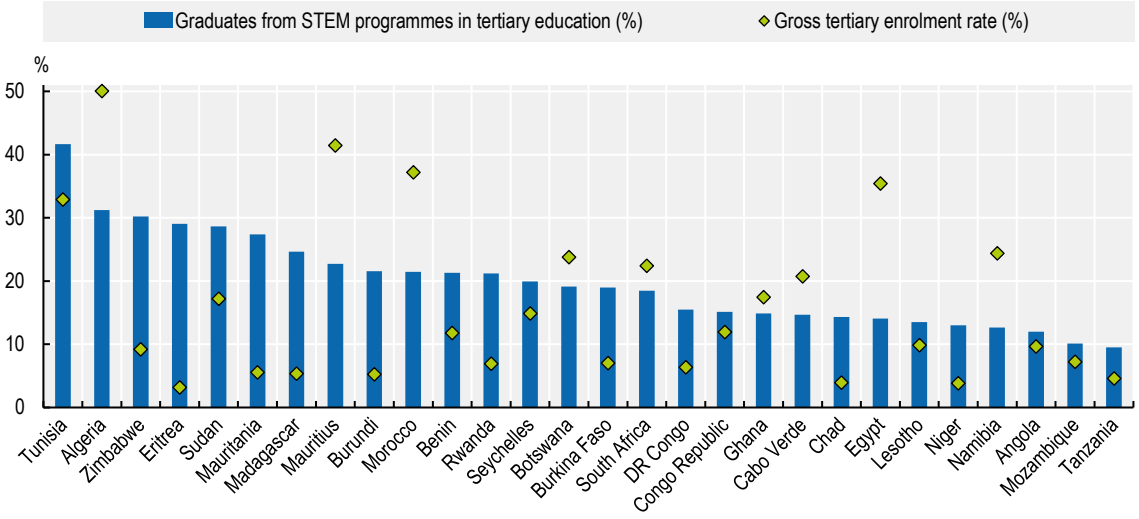
Figure 1.16. **Percentage of tertiary education graduates from programmes in science, technology, engineering and mathematics (STEM) and gross tertiary enrolment rates in African countries, average 2015-23**



Note: Gross enrolment rates represent total enrolment in tertiary education (ISCED 5 to 8), expressed as a percentage of the total population of the five-year age group following on from secondary school leaving.

Source: UNESCO Institute for Statistics (2023[85]), *UIS Stat* (database), http://data.uis.unesco.org/.

StatLink https://stat.link/yf06cr

Improving agricultural productivity and enhancing agro-processing hinge on technical skills. As would be expected, on average, technical skills in food production, mechanics, biology and geography are more important in agrarian than in diversifying economies (Figure 1.16). According to a survey of over 200 African technical and vocational education and training (TVET) stakeholders (mostly government bodies and TVET providers), agriculture represents the sector with the greatest need for new technical qualifications (Allais, 2023[86]). Research on Rwanda's agri-food systems finds skill gaps in crop planting techniques, harvest and post-harvest, and knowledge of and compliance with standards in food processing and conditioning (PSF, 2021[87]). In Ethiopia, 80% of surveyed firms stress the need for technical skills to support the development of agro-processing activities in edible oil, poultry, floriculture, and fruits and vegetables (ILO, 2021[88]). In North Africa, increased consumption of processed food products is driving demand for skills in baking, cheesemaking, fruit drying, gastronomy, pastry making, and the packaging of ready-to-eat products (OECD, 2023[89]; OECD et al., 2021[90]).

Closing managerial and entrepreneurial skill gaps can increase labour productivity and technology adoption

Business and managerial skills are key to increasing firm productivity and encouraging the adoption of technology across sectors. While skills in administrative functions are more important in diversifying than in agrarian African economies (by about 9.6 points), other business and managerial skills, such as sales, marketing, finance and accounting, are equally important in both types of economies (Figure 1.15). Currently, managerial skills are often missing in African countries compared to other world regions, lowering firm performance (Lemos and Daniela, 2015[91]). For instance, research across 200 manufacturing firms in Zambia demonstrated that quality managerial practices significantly improved firm productivity and profitability (Grayson, Nyamazana and Funkila-Mulenga, 2016[92]). Cross-country surveys on firm-level adoption of technology show that firms using more sophisticated technologies require more managers with advanced degrees. However,

the same data also highlight the relative scarcity of better-trained managers in Africa, impeding technology adoption (Begazo, Blimpo and Dutz, 2023[93]).

Informal entrepreneurs often struggle to master the range of skills needed to run their businesses. Africa has the highest share of adults in the process of starting or running new businesses of all world regions (OECD/AfDB/UNDP, 2017[94]). A range of skills – from project planning to delegation of tasks and sales – are important for entrepreneurs to be able to grow their businesses but are often missing for informal enterprises in developing countries (Magidi and Mahiya, 2021[95]). For instance, over 70% of self-employed workers in Côte d'Ivoire and Madagascar (of which over 85% are informal) do not keep written accounts (OECD, 2017[52]). Similarly, surveys across seven African capital cities showed that the share of informal business owners preparing a profit and loss statement at least once a year varies from around 40% in Khartoum (Sudan) and Mogadishu (Somalia) to less than 10% in Maputo (Mozambique) (World Bank, 2023[96]).

Digital skills are in demand across the continent, while the need for green skills will increase with climate challenges

The digital and green transitions represent unique opportunities for skills development in African countries and make it an urgent priority. With the digital revolution and climate change, African countries are facing two fundamental transformations that require them to equip their workforce with digital and green skills. These transitions have generated new job opportunities and are also reshaping the future of work and, with it, the demand for and supply of skills (Nedelkoska and Quintini, 2018[97]).

Basic and intermediate digital skills are in high demand across African countries, while the demand for and supply of advanced digital skills remain scarce

Digital skills refer to abilities to productively use digital technologies, such as the Internet, software applications, smartphones and computers. They can be categorised into three levels of sophistication: basic, intermediate and advanced (Table 1.3). In African countries, the demand for and supply of skills are diverse, with each country having unique challenges and strengths (Chapter 5).

Digital infrastructure has improved across the continent, but Internet connections remain slow or inaccessible in many parts of Africa. Adequate and reliable Internet access is fundamental for the digital sector and digital skills development (World Bank, 2020[98]). It can also support innovative approaches to education, such as online learning (Box 1.3). Africa's Internet penetration has more than doubled since 2015 and increased fivefold since 2010.[12] Despite these improvements, in 2016-18, only 28% of Africa's population had Internet access, compared to 58% in Latin America and the Caribbean and 41% in developing Asia. Similarly, broadband Internet speeds are still slow. In January 2024, the average download speed was 23 megabits per second (Mbps) in Africa, compared to 78 Mbps in Latin America and the Caribbean and 54 Mbps in developing Asia.[13]

Table 1.3. **Demand for and supply of digital skills across Africa**

	Basic digital skills (e.g. smartphone use, e-mail, basic file management, web browsing, mobile communication)	**Intermediate digital skills** (e.g. use of multiple devices, e-commerce and financial software, professional social media, data entry and management)	**Advanced digital skills** (e.g. web design, programming, AI development, data science)
Demand	*Very large demand* 70% of demand for digital skills is expected to be for basic digital skills by 2030 (World Bank, 2021[99]).	*Large demand* 23% of demand for digital skills is expected to be for intermediate skills by 2030 (World Bank, 2021[99]).	*Emerging demand* While AI markets are more mature in high-income economies, some African countries are emerging as regional AI leaders (World Bank, 2021[99]).
Supply	*Growing supply* 26.4% of the African population knows how to use a mobile money account. Across 15 African countries, 9% of the workforce possesses basic digital skills (Authors' calculations based on World Bank (2021[100]); and UNICEF (2022[101]).	*Limited supply* 5% of the workforce possesses intermediate digital skills across 15 African countries (Authors' calculation based on UNICEF (2022[101]).	*Scarce supply* Africa comprises only 1.3% of global users of GitHub – a widely used platform for program developers (OECD et al., 2021[90]).

Note: AI – artificial intelligence.
Source: Authors' compilation.

Box 1.3. **Massive open online courses and e-learning in Africa**

Online learning increasingly offers an alternative to traditional education in Africa. The continent's demand for online learning is on the rise. The percentage of users within the total population is estimated to increase from 1.5% in 2024 to 1.8% by 2028, reaching 25 million users by 2028 (Statista, 2023[102]). Massive open online courses (MOOCs) provide digital access to learning content and materials offered from anywhere in the world. MOOCs thereby have the potential to address some of the shortcomings in African education, such as overcrowded classrooms, missing infrastructure and high costs of education (Ochieng', Mutisya and Thiong'o, 2022[103]).

While there is a strong demand for MOOCs in Africa, the number of African MOOCs remains low. In 2015, Africans took 13% to 20% of MOOCs offered by the Francophone University Agency (AUF) – a global leading association of higher education institutions (Rimondi, 2015[104]). However, the continent designs and produces a small percentage of the world's MOOCs: 98% of existing MOOCs were produced mainly by public or private universities in high-income countries (Elongué, 2021[105]).

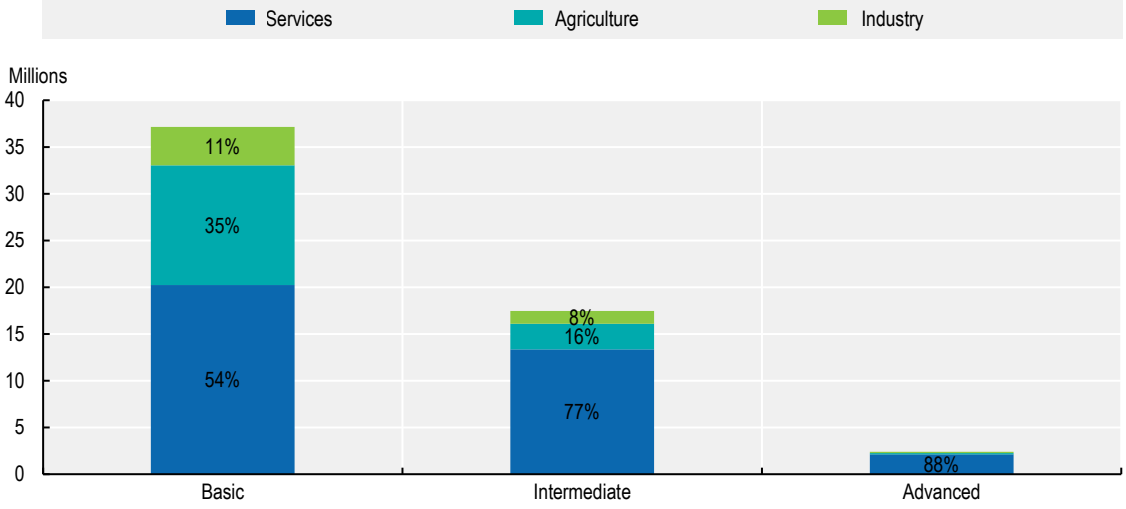
Civil society is offering solutions to meet the growing demand for e-learning. Start-ups increasingly supply e-learning, in the form of courses delivered through community-based mobile applications and online platforms, especially in East Africa (AU-Startups, 2023[106]). In the most rural areas of Uganda, where Internet-based education is not possible, distance learning has developed through sponsored educational radio broadcasts by local non-governmental organisations (Vincent-Lancrin, Cobo Romaní and Reimers, 2022[107]).

Surveys show large gaps in the supply of digital skills across the continent, sometimes forcing employers to recruit internationally. Recent surveys of employees and employers led in nine African countries indicate both an increasing demand for and a short supply of digital skills, especially in high-skilled occupations (ILO, 2022[75]). In Ghana, the supply gap for digital skills is driving employers to recruit internationally. Survey findings from 2019 show that nearly 20% of surveyed Ghanaian companies recruit employees with digital skills only internationally, and of these, nearly 70% do so because they cannot find skilled local talent (IFC, 2019[108]). In another survey, companies in Kenya, Nigeria and South Africa identified the limited availability of skills as a major challenge, with 97% of firms stating that they expected to have difficulties in recruiting and retaining skilled digital workers (SAP, 2023[29]).

The demand for basic digital skills in Africa is on the rise. The COVID-19 pandemic has accelerated the need for basic digital skills, as firms were pushed to digitalise their operations (AUC/OECD, 2021[7]). Even after the pandemic, the number of jobs requiring the performance of digital tasks will continue to grow quickly. By 2030, 70% of this new demand across much of the continent will be for basic digital skills (World Bank, 2021[99]). In countries leading Africa's digital transformation, like Kenya, by 2030, 50-55% of all jobs (or 21 million workers) may require basic digital skills, driven by the expansion of the domestic digital sector and start-up ecosystem. In economies less reliant on the digital sector such as Côte d'Ivoire, Nigeria and Rwanda, 35% to 45% of jobs are expected to require basic digital skills. Among the jobs requiring basic digital skills in 2030, 54% will be in services, 35% in agriculture and 11% in industry (Figure 1.17).

The demand for intermediate and advanced digital skills is growing across all sectors, particularly in services. Intermediate digital skills enable the use of digital technology for task-oriented purposes and for specific occupations and professions. In 2022, 93% of firms in Kenya, Nigeria and South Africa reported that the need for intermediate digital skills had increased over the past 12 months, with not one participating enterprise indicating that the need had decreased (SAP, 2023[29]). By 2030, most of the jobs needing intermediate and advanced digital skills will be in the service sector (Figure 1.17).

Figure 1.17. **Jobs requiring digital skills in 2030 in five African countries, by skill level**



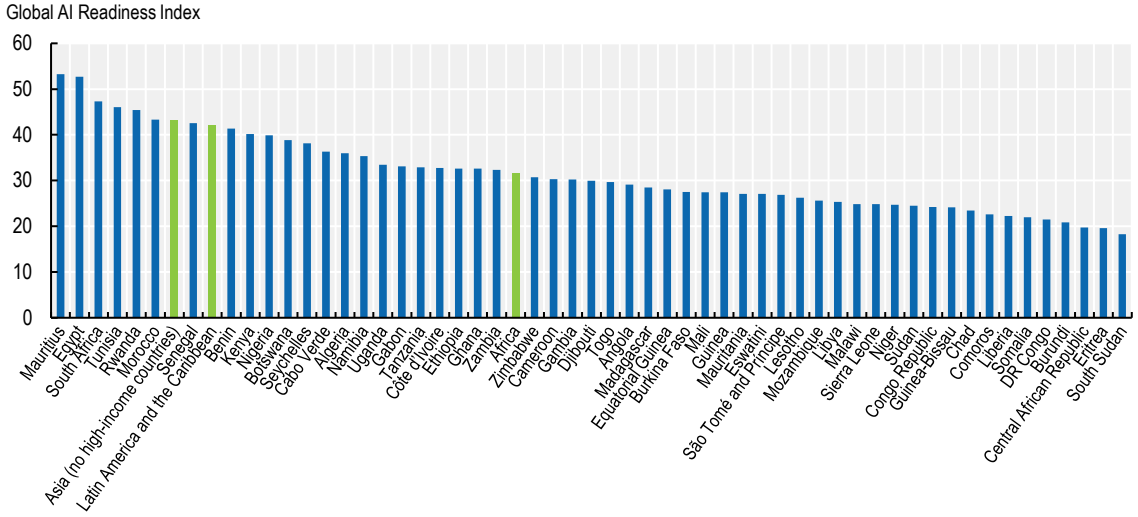
Note: Data cover Côte d'Ivoire, Kenya, Mozambique, Nigeria and Rwanda.

Source: Authors' calculations based on World Bank (2021[99]), *Demand for Digital Skills in Sub-Saharan Africa*, https://www.datocms-assets.com/37703/1623797656-demand-for-digital-skills-in-sub-saharan-africa.pdf.

StatLink https://stat.link/jgkp16

The Fourth Industrial Revolution (4IR) is beginning to increase the demand for advanced digital skills in Africa. Technological progress in automation, robotics, artificial intelligence (AI) and biotechnology is poised to redefine labour markets globally. While so far the 4IR is predominantly affecting high-income countries, digital skill demand in Africa is increasing through online labour (Box 1.4). African firms have accelerated their adoption of AI in recent years (PCNS, 2023[109]), increasing the demand for AI skills. In a survey of representatives of UNESCO's 32 African member states, 27 out of 32 declared that updating education, skills and training systems for imparting AI skills and knowledge is a priority (UNESCO, 2021[110]). Currently, however, there are significant differences in AI adoption across countries (Figure 1.18). In the 2023, AI Readiness Index, Africa has an average score of 31.6. For comparison, the first country in the global ranking is the United States, with 84.8 points, and at the bottom stands North Korea, with 9.2 points.

Figure 1.18. **Differences in adoption of artificial intelligence across African countries and other world regions**



Source: Authors' calculations based on Oxford Insights (2023[111]), *Government AI Readiness Index* (database), https://oxfordinsights.com/ai-readiness/ai-readiness-index/.

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Box 1.4. The artificial intelligence revolution and online labour

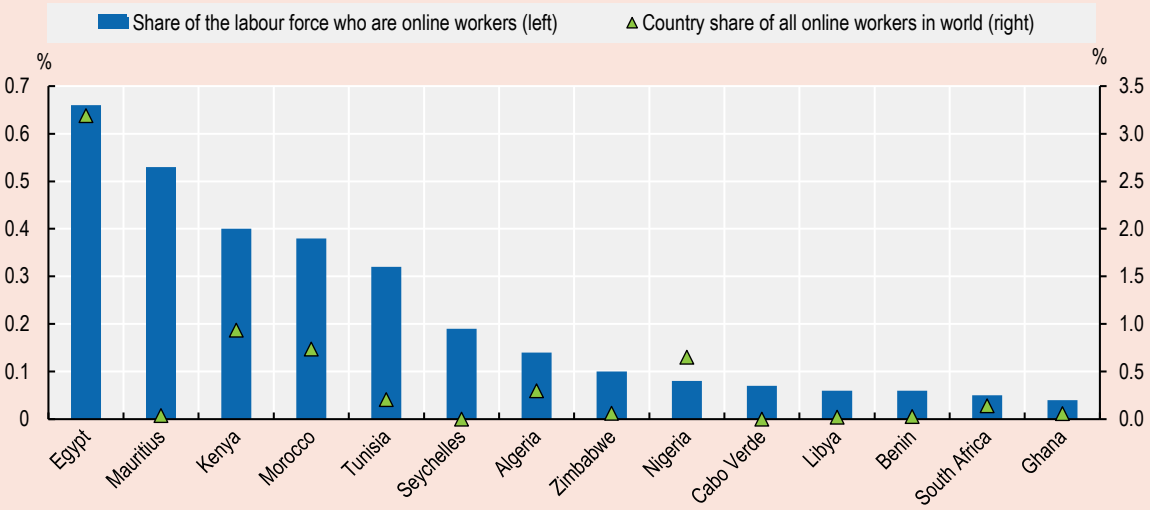
Some African countries contribute significantly to the global supply of online labour. African online workers can benefit from the globally rising demand for digital tasks. With 70% of online workers being software developers, Africa was supplying 5.5% of the world's online labour force in 2020, lower than the 65.5% in developing Asia, but above the 3.5% in Latin America and the Caribbean.[14] However, African online workers represented less than 0.1% of the continent's overall labour force in 2020, despite differences across African countries (Figure 1.19).

Artificial intelligence can improve online workers' productivity. Recent studies have found that AI can increase the productivity of online digital workers by cutting routine tasks. A randomised controlled trial of 640 Kenyan micro, small and medium-sized enterprises found that business owners could benefit from conversations with the chatbot GPT-4 (Otis et al., 2023[112]).

Box 1.4. **The artificial intelligence revolution and online labour *(continued)***

In the Philippines, using GPT-4, low-skilled online workers increased their productivity by 34% and average skilled workers by 14%, while the most skilled showed only negligible improvements (Brynjolfsson, Li and Raymond, 2023[113]). Together, these findings suggest that generative AI could boost productivity, especially that of low-skilled, vulnerable African online workers, given that it does not require new infrastructure and is intuitive to use.

Figure 1.19. **Shares of online workers across selected African countries, 2020**

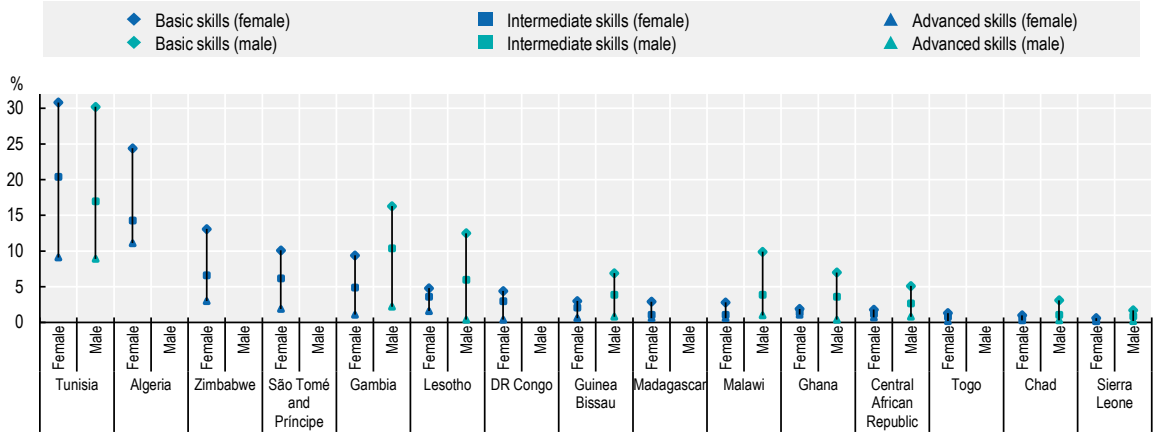


Source: Authors' calculations based on Kässi, Lehdonvirta and Stephany (2021[114]), "How many online workers are there in the world? A data-driven assessment", https://doi.org/10.12688/openreseurope.13639.4 and Stephany et al. (2021[115]), "Online Labour Index 2020: New ways to measure the world's remote freelancing market", https://doi.org/10.1177/20539517211043240.

StatLink https://stat.link/1x30h6

Africans' basic digital skills vary, and intermediate and advanced digital skills remain scarce. On average across 30 African countries, 26.4% of the population knows how to use a mobile money account without any help compared to 16% in Latin America and the Caribbean and 11% in developing Asia and at a global level (World Bank, 2021[100]).[15] However, computer skills (a subset of all digital skills) are scarcer (Figure 1.20). Currently, only 9% of the workforce aged 15-24 in 15 African countries for which data are available possesses at least basic computer skills – 10% of the male workforce and 7% of the female workforce. Only 1% of the workforce in Chad and 2% in the Central African Republic have basic computer skills, while the figure reaches 33% in Tunisia. Intermediate computer skills are scarcer, remaining below 13% in all countries for which data are available, except for Tunisia, Algeria and Zimbabwe (23%, 19% and 17%, respectively). While growing, advanced computer skills remain limited: 2% of workers have programming skills. Only 1.3% of global users of GitHub – a widely used platform for program developers – reside in Africa, compared to 37% for Europe and 23% for Asia (OECD et al., 2021[90]).

Figure 1.20. **Computer skill differences among 15-24 year olds by gender in selected African countries**



Note: Percentage of people aged 15-24 who used at least one of nine computer skills in the three months leading up to the survey. Basic skills: copied or moved a file or folder; used a copy and paste tool to duplicate or move information within a document; sent an e-mail with an attached file. Intermediate skills: used a basic arithmetic formula in a spreadsheet; downloaded and configured software; created an electronic presentation; connected and installed a new device, such as a modem or printer; transferred a file between a computer and another device. Advanced skills: wrote a computer program in any programming language. See UNICEF (2022[101]).

Source: Authors' calculations based on UNICEF (2022[101]), *UNICEF Global Database on Information and Communications Technology (ICT) Skills* (database), https://data.unicef.org/.

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Addressing climate change can create jobs and raise Africa's productivity in key sectors, but more green skills are needed

Mitigating and adapting to climate change can create jobs that require new skills. Producing less than 3% of global greenhouse gas emissions created by human activity, Africa is the world region that contributes the least to climate change; yet it is the most vulnerable and most exposed to its consequences (IPCC, 2022[116]). In 2022, climate and water-related hazards in Africa caused more than USD 8.5 billion in economic damages (WMO, 2023[117]). Notwithstanding, a green transition could create job and growth opportunities in Africa. Climate change mitigation efforts, such as the move towards renewable energy and sustainable infrastructure, could generate over 9 million job opportunities from 2019 to 2030 and a further 3 million jobs by 2050 (IRENA/AfDB, 2022[118]). Adaptation measures, including improved climate literacy and climate-smart agriculture, can increase productivity and provide additional employment opportunities (IPCC, 2022[116]; Williams et al., 2021[119]). These transformations not only create new jobs, they also change existing ones and demand new soft and technical skill sets (ILO, 2015[120]).

Adopting new skilled practices will allow agricultural workers to better respond to climate change and boost productivity. Agriculture is the sector with the greatest need for new technical qualifications and complementary green skills (Allais, 2023[86]). Innovative green agriculture techniques require a workforce equipped with skills to mitigate and adapt to the impacts of climate change. Green solutions for agriculture should be based on climate-smart agricultural practices that address climate change and food security. Examples of these practices are diversifying crops, advancing agriculture through technology (agri-tech) and reducing emissions from farming practices through agroforestry (Williams et al., 2021[119]). Adopting such agricultural practices can boost productivity and contribute to the sustainability of land use. For instance, in East and

Southern Africa, agricultural productivity could double or triple if better farm inputs and production technologies were adopted, water and soil resources were used more efficiently, and natural capital and ecosystems were restored (World Bank, 2022[121]).

Climate change literacy remains limited. Climate change literacy involves understanding both climate change and its human-caused origins, forming the basis for informed actions in both mitigation and adaptation (Simpson et al., 2021[122]). While about six in ten Africans (58%) have heard of climate change, only one in four (28%) also understands it to have negative consequences and recognises it as caused in part by human activity. Groups that are less familiar with the concept of climate change include rural residents, women, the poor and the less educated, as well as people who work in agriculture. Countries such as Liberia, Niger and Sudan are among the most vulnerable to climate change while showing some of the lowest levels of climate change awareness (Selormey et al., 2019[123]).

The renewable energy sector has strong job creation potential, but the lack of clean energy skills is hindering its growth. In 2020, renewable energies, such as of hydro, geothermal, solar and wind power, accounted for over 55% of the total primary energy supply in 34 African countries (OECD, 2023[124]). Transitioning jobs from fossil fuel to clean energy sectors is already happening in Africa. Between 2019 and 2022, around 400 000 clean energy jobs were created in the continent, while around 200 000 jobs in fossil fuels disappeared. Yet, skilled labour shortages have limited the economic gains of the renewable energy sector. An important reason is its demand for highly skilled workers, which is higher than that of any other industry in the economy. Thirty-six per cent of the global energy workforce typically requires some form of tertiary education, and 51% vocational training. Many key shortages in skilled labour in the clean energy sector are found in vocational roles. These mid-skilled roles often require specialised training beyond typical energy-related jobs. For instance, heating, ventilation and air conditioning specialists may need to retrain for heat pump installation, while electricians may require training in battery or solar installation (IEA, 2023[125]).

Jobs in infrastructure and construction need green skills, and African cities offer a skilled workforce. Infrastructure is responsible for 79% of all greenhouse gas emissions and 88% of all adaptation costs (Thacker et al., 2021[126]). Resource-efficient buildings can reduce the negative impacts of climate change. Since 80% of the buildings that will exist in 2050 in Africa are yet to be built (World Green Building Council, 2023[127]), construction skills should focus on such green buildings. Africa already has skilled construction workers in cities; it has a greater availability of skilled labour in the construction sector than in other world regions. Of the 9 African cities in a global survey of 89 large cities, 6 had a surplus of skilled construction workers, while only 2 had skill shortages. This stands against a global skill shortage rate of 74% (Turner & Townsend, 2023[128]).[16]

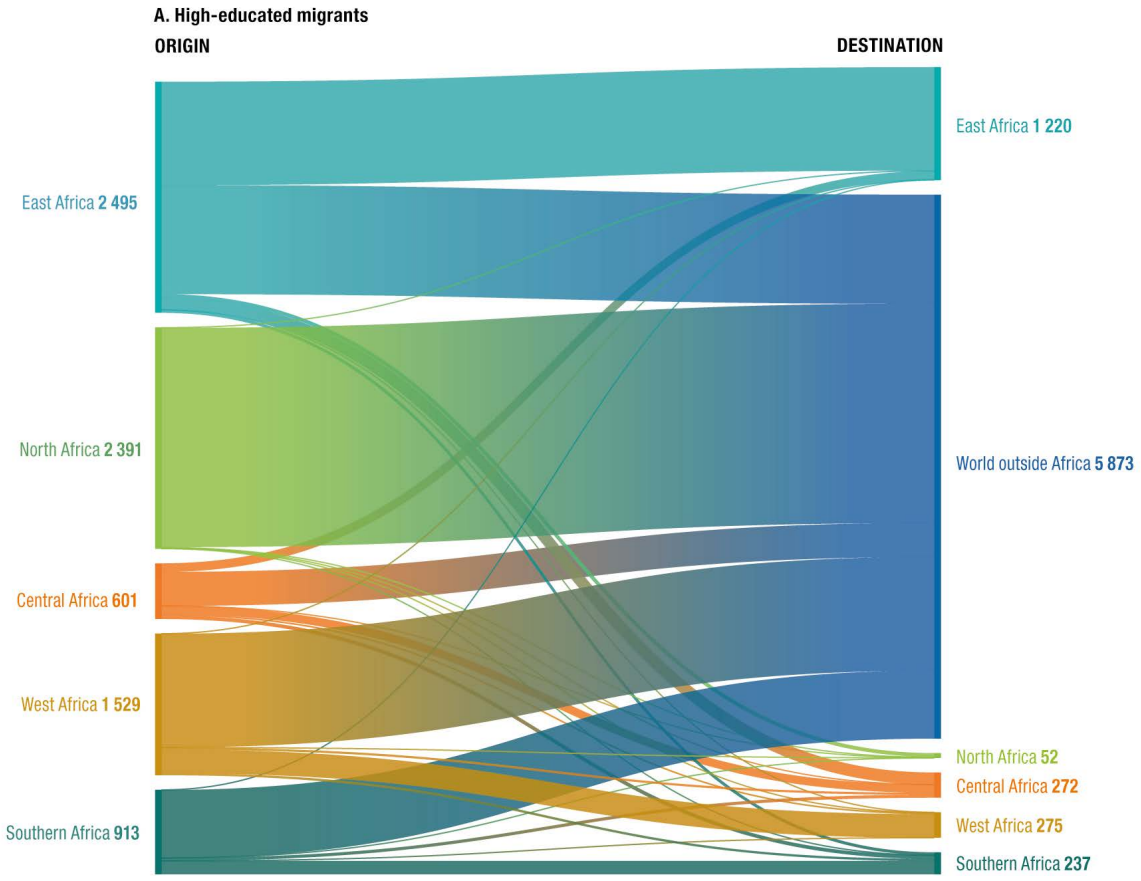
Africa's waste management sector is poised to grow – creating new jobs. Efficient recycling and waste management practices are needed to minimise environmental pollution. An estimated 70-80% of municipal solid waste generated in Africa is recyclable, while only 4% is recycled (UNEP, 2020[129]). Rapid urbanisation and buoyant economic activity further increase the need for recycling and waste-to-energy activities, with the continent's waste management sector projected to grow at an annual rate of 5% by 2029 (Mordor Intelligence, 2023[130]). Similarly, the circular economy can generate numerous additional economic opportunities in this sector and beyond (Never, 2023[131]).

Annex 1.A. The nexus of migration and skills in Africa

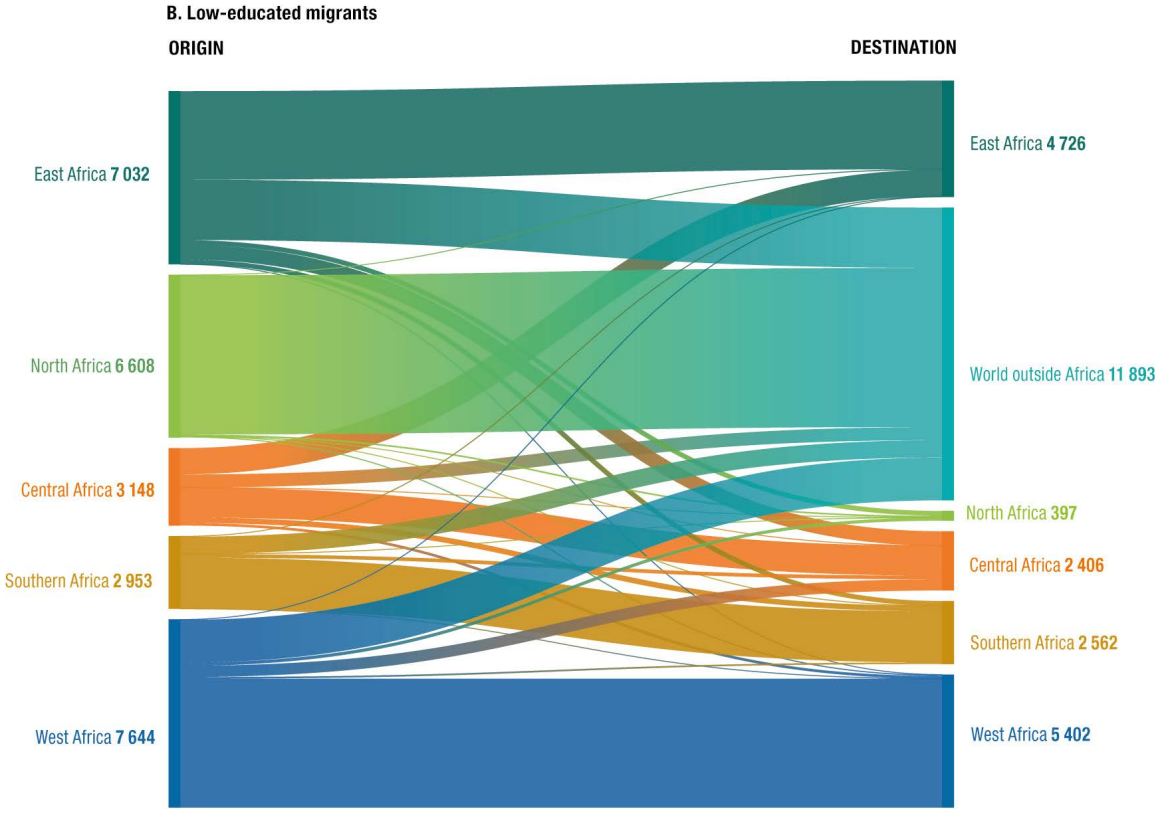
African workers who migrate to other African countries tend to be low-educated and migrate for higher pay. International migration decisions are complex, being influenced by factors such as demographic, sociocultural, political, environmental and economic conditions in the migrant's home country (push factors) and destination country (pull factors). A key motivation for African workers' migrating is the prospect of higher earnings abroad (De Vreyer, Gubert and Roubaud, 2010[132]). Rural, low-skilled Africans often move to nearby countries, due to labour demand in sectors such as construction, private household services and trade, and seasonal agriculture, while keeping migration costs low (OECD/ILO, 2017[133]; Mercandalli, 2017[134]). In 2020, more than half (57%) of African migrants with secondary education or less moved within the continent (Annex Figure 1.A.1, Panel B), amounting to more than double Latin America and the Caribbean's intra-regional migration rate (27%) (World Bank, 2023[135]).

Africa's high-educated migrants generally leave the continent, which can sometimes benefit their countries of origin. High-educated migrants tend to leave Africa (Annex Figure 1.A.1, Panel A). However, when workers return from abroad, they can help enrich skill sets in their home countries (OECD, 2017[136]).

Annex Figure 1.A.1. **Africa's stocks of high- and low-educated migrants per region of origin and destination, in thousand, 2020**



Annex Figure 1.A.1. **Africa's stocks of high- and low-educated migrants per region of origin and destination, in thousand, 2020 *(continued)***



Note: "Low-educated" refers to individuals holding secondary education degrees or less. "High-educated" represents those with a tertiary education or more.

Source: Authors' calculations based on World Bank (2023[64]), *Global Bilateral Migration* (database), https://databank.worldbank.org/source/global-bilateral-migration.

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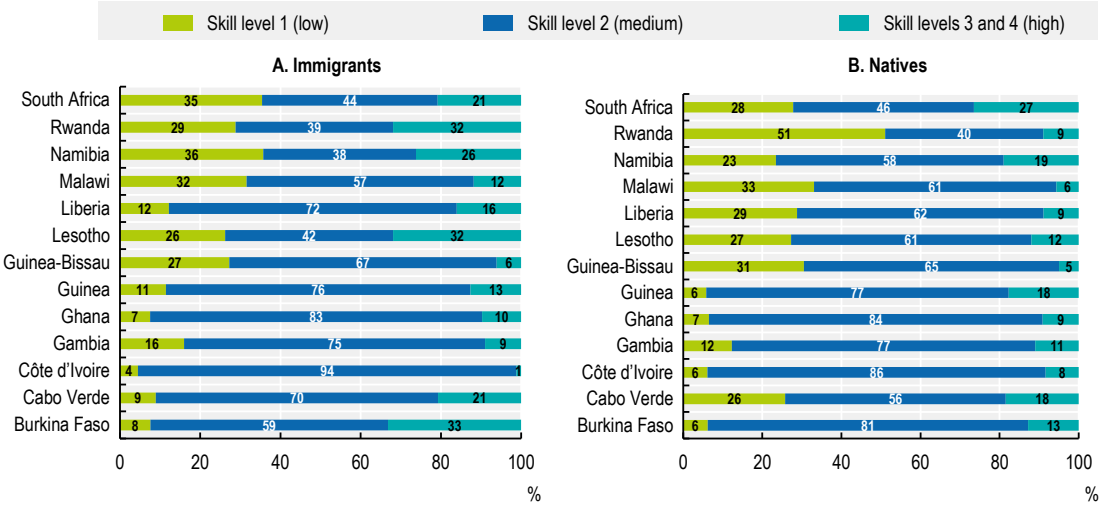
Over one-third of intra-Africa labour migrants work in agriculture, and around a third of the continent's medium- and low-skilled workers migrate to the same two regions. Between 2017 and 2021, the largest share of African immigrants in the continent was employed in agriculture (34.5%), followed by services and trade (22.3%) and other elementary occupations (19.6%). East and West Africa emerged as the primary destinations for low-educated workers from other African countries. In 2020, East Africa welcomed 30% of the low-educated workforce and West Africa 35% (Annex Figure 1.A.1, Panel B). This influx is potentially driven by the significant role of agriculture, which attracts a considerable labour force, and its contribution to the value chains in both regions (AUC/OECD, 2022[32]). Intra-African migrants tend to hold more high-skilled occupations than do the local host populations. Nine African countries out of 13 have a larger share of immigrant workers in high-skill occupations than the share of the native populations (Annex Figure 1.A.2).

Annex Figure 1.A.2. **Occupational skills of immigrants and natives across selected African countries**



Note: Skill level is defined as a function of the complexity and range of tasks and duties to be performed in an occupation. Skill level 1 (low) covers elementary occupations. Skill level 2 (medium) covers plant and machine operators and assemblers, craft and related trades workers, skilled agricultural, forestry and fishery workers, service and sales workers, and clerical support workers. Skill levels 3 and 4 (high) cover technicians and associate professionals, professionals, and managers. Data are based on labour force statistics across 13 African countries for which complete data are available for 2017-21.

Source: ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org.

StatLink *https://stat.link/wlyoqh*

Annex 1.B. Analysis of skill importance using labour force statistics and the O*NET database

The methodology used in this report to assess the country profiles of skill requirements relies on two main data sources:

- The United States Occupational Information Network (O*NET) database contains detailed occupation-specific information on skill requirements by occupation from standardised questionnaires filled out by American workers with over six months of seniority at business establishments statistically selected from a random sample. Each dimension in O*NET is attributed categorical values to their "importance" for the job. Respondents indicate the importance of a given skill for their job on a scale from one (not important) to five (extremely important).
- The harmonised labour force statistics of the International Labour Organization (ILO) derived from national labour force statistics available for 31 African countries provide detailed information on employment structure by occupation.

To compute weighted skill importance scores, the analysis used the following approach:

- First, importance scores were standardised for each occupation. Standardised score = 100* ((O - L)/(H - L)) where O is the original rating score, L is the lowest possible score (1) and H is the highest possible score on the rating scale used (5).
- Second, O*NET occupation classifications (O*NET-SOC 2019 taxonomy) (Annex Table 1.B.1) at the six-digit level were converted to the International Standard Classification of Occupations (ISCO-08) at the two-digit level through available crosswalks.
- Third, O*NET skill importance scores by occupations were matched to labour force statistics from ILO.
- Fourth, weighted skill importance scores were computed, using the share of employed people by occupation as a weight.

Caveats and limitations of this approach

- While several studies have applied O*NET to the assessment of occupations in low-income countries (Arias, 2014[137]; Aedo et al., 2013[138]; Aedo, 2012[139]), the skill content of certain occupations might differ between low- and high-income countries like the United States, as countries differ significantly in terms of technology and regulatory context.
- The present analysis focused on two groups of African economies (agrarian and diversifying). This choice was made partly because skill importance scores are derived from surveyed United States workers. As skill importance scores vary across countries according to occupational structures, a significant difference between groups was required to obtain distinct average skill importance scores.

Annex Table 1.B.1. **Classification used for the *Africa's Development Dynamics 2024* analysis**

Broad skills category	Skills	Description
Foundational skills	Mathematics	Using mathematics to solve problems.
	Reading comprehension	Understanding written sentences and paragraphs in work-related documents.
	Speaking	Talking to others to convey information effectively.
	Writing	Communicating effectively in writing as appropriate for the needs of the audience.
Soft skills	Active listening	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate and not interrupting at inappropriate times.
	Active learning	Understanding the implications of new information for both current and future problem-solving and decision-making.
	Critical thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or problem approaches.
	Learning strategies	Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things.
	Monitoring	Monitoring/assessing the performance of yourself, other individuals or organisations to make improvements or take corrective action.
	Complex problem-solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
	Time management	Managing one's own time and the time of others.
	Co-ordination	Adjusting actions in relation to others' actions.
	Instructing	Teaching others how to do something.
	Negotiation	Bringing others together and trying to reconcile differences.
	Persuasion	Persuading others to change their minds or behaviour.
	Service orientation	Actively looking for ways to help people.
	Social perceptiveness	Being aware of others' reactions and understanding why they react as they do.
Business and managerial skills	Administration and management	Knowledge of business and management principles involved in strategic planning, resource allocation, human resources modelling, leadership technique, production methods, and co-ordination of people and resources.
	Administrative	Knowledge of administrative and office procedures and systems such as word processing, managing files and records, stenography and transcription, designing forms and workplace terminology.
	Customer and personal service	Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
	Finance and accounting	Knowledge of economic and accounting principles and practices, the financial markets, banking, and the analysis and reporting of financial data.
	Personnel and human resources	Knowledge of principles and procedures for personnel recruitment, selection, training, compensation and benefits, labour relations and negotiation, and personnel information systems.
	Sales and marketing	Knowledge of principles and methods for showing, promoting, and selling products or services. This includes marketing strategy and tactics, product demonstration, sales techniques, and sales control systems.

Annex Table 1.B.1. **Classification used for the *Africa's Development Dynamics 2024* analysis *(continued)***

Broad skills category	Skills	Description
Technical skills	Building and construction	Knowledge of materials, methods, and the tools involved in the construction or repair of houses, buildings, or other structures such as highways and roads.
	Computers and electronics	Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
	Design	Knowledge of design techniques, tools, and principles involved in the production of precision technical plans, blueprints, drawings and models.
	Engineering and technology	Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
	Mechanical	Knowledge of machines and tools, including their designs, uses, repair and maintenance.
	Biology	Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
	Chemistry	Knowledge of the chemical composition, structure and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques and disposal methods.
	Geography	Knowledge of principles and methods for describing the features of land, sea and air masses, including their physical characteristics, locations, interrelationships, and distribution of plant, animal and human life.
	Mathematics	Knowledge of arithmetic, algebra, geometry, calculus, statistics and their applications.
	Physics	Knowledge and prediction of physical principles, laws, their interrelationships, and applications to understanding fluid, material, and atmospheric dynamics, and mechanical, electrical, atomic and sub-atomic structures and processes.
	Food production	Knowledge of techniques and equipment for planting, growing and harvesting food products (both plant and animal) for consumption, including storage/handling techniques.
	Production and processing	Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximising the effective manufacture and distribution of goods.
	Transportation	Knowledge of principles and methods for moving people or goods by air, rail, sea or road, including the relative costs and benefits.

Source: Authors' selection based on O*NET OnLine (2023[76]), *O*NET Data* (database), https://www.onetonline.org.

Notes

1. Authors' calculations based on UN DESA (2022[143]).
2. Benin, the Republic of the Congo, Egypt, Liberia, Madagascar, Malawi, Tanzania, Togo, Uganda and Zambia are covered in the study (Morsy and Mukasa, 2019[8]).
3. Côte d'Ivoire, Ethiopia, Ghana, Niger, Rwanda and Uganda are considered in these studies (ACET, 2022[9])
4. Compare https://cieffa.au.int/sites/default/files/files/2021-09/continental-strategy-education-africa-english.pdf and https://au.int/en/documents/20201107/african-decade-technical-professional-entrepreneurial-training-and-youth.
5. Authors' calculations based on Cummins (2021[148]).
6. Vulnerable employment refers to the sum of (i) self-employed (own-account) workers and (ii) contributing family workers. The measure includes *formal self-employed* workers and excludes *informal* wage-employed workers. As such, it is an approximation of informal employment, especially in economies where the vast majority of self-employed workers are informal and the number of informal employed workers is low, which applies to most African countries (World Bank, n.d.[146]; ILO, 2018[141]). In this report, vulnerable employment is used only to show broad trends and patterns, when data on informal employment are limited or missing.
7. Egypt, Ethiopia, Gambia, Ghana, Liberia, Malawi, Namibia, Nigeria, Senegal, Sierra Leone, South Africa and Tanzania.
8. Authors' calculations based on World Bank (2023[64]).
9. Authors' calculations based on UNESCO Institute for Statistics (2023[85]).
10. Elementary occupations consist of simple and routine tasks that mainly require hand-held tools and often some physical effort. They include cleaners and helpers; agricultural, forestry and fishery labourers; labourers in mining, construction, manufacturing and transport; food preparation assistants; street and related sales and services workers; refuse workers and other elementary workers (ILO, 2012[142]).
11. Côte d'Ivoire, Ethiopia, Ghana, Niger, Rwanda and Uganda are covered in these studies (ACET, 2022[9]).
12. Authors' calculation based on International Telecommunication Union (2023[147]).
13. Authors' calculation based on fixed broadband Internet speed from Ookla (2024[144]).
14. Authors' calculation based on Stephany et al. (2021[115]).
15. Authors' calculations based on World Bank (2021[100]).
16. Authors' calculation based on Turner & Townsend (2023[128]).

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Chapter 2

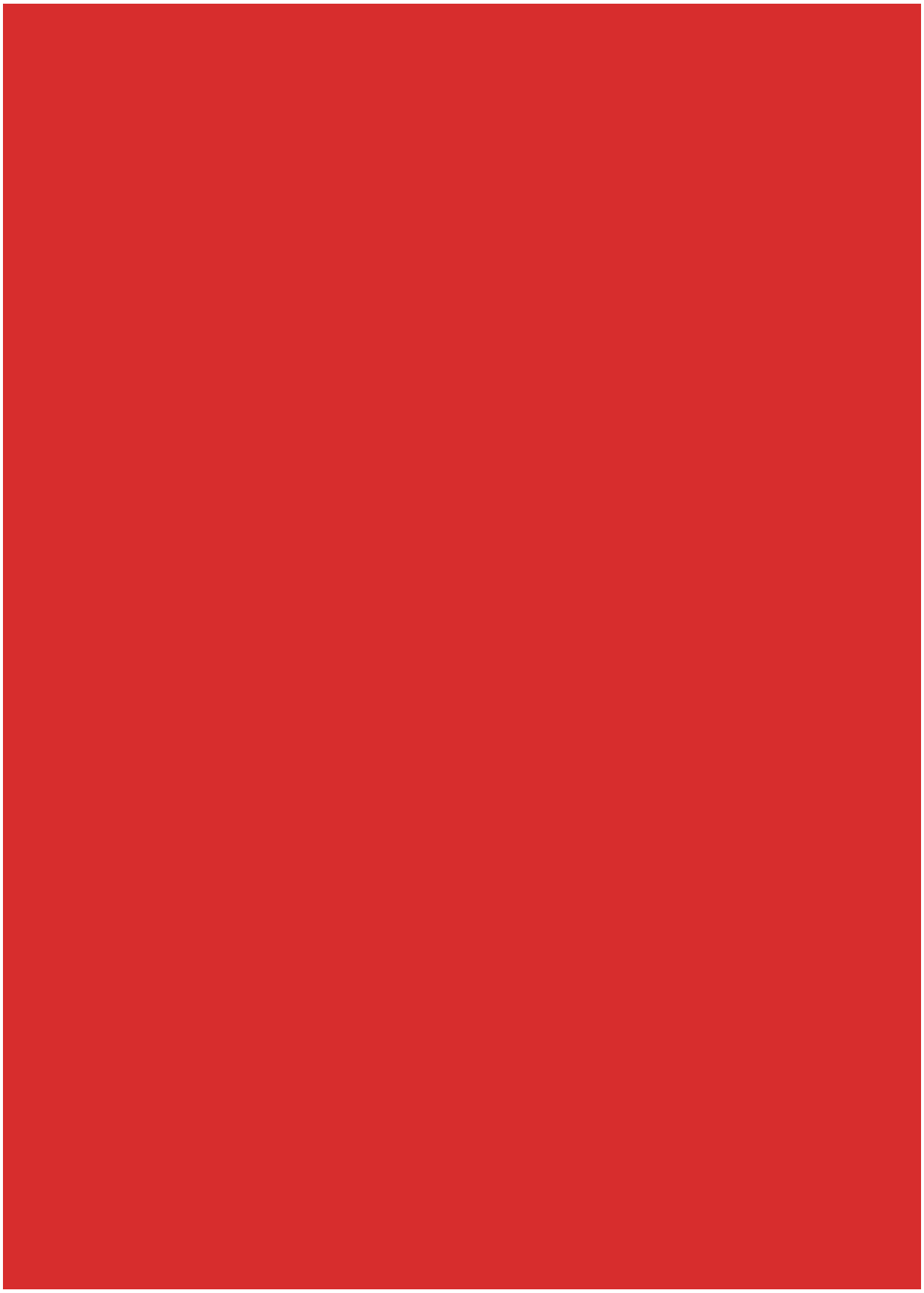
Policies for productive and inclusive skills development in Africa

This chapter identifies policy priorities for African policy makers to increase the supply of quality skills across the continent, in line with current and future demand, to support productive employment. First, it highlights the importance of national skill strategies driven by data. Second, it suggests ways to expand quality education in more cost-effective ways. Third, the chapter discusses innovative training formats with a wide reach. Fourth, it shows how technical and vocational education and training could be upgraded. Fifth, the chapter outlines the most important steps for the regional integration of African skills development policies, including the circulation of skills.

IN BRIEF

Skills development policies for African countries face the dual challenge of boosting labour productivity while enabling better employment prospects for all. In view of strained budgets, achieving these requires carefully balancing investments in high-potential sectors with cost-effective, scalable and inclusive skill provision. Five sets of policy instruments stand out:

1. African national governments can devise skill strategies that focus on sectors with exceptional productivity, based on thorough data analysis of skill gaps and future skill demands. Governments can select priority sectors based on national comparative advantages and on megatrends like the demographic, digital and green transitions.
2. African countries can expand affordable quality education. Extending the most cost-effective and scalable interventions to Africa's primary school students would deliver 1.2 learning-adjusted years of schooling at a cost of just 2.3% of current education spending. Harmonised learning assessments can help identify foundational skill shortages.
3. Training providers and the private sector can extend innovative wide-reaching training formats to informal and female workers. Entrepreneurship and on-the-job training can increase the productivity of informal and female-led small enterprises. Effective skill recognition can help informal workers benefit from their prior work experience and reassure employers.
4. Technical and vocational education and training (TVET) institutions can upgrade their programmes to equip learners with in-demand skills and set them on promising career paths. They can also be more responsive to the local private sector and the digital and green transitions. TVET financing can improve on traditional models, such as payroll levies.
5. Regional economic communities, the African Union and African educational institutions can support regionally integrated policies for the development of skills. Beyond harmonised qualification frameworks, regional Centres of Excellence and specialised training centres can drive technical skills development, especially within regional value chains. Exchange and skill mobility programmes can help retain African talent.



African countries' skills development policies can better focus on productive employment, while taking into account each country's comparative advantages, capacities and financial resources. By improving educational outcomes for a fast-growing population, African countries have expanded their supply of foundational skills. Cost-effective interventions, such as structured pedagogy and teaching based on individuals' learning levels (Angrist et al., 2023[1]), can further increase that supply. Applying such interventions could raise the level of education by 1.2 learning-adjusted years of schooling for 90% of Africa's primary school students at a cost of USD 3.6 billion per year, equivalent to just 2.3% of current education spending. However, expanding skill provision alone is insufficient because productive employment remains scarce in most African countries (Beber et al., 2020[2]). Skills development policies need to identify national opportunities for increasing productive employment. Such opportunities are often linked to comparative advantages, like natural resources or talent pools in specific sectors.

Increasing social protection, workers' rights, and the accessibility of education and training can improve the cost-benefit ratio of skills development from the workers' perspective and can make skills development more inclusive. Workers will actively seek quality skills if the expected benefits outweigh the costs. Across an economy, social protection and workers' rights have an impact on individual and societal development benefits, while the overall affordability and accessibility of education and training (in part, depending on public transportation and local infrastructure) affect the costs. In 2020, only 17% of the African population was covered by at least one social protection benefit, compared to a global average of 47% (ILO, 2021[3]). Social protection coverage can be extended to informal workers, for instance, by introducing non-contributory schemes to complement contributory ones (OECD, 2024[4]). In addition, if education and training are not widely accessible, rural populations, women, refugees and internally displaced people are at a disadvantage compared to workers who attain higher earnings by acquiring skills, thus increasing inequality (Mastrorillo, Scognamillo and Ignaciuk, 2024[5]; OECD, 2021[6]).

African countries require skills development policies with a balanced focus on high productivity and employment potential. This chapter proposes five policy options that respond to the trends identified in Chapter 1 (Table 2.1). Throughout the chapter, the policy recommendations suggest involving the whole range of private sector firms to ensure skills are developed to align with demand:

1. African national governments can devise skill strategies that identify priority sectors with exceptional productivity potential, based on granular data.
2. African countries can use cost-effective interventions and learning assessments to expand quality education.
3. Training providers and the private sector can widen the reach of on- and off-the-job training that offers immediate productivity gains for informal workers, in particular women.
4. Technical and vocational education and training (TVET) institutions can upgrade their programmes to equip learners with in-demand skills and set them on promising career paths.
5. Regional economic communities, the African Union and African educational institutions can improve the functioning of cross-border labour markets by harmonising skill certification and recognition frameworks, strengthening regional skills development and enabling high-skill mobility.

Table 2.1. **Challenges and policy actions for skills development for productive employment**

Challenges	Policy agenda	Policy actions	Primary implementers
Population growth that is outpacing formal job growth; significant country differences in skill supply and demand, especially for digital and green skills	Nationally specific strategies to tackle emerging skill needs	• Target skill strategies through harmonised, up-to-date and comparable data on skill mismatches • Select priority sectors with high productivity and employment potential, based on national comparative advantages • Integrate digital and green skills into strategies, addressing country-specific skill gaps	National governments and agencies, international partners
Significant foundational skill shortages; gender and rural-urban divides	Learning assessments and cost-effective interventions to expand quality education	• Assess weaknesses in national education systems that result in foundational skill gaps • Target investments towards the most cost-effective measures • Monitor progress against international benchmarks to inform reforms	National and sub-national governments and agencies, international partners
Employment growth confined to low-productivity/ high-informality sectors; gender and rural-urban divides	Innovative on- and off-the-job training and skill recognition to improve labour productivity of informal and female workers	• Expand entrepreneurial and soft skills training to impart transferable skills that increase worker productivity • Offer certified apprenticeships in co-operation with the private sector to provide practical experience and documented technical skills • Establish frameworks for the recognition of prior learning and professional certificates	Training providers, employers, the private sector, workers (including informal and female workers)
Varying technical skill needs across African countries; basic and intermediate digital skill gaps	TVET institutions to embrace innovative approaches that better respond to emerging skill needs	• Involve the private sector, including small and medium-sized enterprises, in programme delivery to ensure effectiveness and employability • Increase the appeal of TVET to students by upgrading institutions' curricula, governance and reputation • Increase female and rural participation through local outreach and private sector involvement • Make TVET levies more accountable, and improve the co-ordination of partner finance	TVET institutions, private sector, international partners
Limited high-skilled migration within Africa; large high-skilled emigration to high-income countries	Regional integration of African skills development policies	• Identify skill needs within cross-border labour pools and regional value chains • Address skill shortages and gaps along regional value chains • Improve cross-border skill recognition and portability • Reduce talent outflow and encourage the international circulation of skills via partnerships	Regional economic communities, African Union, educational institutions, international partners

Source: Authors' compilation.

The policy recommendations in this chapter cover high-priority options at the disposal of stakeholders of skills development in Africa. They include fundamental issues (national strategies, quality education), skill provision implementation (training and TVET), and specific regional frameworks and interventions. The recommendations target various stakeholders (Table 2.1).

African countries can be strategic in meeting emerging needs for technical skills in priority sectors, digital skills and green skills

Significant differences in African countries' opportunities and challenges for skills development require them to design individual skill strategies. To align with current and future skill demand, national strategies can use granular data analysis to focus skills development on priority sectors and specific digital and green skill gaps (Table 2.2).

Table 2.2. **Steps to design nationally specific skill strategies**

Step	Policy action	Example
1. Data analysis	Target skill strategies through harmonised, up-to-date and comparable data on skill mismatches	The Skills4Jobs database on South Africa provides a comprehensive view of skill gaps based on various data sources (OECD, 2023[7]).
2. Priority sector selection	Select priority sectors with high productivity and employment potential, based on national comparative advantages	In 2018, Rwanda published a six-year ICT Sector Strategic Plan, which aims to advance digital skills by developing suitable digital infrastructure, engaging in public-private partnerships to improve banking systems and mobile coverage, and adopting curriculums that integrate digital skills across all levels of education (Rwanda Development Board, 2024[8]; Rwanda's Ministry of Information, Technology and Communications, 2017[9]).
3. Digital and green skills development	Integrate digital and green skills into strategies, addressing country-specific skill gaps	As part of Ghana's National Green Jobs Strategy 2021-2025, the Ghana Green Jobs Programme entails a component on the greening of existing skill sets and developing new green skills and professions, through the creation of an observatory as part of the Ghana Labour Market Information System. It predicts future green skill demand and identifies critical skill sets for the green and circular economies (Ghana's Ministry of Employment and Labour Relations, 2021[10]).

Source: Authors' compilation.

Assessing current and future skill gaps requires more comprehensive data analysis, including using big data

By strengthening the quality of labour market information systems (LMIS), increasing survey frequency and fostering private sector collaboration, African countries can better assess skill supply and demand. LMIS in Africa are often incomplete and underfunded and fail to adequately address the informal economy (African Centre for Technology Studies, 2023[11]; OECD, 2023[12]). In 2016, only 38 African countries had become members of the African Union's inventory of LMIS, and only 26 had conducted a labour force survey at any point in time (Sorensen and Mas, 2016[13]). As a result, skill supply and demand are mainly inferred from indirect measures, such as education output data (e.g. number of years in school) (Morsy and Mukasa, 2019[14]; OECD, 2017[15]). To bridge this gap, African countries can enhance the African Union's LMIS inventory, conduct more frequent and granular labour force surveys, and actively engage the private sector in data collection efforts.

Multi-dimensional assessments can better measure current skill gaps and inform skills anticipation. Assessments of current skill gaps and the anticipation of future skill demand can embrace multi-dimensional data, including wage growth or unfulfilled vacancies, to inform skill strategies and better matching supply with demand in labour markets (OECD, 2017[15]). Cross-sectoral assessments, occupational definitions harmonised with international standards, and active private sector engagement are key for effectively analysing national skill gaps (Table 2.2) (OECD, 2023[7]).

Box 2.1. **Deriving skill trends through occupation-skill matching classifications**

Using the O*NET occupation-skill classification is a common approach to measuring skills in labour markets. However, the classification originates from a survey in the United States and is not available in languages other than English. Adapting O*NET surveys to African countries could inform strategic skill investments (ILO/OECD, 2023[16]), as illustrated by examples from other world regions:

- In Indonesia, the Occupational Tasks and Skills (Indotask) pilot survey introduced a nationally specific classification system based on modules from O*NET, surveying 51 occupations significant for Indonesia's economy. Results revealed that foundational skills such as speaking, reading and listening were the most required by employers (World Bank, 2020[17]).
- In Viet Nam, the Survey of Detailed Skills (SDS) measured 30 high-demand occupations. It showed that 43% of them required at least a secondary degree, with basic and financial math skills needed in about one-third of the occupations (Granata, Moroz and Thi Nguyen, 2023[18]).
- In Uruguay, the O*NET Project extends the O*NET framework to 23 selected occupations, using online questionnaires for enterprises and workers (ILO/OECD, 2023[16]).

Using big data can facilitate real-time and detailed skills anticipation in formal job markets. Analysis based on big data includes both quantitative forecasts and qualitative foresight (e.g. text mining) tailored to specific sectors or countries (Bakule et al., 2016[19]). For example, data extracted from online job postings can provide a nuanced understanding of evolving job markets in African countries where one or two job boards are dominant (Box 2.2). Notably, big data offer advantages like frequent updates and low costs, allowing algorithms to infer skill relevance in occupations and create data-based indicators akin to O*NET (OECD, 2023[20]). During external shocks (e.g. COVID-19), big data can facilitate rapid skills assessments for reskilling needs. Challenges include accounting for the underrepresentation of jobs that are not advertised online, biases towards high-skilled roles and difficulties in aggregating occupation-specific skills due to their various definitions (OECD, 2023[20]). This makes participatory preparatory work and the harmonisation of definitions particularly important for African countries.

> Collaboration with job platforms – such as the Asian Development Bank co-operating with LinkedIn or the Development Data Partnership joining international organisations like the OECD with data providers – illustrates that big data can help anticipate emerging skills (Data Partnership, 2024[21]; ADB, 2022[22]).

Box 2.2. The potential of job board data to inform skill gap assessments in Africa's labour markets

Innovative data analysis can enable assessments of skill demand. With data collected from online job boards, countries can assess skill demand within white-collar professions. The data available encompass a wide range of information on occupations, skills, salaries, locations, industries, experience and user profiles. Online job vacancies specify skills in precise terms such as "data science," "SQL" (structured query language) and "software engineering". Data can be extracted from international and national job boards and staffing agencies and be supplemented with public employment services and corporate websites. This approach can be especially useful in countries where a single job board is dominant and likely to represent the national job market (Table 2.3).

Table 2.3. **Job boards in selected African countries**

Examples of dominant job boards	Country coverage
Brightermonday	Kenya, Uganda
Jobberman	Nigeria, Ghana
Careerjunction	South Africa
Wuzzuf	Egypt
Emploi.ma	Morocco

Source: Authors' compilation.

Job board data are a valuable source of insights into the demand for skills. Job vacancies are relevant sources of information on skills sought by employers to analyse labour market needs. A 2019 study in Ghana analysed job advertisements from a local daily newspaper. The analysis highlighted the top skills required by the Ghanaian market: computer literacy (27%), communication (12.7%) and teamwork (10.8%) (Asomaning et al., 2021[23]).

Existing data platforms can be used by international organisations to conduct analysis. Lightcast is a platform that gathers data from online vacancies from several sources. It covers over 150 countries, including more than 50 countries in Africa. Data include more than 1 million online job postings in South Africa and more than 800 000 in Nigeria (Lightcast, 2023[24]). International organisations such as the World Bank, the International Labour Organization and the OECD have begun to use data from such providers for labour market analysis (ILO/OECD, 2023[16]; World Bank, 2020[25]).

National skill strategies can respond to specific skill gaps in high-potential sectors, including the digital and green economies

Countries can support different skills, based both on whether they have agrarian or diversifying economies and on regional value chain opportunities. Agriculture contributes 32% of Africa's gross domestic product (GDP), and approximately 50% of the continent's employment; yet, only 2% of students specialise in this field (Andinet et al., 2017[26]). Agrarian economies (see Chapter 1) can invest in deepening workers' technical skills, for instance, in commercial agriculture, agro-processing, agroecology, food processing and urban agriculture (AfDB, 2016[27]). Least developed agrarian countries with small populations (e.g. Sierra Leone) can specialise within regional value chains while targeting larger neighbouring markets (AUC/OECD, 2022[28]). Diversifying economies can target sectors with productivity potential, such as services. Services productivity in Rwanda, for example, is more than ten times higher than agriculture productivity (Newfarmer, Page and Tarp, 2018[29]).

> Kenya has introduced the National Skills Development Policy 2020, establishing a Sector Skills Advisory Council responsible for co-ordinating sector skills committees comprised of subject experts across ten sectors in alignment with the Vision 2030 strategy (Republic of Kenya, 2020[30]).
>
> South Africa developed a Sector Skills Plan specifically on skills within the wholesale and retail sectors, aiming to transition towards a technology-based retail sector (South Africa's Higher Education and Training Department, 2023[31]).

Integrating the development of digital and green skills into national strategies can strengthen the supply of sought-after skills. Gaps in intermediate and advanced digital skills, as well as in sector-specific green skills, are growing across African countries (Chapter 1). Policy frameworks such as the World Bank Methodological Guidebook (World Bank, 2021[32]) and the Digital Manifesto[1] (Pathways for Prosperity Commission, 2019[33]) offer insights into crafting national cross-sectoral strategies for digital skills. Integrating green skills in environmental and labour policies can facilitate the transition from "brown" to "green" economies (CEDEFOP/OECD, 2015[34]). Countries can broaden the scope of their artificial intelligence (AI) strategies by adding development plans for digital skills (Box 2.3).

> Nigeria has created a National Digital Economy Policy and Strategy that focuses on eight pillars including developing digital skills and indigenous content development and adoption (Nigeria's Ministry of Communications and Digital Economy, 2019[35]).

Box 2.3. National artificial intelligence strategies and inclusive skills development in Africa

The African Union's forthcoming African AI Strategy can guide African countries' national strategies (AU, 2023[36]). So far, Egypt and Mauritius have developed strategies, while Kenya is advancing towards one. While Egypt focuses its strategy on reskilling, upskilling and lifelong learning, Mauritius encourages skills attraction and skills acquisition, particularly for AI-related research and development and innovation) (ANDP, 2019[37]; Republic of Mauritius, 2018[38]). Ethiopia, Ghana, Rwanda, South Africa and Uganda are formulating policies specifically on AI skills development (Diplo, 2022[39]).

Women and marginalised groups are vastly underrepresented among workers with advanced AI skills, and their jobs are more likely to be replaced by AI-induced automation (Musoni, 2024[40]; Adams, 2022[41]). Building on existing policy frameworks, such as Rwanda's AI policy and South Africa's 2019 *White Paper on Science, Technology, and Innovation*, African governments can prioritise gender-sensitive and inclusive AI reskilling strategies (Musoni, 2024[40]).

Efficient education spending, cost-effective interventions and learning assessments can help expand quality education

Expanding quality education is necessary to increase the supply of foundational skills in all African countries. Proven, cost-effective interventions can be further scaled, while harmonised learning assessments can serve to detect foundational skill gaps and monitor progress (Table 2.4).

Table 2.4. **Steps to expand quality education through learning assessments and cost-effective interventions**

Step	Policy action	Example
1. Assessing foundational skill gaps	Assess weaknesses in national education systems that lead to foundational skill gaps	A survey across 35 low- and middle-income countries (including 28 in Africa) revealed that policy makers tend to overestimate current levels of foundational learning outcomes. More accurate perceptions are associated with a larger allocation of funding towards foundational skills (Crawfurd et al., 2021[42]).
2. Cost-effective interventions	Target investments towards the most cost-effective measures	Meta-analysis across African countries found that supporting teachers with structured pedagogy (lesson plans, learning materials, coaching) had the largest effect on learning outcomes compared to other types of programmes (Conn, 2017[43]).
3. Monitoring	Monitor progress against international benchmarks to inform reforms	In 2022, Morocco's Ministry of Education rolled out a new roadmap for reforming the education system, designed to respond to the country's low results in 2018 in PISA, the OECD's Programme for International Student Assessment. The roadmap focuses on learning impact, student well-being and improving foundational learning results (Madrastna, 2022[44]; Madrastna, 2022[45]).

Source: Authors' compilation.

More funds for education, efficient spending and cost-effective interventions can increase learning outcomes

African countries can increase education spending and improve the efficiency of spending. On average, in 2021, African governments spent 3.7% of GDP on education, accounting for 14.5% of total public expenditure, slightly below the international benchmarks set by UNESCO of at least 4% of GDP and 15% of total public expenditure (UNESCO, 2015[46]). Of the 42 African countries with available data in 2020-23, 12 countries met both minimum targets while 16 did not meet either of them (GEM/UNESCO/World Bank, 2024[47]). The continent's annual average education financing gap between 2023 and 2030 is estimated at USD 77 billion (GEM/UNESCO, 2024[48]). Africa's spending inefficiencies also remain high: between 2000 and 2017, they were equivalent to over USD 40 billion annually (IMF, 2021[49]) (Table 2.4).

Cost-effective interventions can improve learning outcomes while keeping spending low. In view of tight public budgets, education interventions in African countries need to carefully balance effectiveness and cost. For instance, it is costly to eliminate school tuition for all, though doing so can improve access to education. Offering free tuition for underserved communities and gradually expanding it can be a more efficient use of scarce resources (Gruijters, Abango and Casely-Hayford, 2023[50]). Recent systematic research of over 13 000 studies highlights cost-effective, immediate and scalable options for governments from low- and middle-income countries that can complement broader reforms, such as curriculum revisions, in improving educational outcomes (Table 2.5). For instance, structured pedagogy and targeted teaching by learning level[2] are the most cost-effective and scalable (Angrist et al., 2023[1]). Applying these two types of interventions to reach 90% of the 220 million primary school pupils in African countries would cost USD 3.6 billion annually. This would represent only 2.3% of the USD 159 billion the continent spent on education in 2021 while generating a return of 1.2 learning-adjusted years of schooling.[3]

> In Uganda, removing tuition fees in public and private secondary schools increased girls' school attendance by at least 0.28 additional years. Following the removal, educational outcomes improved more for private schools than for public ones (Lauterbach, 2024[52]).
>
> In Nigeria, the Edo Basic Education Sector Transformation (EdoBEST) programme aims to improve the teaching and learning processes in basic education in Edo State. Three years after the intervention began, EdoBEST students in grade 6 could read about 100 words per minute compared to over 40 words per minute by students in other states (EdoBEST, 2021[53]).

> In Zambia, the Teaching at the Right Level (TaRL) programme was scaled to over 160 000 students between 2016 and 2019. In the span of one school year, it managed to increase the number of students in grades 3-5 who could read at least a simple paragraph by 60%, and the number of those who could do subtraction by 89% (UNICEF, 2022[54]).

Table 2.5. **Policy options to improve learning outcomes in African countries, by cost-effectiveness**

Cost-effectiveness	Interventions
High cost-effectiveness	• Supporting teachers with structured pedagogy (including structured lesson plans, learning materials and ongoing teacher support) • Targeting teaching instruction by learning level, not grade (in or out of school) • Providing information to parents and children on the benefits, costs and quality of education
Medium cost-effectiveness	• Reducing travel times to schools • Merit-based scholarships to disadvantaged children and youth • School-based mass deworming where worm load is high • Quality pre-primary education (for ages 3 to 5) • Parent-directed early childhood stimulation programmes (for ages 0 to 36 months)
High effectiveness but missing evidence on cost-effectiveness or on implementation at scale	• Software that allows personalised learning and adapts to a child's learning level (where hardware is available in schools) • Augmenting teaching teams with community-hired teaching assistants • Providing school-based mass treatment of specific health conditions • Leveraging mobile phones to support learning • Safeguarding students from violence • Teaching soft skills • Involving communities in school management • Targeting interventions towards girls
High effectiveness but expensive	• Cash transfers as a tool for improving learning • Providing free meals in primary schools where attendance is low and malnutrition high
Not cost-effective	• Providing additional inputs alone, such as textbooks, additional teachers to reduce class size, school buildings, grants, salaries and libraries, without improving how these inputs are used or connecting them to other policies.

Source: GEEAP (2023[55]), *Cost-Effective Approaches to Improve Global Learning*, https://documents1.worldbank.org/curated/en/099420106132331608/pdf/IDU0977f73d7022b1047770980c0c5a14598eef8.pdf.

Comparable national, regional and international learning assessments can serve to monitor education outcomes and policy impacts

Improving countries' participation in learning assessments and comparability across assessments can help policy makers set priorities and monitor the policy impacts. Increasing the availability of and communication on learning outcomes can improve prioritisation and monitoring. Currently, two-thirds of African countries do not assess internationally comparable measures of learning in primary education, and a majority lack measures of learning at the secondary level.

Established international, regional and national learning assessments can complement each other by measuring proficiency in different subjects at different grades (Table 2.6). International and regional assessments often come with high standards of rigour and offer credible results (Box 2.4); however, they tend to allow less involvement from local stakeholders, are relatively more costly than national assessments and may not sufficiently consider national curriculum and learning objectives. Recalibration exercises (i.e. running parallel tests enabling the conversion of scores from different national tests or conducting statistical recalibration of existing data), such as the Rosetta Stone project, can make assessments comparable (UNESCO/PASEC/LLECE/IEA, 2022[56]; Altinok, Angrist and Patrinos, 2018[57]; Patrinos and Angrist, 2018[58]).

Table 2.6. **Overview of standardised learning assessments in African countries**

		Participating African countries	Subjects	Grade/age	Envisioned frequency	Cost
International assessments	PISA	Eight countries (Algeria, Egypt, Kenya, Morocco, Rwanda, Senegal, Tunisia, Zambia)	Mathematics, language (reading), natural sciences	15-year-old students	Every 3 years	Around USD 800 000; total cost can vary by country depending on the assessment programme and local cost factors
	TIMSS	Seven countries (Algeria, Botswana, Côte d'Ivoire, Egypt, Ghana, Morocco, South Africa)	Mathematics, natural sciences	Grades 4 and 8	Every 4 years	
	PIRLS	Four countries (Botswana, Egypt, Morocco, South Africa)	Language (reading)	Grade 4	Every 5 years	
Regional assessments	PASEC	Ten countries (Benin, Burkina Faso, Burundi, Cameroon, Chad, Republic of the Congo, Côte d'Ivoire, Niger, Senegal, Togo)	Mathematics, language (listening/oral comprehension, decoding, reading)	Grades 2 and 6	2000-10, 2011-12, 2014, 2019, 2021	USD 200 000-500 000; total cost can vary by country depending on the assessment programme and local cost factors
	SACMEQ	Fourteen countries (Botswana, Eswatini, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Uganda, Zambia, Zimbabwe)	Mathematics, language (reading), health	Grade 6	1995, 2000, 2007, 2013, 2019	
National and sub-national assessments	Uwezo	Three countries (Kenya, Tanzania, Uganda)	Mathematics, language (decoding, reading, writing).	Children/ youth aged 6-16	Annually	Around USD 200 000; total cost can vary depending on assessment implementation (e.g. national versus subnational level) and local cost factors

Note: PISA = Programme for International Student Assessment; TIMSS = Trends in International Mathematics and Science Study; PIRLS = Progress in International Reading Literacy Study; PASEC = Program for the Analysis of Educational Systems; SACMEQ = Southern and Eastern Africa Consortium for Monitoring Educational Quality. The national and subnational section offers illustrative examples rather than a comprehensive overview.

Source: Gustafsson (2019[59]), *Costs and Benefits of Different Approaches to Measuring the Learning Proficiency of Students (SDG Indicator 4.1.1)*, https://uis.unesco.org/sites/default/files/documents/ip53-costs-benefits-approaches-measuring-proficiency-2019-en.pdf and Ramírez (2018[60]), *Quick Guide No. 2: Making the Case for a Learning Assessment*, https://unesdoc.unesco.org/ark:/48223/pf0000265404.

Box 2.4. **The OECD's Programme for International Student Assessment**

The Programme for International Student Assessment (PISA) tests the skills and knowledge in reading, mathematics and science of 15-year-old students (i.e. corresponding to the end of compulsory education in most OECD countries). PISA's aim is to measure the extent to which students can use what they learned in and out of school to participate in society. It collects information on student attitudes and motivations and assesses soft skills such as collaborative problem-solving, communication, critical and creative thinking, and learning in a digital world. PISA uniquely focuses on:

- Public policy issues: PISA aims to answer questions such as, "Are our schools adequately preparing young people for the challenges of adult life?", "Are some kinds of teaching and schools more effective than others?" and "Can schools contribute to improving the futures of students from immigrant or disadvantaged backgrounds?".
- Foundational and soft skills: Rather than examining mastery of specific school curricula, PISA looks at students' ability to apply knowledge and skills in key subject areas and to analyse, reason, and communicate effectively when examining, interpreting and solving problems.

Box 2.4. **The OECD's Programme for International Student Assessment *(continued)***

- Lifelong learning: To be effective lifelong learners, young people need not only knowledge and skills but also an awareness of why and how they learn. In addition to measuring student performance, PISA asks students about their motivations to learn.

PISA allows policy makers to set and measure progress towards national objectives and to steer effective action. Over 100 countries and economies have participated in PISA to track their progress in meeting key learning goals. Researchers and policy makers use the results to chart national progress against international standards and identify strengths and weaknesses in education systems. A module for low- and middle-income countries (called PISA for Development in its piloting phase) aims to expand PISA's global reach. So far, eight African countries have participated or are participating in PISA: Algeria (2015), Egypt (2025), Kenya (2025), Morocco (2018 to 2025), Rwanda (2025), Senegal (PISA for Development, 2015), Tunisia (2003 to 2015) and Zambia (PISA for Development, 2014, 2025).

Source: OECD Directorate for Education and Skills, PISA Unit.

Training and skill recognition can benefit informal and female workers in African countries

Skill training and recognition can improve the productivity and employability of Africa's informal and female workers, on the condition they be effective. Entrepreneurial, managerial and soft skills training are widespread, but training formats vary in effectiveness and need to be chosen with care to increase productivity. Likewise, skill recognition is an essential tool to improve the employability of informal workers, but it needs to be well-designed and practice-oriented to be effective (Table 2.7).

Table 2.7. **Steps to improve the labour productivity of informal and female workers through innovative on- and off-the-job training and skill recognition**

Step	Policy action	Example
1. Entrepreneurial and soft skills training	Expand entrepreneurial and soft skills training to impart transferable skills that increase worker productivity	Training for informal enterprises in Togo compared the impact of a "personal initiative" intervention (i.e. goal setting, future orientation, problem-solving) based on four monthly mentoring sessions, developed by the Frese Research Group in Germany, to a long-established managerial training programme. The former showed superior gains in productivity, innovation and firm profits (30% vs. 11% gains) (Campos et al., 2017[61]).
2. Certified apprenticeships	Offer certified apprenticeships in co-operation with the private sector to provide practical experience and documented technical skills	In Tanzania, as of 2019, the Dual Apprenticeship Training System, a three-year work-based learning training programme, jointly developed by TVET institutions and the Hamburg Chamber of Crafts, had recruited around 100 companies and completed training for 200 apprentices (AUDA-NEPAD, 2024[62]).
3. Skill recognition	Establish frameworks for the recognition of prior learning (RPL) and professional certificates	Based on prior RPL legislation and pilot projects for RPL qualification in the hospitality sector, Cabo Verde expanded the qualifications for RPL eligibility to the administrative services and customer support sector in 2021 (Cabo Verde's National System of Qualifications, 2024[63]).

Source: Authors' compilation.

Entrepreneurial and soft skills training and apprenticeships can benefit firms and workers, including women

Entrepreneurial training for self-employed workers and students can help increase firms' inclusiveness and scale. Entrepreneurship is widely spread in Africa, with a national average of 65% of the working population being self-employed on the continent in 2022.[4]

Entrepreneurial training can complement traditional learning of business practices (i.e. accounting, cash flow management, customer relations, human resources, marketing, etc.) by instilling an entrepreneurial mindset. Introducing entrepreneurship education starting at primary level can improve its inclusiveness and scale (AAP, 2022[64]).

> In rural Rwanda, the involvement of village savings and loan associations in entrepreneurial training provided by CARE International allowed for an increase in profit and financial literacy (Rubyutsa et al., 2023[65]).
>
> Fundis ("artisan" in Swahili) is a Kenyan e-platform that connects accredited informal artisans and builders to employment (Fundis, 2024[66]). In 2023, it launched the IngiaBiz initiative in partnership with the Kenya Association of Certified Training Providers for Industry to upskill and certify artisans and promote youth employment over a three-year period (Fintech, 2024[67]).
>
> Digify Africa offers digital and business skill training to young Africans, drawing on an alumni network and private sector partners; it has enabled the careers of more than 500 graduates (IFC/LEK, 2019[68]).

On-the-job training can increase firms' benefits, but the majority of Africa's firms do not provide it. On-the-job training refers to learning or directed training undertaken in the workplace, both structured (apprenticeships, internships) and unstructured (experiential learning by doing). In Ghana and Tanzania, on-the-job management training using the Kaizen approach, which enhances firm-level productivity by gradually applying tools such as production management and quality control, had substantial benefits. The two countries increased the value added of small businesses in a garment production cluster by 50% and raised the resilience of small firms in the metal industry by 20% (ILO, 2018[69]). For African enterprises in manufacturing and services that provide training to employees, sales per worker are around 20% higher compared to those that do not. Yet, less than 30% of firms registered in Africa provide formal training to employees, compared to almost 50% in Latin America (AfDB, 2020[70]).

Apprenticeships significantly help people get jobs. In Ghana, a large majority of technical and vocational skills are acquired through apprenticeships: the number of apprentices is ten times higher than students in formal TVET (MasterCard Foundation, 2018[71]). Seventy-five per cent of informal apprentices find a job less than six months after finishing their apprenticeships, most of them becoming self-employed or employed by the business that hosted their apprenticeships (ILO, 2022[72]). Apprentices who receive certificates are more likely to transition to formal jobs, even if the certificates are not formally recognised. For instance, in Malawi, 31% of apprentices with a certificate obtained a formal job compared to only 5% of those without (IFC/LEK, 2019[68]).

Including socio-emotional skills development and peer networks in training programmes oriented towards women can bolster female workers' skills and entrepreneurial success. In many parts of Africa, women suffer from persisting discriminatory social norms that hinder their access to quality education. Women are usually either absent from work or confined to traditionally feminine jobs (ILO, 2022[72]; OECD, 2021[6]). One study examined gender differences in ten socio-emotional skills that are associated with success in a competitive workplace (like positive self-concept or expressiveness). Based on respondent data from 17 African countries, the study found that the skill gap between women and men was equivalent to the skills gained in 5.6 years of education, with the male advantage increasing with higher education levels (Ajayi et al., 2022[73]). Training programmes focusing on socio-emotional skills can thus yield higher earnings for female workers and ensure a greater likelihood of success in their entrepreneurial endeavours (Baliamoune-Lutz, Brixiova and Ncube, 2014[74]). In addition to formal training, networks and kinship relationships contribute distinctly to women's entrepreneurial success. This

is especially true for women who try to transition to more profitable sectors, which are often male-dominated (e.g. the digital economy, infrastructure, transport) (OECD, 2021[6]).

> Mauritius implements targeted skills training for marginalised groups, in particular women and youth. This has contributed to a steady increase in women's labour force participation since 2005 (World Bank, 2018[75]).

Recognition of prior learning can profit workers and employers, and digital platforms and education technology startups are increasing their reach

Recognition of prior learning (RPL) can create win-win scenarios for informal workers and employers, but the available support often remains unknown to both. Expert interviews conducted for this report stressed that, by officially recognising all prior learning, including that acquired outside of formal[5] education systems, RPL enhances the employability of informal workers. Certificates obtained through RPL are akin to those awarded by training centres. RPL can expand informal workers' access to formal training opportunities and jobs while offering a path out of informality (OECD, 2024[4]). RPL serves employers' interests in that it makes the supply of sought-after skills from marginalised workers more visible. However, challenges in implementing RPL schemes include a lack of adequate awareness of RPL and insufficient tracking and monitoring of impacts (ILO, 2022[76]). Increasing the availability of RPL tools, especially in remote communities, could reassure employers (ACQF, 2023[77]; Aggarwal, 2015[78]).

> Tunisia allows candidates with at least three years of experience as a craftsperson to obtain a certificate to prove professional competence in a given sector. This "certificate of professional aptitudes" (certificat d'attestation de qualification professionnelle) facilitates their integration into the formal labour market (Tunisia's Ministry of Employment and Professional Training, 2024[79]).

Professional certificates issued for courses on digital platforms are growing in importance. Professional certificates from digital platforms have become more relevant following the COVID-19 pandemic. They can be obtained through platforms such as Coursera or LinkedIn Learning. Nigeria has the third highest enrolment rate globally on the Coursera platform (which counts 124 million learners), only behind the United States and India. Learners in 13 of the 18 African countries covered in a study by Coursera showed their best performance in business skills, followed by entrepreneurial skills, while technology and data science skills allowed for improvement (Coursera, 2023[80]).

> Education technology startups, such as Women in Data Africa and Femafricmaths,[6] offer training courses and skill certification, often through partnerships with the private sector.

TVET institutions can better respond to Africa's emerging skill needs

Table 2.8. **Steps to help technical and vocational education and training institutions embrace innovative approaches to emerging skill needs**

Step	Policy action	Example
1. Private sector participation	Involve the private sector, including small and medium-sized enterprises, in programme delivery to ensure effectiveness and employability	Morocco's ten Delegated Management Institutes (Instituts à Gestion Déléguée) are strategically located within the special economic zones of the priority sectors for which they provide tailor-made training courses (e.g. Tangier's Vocational Training Institutes for the Automotive Industry (World Bank, 2020[81]).
2. Updated curricula, governance and reputation	Increase the appeal of TVET to students by upgrading institutions' curricula, governance and reputation	Technical curriculum reviews in South Africa led to the inclusion of renewable energies and emerging technologies in TVET curricula in 2013 and 2023, respectively, with certificates in robotics and renewable energy now available in 29 out of the 50 registered TVET colleges (Freimann and Magnus, 2023[82]).
3. Respond to contextual challenges	Increase female and rural participation through local outreach and private sector involvement	Between 2020 and 2022, the GEN-UP project employed gender-based mentoring to overcome stereotypes and empower young women to join TVET programmes to build careers in male-dominated sectors. It was implemented by the Don Bosco vocational training network and two research partners: Yaoundé University (Cameroon) and Njala University (Sierra Leone) (Wignall et al., 2023[83]).
4. Multi-stakeholder financing	Make TVET levies more accountable, and improve the co-ordination of partner finance	The West African Economic and Monetary Union's platform, co-developed by the Africa-based office of UNESCO's International Institute for Educational Planning (IIEP-UNESCO Dakar), pools methodological and financial resources to respond to common training challenges in the region (UEMOA platform, 2024[84]).

Source: Authors' compilation.

TVET can increase the skills needed in African countries, but its success is mixed

TVET programmes can provide skills needed in African countries' priority sectors for the exploding number of students. TVET programmes offer practical and technical skills for entry into occupations, dividing learners' time between the classroom and work-based training. To improve graduates' employability, TVET programmes can align with the demand for skills in national priority sectors. By 2040, the number of secondary TVET students is expected to more than quadruple in agrarian economies like Burundi, Mali and Uganda and to increase ten-fold in Niger (ILO/World Bank/UNESCO, 2023[85]).

> The East Africa Skills for Transformation and Regional Integration Project (EASTRIP), led by the World Bank, brings a regional approach to developing specialised TVET skills. Since 2018, it has created a cluster of 16 TVET Centres of Excellence in three countries. The centres offer skill supply for major regional infrastructure projects. Each centre focuses on a specific sector: road transport (Ethiopia), textiles (Kenya) and renewable energies (Tanzania).

Evaluations show that the implementation of TVET in Africa has had mixed results. Analysis of 22 evaluations of TVET programmes from the DEReC and GIZ databases[7] (GIZ, 2024[86]; OECD, 2024[87]) and expert interviews carried out for this report suggest four success factors: i) political will to promote vocational training as a means to economic advancement; ii) partnership and information sharing between employers and providers; iii) competency-based training to improve quality management of TVET institutions; and iv) alignment with donors' international co-operation strategies and recipients' national development plans. The most common hurdles for TVET include: i) lack of follow-up with graduates and weak relations between training centres and the private sector (e.g. missing direct job placement services); ii) lack of results-based management systems, including missing planning of evaluations; iii) slow governance due to centralised decision-making, staff turnover at ministries and lengthy accreditation processes by TVET authorities; and iv) limited applicability of learned skills on training completion. Cost-effectiveness remains understudied, despite continental efforts, including the African Union Strategy for TVET and Decade Plan of Action 2019-2028.[8]

African TVET institutions can upgrade their reputation and curricula and strengthen collaboration with the private sector

TVET institutions would benefit from an improved reputation, more relevant curricula, including on digital skills. TVET's mixed effectiveness has resulted in reputational damage, leading students to perceive TVET-based careers as a second choice relative to academic pathways (IDRC, 2019[88]). To keep content relevant, TVET institutions can more strongly emphasise digital and green skills and promote gender-inclusive access.

> Through its Global Gateway strategy, the European Union will invest EUR 150 billion by 2027 to improve African digital infrastructure and digital skills. In Kenya, for example, the programme will support the digitalisation of TVET centres (European Union, 2022[89]).
>
> Since 2011, UNESCO-Korea's Better Education for Africa's Rise (BEAR) project has supported TVET upgrades in 14 countries. In Uganda, it provided digital equipment to TVET institutions to increase efficiency in agro-food processing and post-harvest management (UNESCO, 2023[90]).
>
> The WorldSkills Africa initiative offering live demonstrations of selected skills, and the Skills in Action Photo Competition hold promise to change the perceptions of TVET (UNESCO, 2022[91]).

Stronger linkages with the private sector can enhance the professionalisation of TVET trainers and help align skill supply with demand. Only 30% of TVET trainers in Africa have recent experience in companies related to the sector they teach (IIEP-UNESCO, 2023[92]). African countries could learn from peers such as the Philippines, where the national TVET authority requires industry immersion for trainer certifications (TESDA, 2021[93]). Involving the private sector in the development of curricula is central to better aligning skill supply with demand.

TVET can be more responsive to learning ecosystems and low female participation

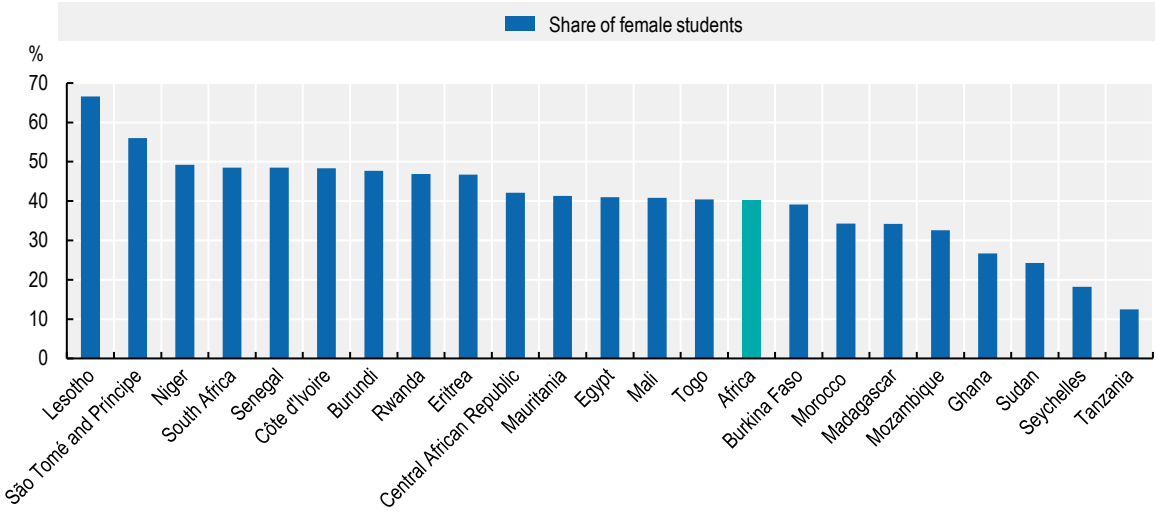
Contextualising TVET programmes within wider learning ecosystems is key to responsive national TVET systems. Improving TVET effectiveness can require an ecosystem approach, which considers how TVET overlaps with universities, workplaces, informal vocational training, and generally the worlds of work, learning and living (Lotz-Sisitka and McGrath, 2023[94]). National TVET systems can improve their responsiveness to contemporary challenges (digitalisation, automation, climate change) and persisting ones (quality lifelong education, informality, internally displaced people) (UNESCO, 2022[95]).

> Senegal's Société de développement et des fibres textiles (SODEFIDEX) works with family farms and cotton co-operatives. In the 2000s, the company began offering its own literacy courses for seasonal workers. It gradually developed more advanced TVET programmes to meet rural job needs linked to changes in agriculture. Courses are given in Pulaar, Mandingo and Wolof, the languages commonly spoken by Senegal's farming populations (IIEP-UNESCO, 2021[96]).

Female enrolment and completion rates are low in TVET programmes. Young girls and women are often prevented from enrolling in and completing TVET programmes. This results from social norms that confine their role to the domestic realm, from long distances to TVET institutions and from the high cost of learning materials. Between 2017 and 2019, female participation in formal TVET at secondary level as a share of total enrolment was lowest in Tanzania (12%) and Seychelles (18%) and highest in São Tomé and Príncipe (56%) and Lesotho (67%) (Figure 2.1). Unfortunately, enrolment does not necessarily translate into completion. For instance, Uganda's TVET end-of-year assessment in 2019 indicates that women comprised only 19% of the examinees (Mawanda, 2020[97]).

> The Gender makes Business Sense e-learning course, implemented by GIZ and AUDA-NEPAD, equips participants with managerial skills, financial know-how and an understanding of social norms and gender dynamics in business development (AUDA-NEPAD, 2024[98]).

Figure 2.1. **Percentage of female students enrolled in secondary technical and vocational education and training in selected African countries, 2017-19**



Source: World Bank/UNESCO Institute for Statistics (2020[99]), *Secondary Education, Vocational Pupils (% female)* (database), https://data.worldbank.org/indicator/SE.SEC.ENRL.VO.FE.ZS.

StatLink https://stat.link/sfirpl

Box 2.5. **Germany's activities in technical and vocational education and training across Africa**

The German Agency for International Cooperation (GIZ) supports African partner countries in expanding access to skills and shaping the transition to decent employment in future-oriented sectors. It does so in line with Germany's priorities and on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ). In 2022, 76 GIZ-implemented TVET programmes were active in Africa.

At the national level, GIZ implements an approach to promoting employment that encourages training women in green and digital skills. Its Employment Promotion for Women for the Green Transformation in Africa (WE4D) programme focuses on developing gender-sensitive training with public and private partners in green sectors (e.g. eco-tourism, sustainable agriculture, renewable energy and green construction). The WE4D programme, funded by BMZ, the Norwegian Agency for Development Cooperation and the European Union (GIZ, 2024[100]), operates across nine African countries. Another such GIZ initiative is the Digital Skills for Jobs and Income in South Africa project. This project, partly funded by the G20 initiative #eSkills4Girls, aims to narrow the gender divide in the digital economy by offering girls training courses for aspiring drone pilots, creative content producers and application developers (GIZ, 2024[101]).

Box 2.5. **Germany's activities in technical and vocational education and training across Africa *(continued)***

GIZ also supports African Union member states in implementing demand-oriented, inclusive TVET through the Skills Initiative for Africa (SIFA) (Box 2.7). Under SIFA, the continental portal ASPYEE (African Skills Portal for Youth Employment and Entrepreneurship), practitioners and policy makers share, collaborate on and engage in key areas (AUDA-NEPAD, 2024[102]).

Source: GIZ.

National funding for TVET can be more accountable, while funding from development partners can be better co-ordinated

Africa's low public spending on TVET is sometimes supplemented by levies from the private sector, with mixed results. On average, Africa devotes 5% of public education spending to TVET (AFD/ADEA, 2014[103]), with the amounts varying greatly across countries. In the Southern African Development Community (SADC), countries dedicate between 0.6% and 13.6% of education spending to TVET (AUDA-NEPAD, 2022[104]; SADC, 2013[105]). In Equatorial Guinea, less than 25% of TVET centres are publicly run. Some countries compensate for insufficient public financing by raising training funds from the private sector, charging a levy rate of between 0.5% (Gabon and Zambia) and 4.0% (Benin and Tanzania) of payroll. However, the levy-based model has limitations, such as the diversion of funds to national general budgets for purposes other than training, thus reducing both fund capacity and firms' willingness to participate. Of funds analysed in 29 African countries, 5% of training levies collected in Burkina Faso go to national TVET funds, 17% in Zambia and 60% in Niger; only Senegal's 3FPT Fund achieves 100% (UNESCO, 2022[106]).

Performance-based schemes can contribute to TVET funding. In 2024, South Africa announced the establishment of an innovative USD 197 million loan fund for middle-income students at TVET colleges and universities. Students who obtain a 70% grade or above and finish within a prescribed time will receive a 50% reduction in loans they have requested (SABC News, 2024[107]).

TVET financing from development partners can be better co-ordinated and targeted towards countries with the greatest need. Donor funding is likely to remain a significant source of financing for TVET in African countries. For example, in Burkina Faso, 46% of TVET funds come from development partners, 4% from the state and only a small portion from the training levy (ILO, 2020[108]). Donor-run grants (e.g. the SIFA Financing Facility and the European Development Fund) can promote innovation and competition but risk leaving out countries with lower capacities (Boxes 2.5, 2.6 and 2.7).

Box 2.6. **Bridging educational and skill gaps in Portuguese-speaking African countries**

Addressing educational disparities and teacher shortages is crucial for Portuguese-speaking African (PALOP) countries – Angola, Cabo Verde, Guinea-Bissau, Mozambique, and São Tomé and Príncipe. The heterogeneity in educational attainment and workforce skill distribution across PALOP countries is significant. In Mozambique, the lower secondary education completion rate among students over 25 years of age is 15%, compared to 28.9% in Angola, 29.5% in Cabo Verde and 38.9% in São Tomé and Príncipe. These figures stand against an average of 30.4% across 29 African countries (UNESCO, 2023[90]). This creates a challenge to educational outcomes, as does the shortage of qualified teachers. The shortage prevents youth from accessing quality education and is the focus of several initiatives. These include the recent training initiatives led by Camões – Instituto da Cooperação e da Língua, I.P. (Camões, I.P), to develop capacities of education professionals which have been implemented in Angola (Saber+), Guinea Bissau (PRECASE[8]) and São Tomé and Príncipe (PAISE-STP[9]).

PALOP countries are seeking to improve technical and vocational education and training to meet job market needs. With unemployment rates among the 15- to 24-year-olds ranging from 4% (Guinea-Bissau) to 28% (Cabo Verde) in 2024 (ILOSTAT, 2024[109]), TVET represents a pathway to transition into the labour market for many youth. Mozambique saw a 6% increase in enrolment in TVET programmes between 2008 and 2018, against a continent-wide declining trend (AfDB, 2022[110]). The Improvement of Skills Development in Mozambique project in partnership with the World Bank, aims at improving the quality of education in secondary and TVET institutions geared towards labour market needs (World Bank, 2024[111]).

International partners and national governments can maximise synergies to narrow skill gaps and boost employment in priority sectors. To this end, Cabo Verde and Portugal signed a memorandum of understanding in 2023 with investment objectives in six strategic areas: metallurgy, digital, civil construction, the social sector, tourism and the energy transition. By improving access to, and the quality of, professional training at the Centres of Professional Excellence, the agreement seeks not only to equip the Cabo Verdean youth with transferable skills but also to attract talent from other PALOP countries. Similarly, the multi-stakeholder PALOPs-Timor-Leste PROCULTURA Programme, with a budget of EUR 19 million, sought to develop artistic and management skills while boosting revenue-generating activities and jobs across creative industries (Futuros Criativos, 2024[112]). Lastly, +EMPREGO Mozambique aims to promote i) better qualifications for available jobs, ii) public-private partnerships and iii) improved access to employment and self-employment in Cabo Delgado Province. This project, co-financed by the European Union and Camões, I.P., targets the professional insertion of 1 200 Mozambicans, aged 15 to 25, and graduates from professional education, 25% of whom are women (+Emprego, 2024[113]).

The regional integration of African skills development depends on harmonised frameworks, international safeguards and partnerships

The regional integration of skills development hinges on better harmonisation of international frameworks and enhanced skill mobility partnerships. To reduce skill gaps at the continental scale, integrating the supply of and demand for skilled labour across national borders is paramount. Harmonising policies across countries can help close skill gaps, allowing African countries to reap the benefits of the interplay of skill mobility, free trade and the free movement of people across borders (Table 2.9).

Table 2.9. **Steps for regional and continental integration of skills policies**

Step	Policy action	Example
1. Skills anticipation	Identify skill needs within cross-border labour pools and regional value chains	AUDA-NEPAD's five Centres of Excellence strengthen regional labour market information, harmonise national occupational standards and design training programmes.
2. Skills development	Address skill shortages and gaps along regional value chains	The Centre of Excellence for Advanced Battery Research between the Democratic Republic of the Congo and Zambia supports private-public co-operation for training and research along different segments of value chains for electric vehicle batteries (Box 4.5).
3. Skill recognition	Improve cross-border skill recognition and portability	Nine SADC countries are implementing national qualification frameworks based on a regional mechanism for comparability and on the recognition of qualifications and credit transfers (Castel-Branco and Mavimbela, 2022[114]).
4. Skill retention and circulation	Reduce talent outflow and encourage the international circulation of skills via partnerships	The SMP programme called Towards a Holistic Approach to Labour Migration Governance and Labour Mobility in North Africa trained 350 young workers from Morocco and Tunisia. One-fourth moved to Belgium as the European host country; three-fourths joined their local labour markets (BAG/OECD, 2024[115]).

Note: AUDA-NEPAD = African Union Development Agency - New Economic Partnership for Africa's Development; SADC = Southern African Development Community; SMP = skill mobility partnership; COMESA = Common Market for Eastern and Southern Africa.

Source: Authors' compilation.

Free trade and the free movement of people across borders can be better integrated into protocol agreements and expanded in scope. While mainly designed to promote free trade, the Protocol on Trade in Services, under the African Continental Free Trade Area (AfCFTA), is a critical precursor of free movement agreements in Africa (AUC/IOM, 2018[116]). Yet, it only targets the mobility of businesspeople and professionals in the context of service delivery. The Protocol to the Treaty Establishing the African Economic Community Relating to Free Movement of Persons, Right of Residence and Right of Establishment has a broader scope, covering informal cross-border traders, seasonal workers and student migrants. However, it lacks an explicit link to free trade, which has made its implementation a low priority in many member states of the African Union (Hirsch, 2021[117]; Bisong, 2021[118]). Coherent international integration protocols could start from regional economic communities. The Economic Community of West African States (ECOWAS), for example, has significantly advanced free trade and the free movement of people between member states (Urso and Hakami, 2018[119]).

AUDA-NEPAD's five regional Centres of Excellence can help anticipate sectoral skills needed across Africa. The centres seek to reflect the diversity and capacity-building needs of the continent; they cover five strategic sectors: supply chain and logistics (Central Africa); climate resilience (Egypt); human capital and institutions development (Kenya); rural resources and food systems (Senegal); and science and technology and innovation (South Africa) (AUDA-NEPAD, 2023[120]). These sectoral specialisations and strategic locations make the centres well-suited for regional skills anticipation, strengthening labour market information, updating national occupational standards and designing training programmes. Anticipating national skills is gaining traction, for instance, via dedicated Skills Anticipation Action Plans in Ghana (launched in 2022), Zambia (2023-27) and Zimbabwe (2022-25). Regional skills anticipation could more directly take into account economies' comparative advantages along regional value chains.

Partnerships can help address challenges for skills development in regional value chains (OECD/AUC/EU/AUDA-NEPAD, 2023[121]). Multistakeholder partnerships, led by organisations such as the AUDA-NEPAD and UNITAID, have established platforms for co-ordinating skills development in value chains (Box 2.7). By increasing the development of skills, such partnerships can also attract more greenfield foreign direct investments and foster regional integration (AUC/OECD, 2022[28]). Regional training centres can help alleviate skill shortages and promote skill mobility for the development of regional value chains (see also the EASTRIP programme above).

Box 2.7. **The Skills Initiative for Africa**

The African Union Commission, AUDA-NEPAD, the European Union and the German government (through the KfW Development Bank) created the Skills Initiative for Africa (SIFA) to promote innovative skills development. Between 2000 and 2023, SIFA financed projects that contributed to employment-oriented skills development for young people in eight African countries, in collaboration with private firms. The SIFA Financing Facility provided grants of up to EUR 3 million to domestic public or private accredited training providers, TVET institutions, international chambers of commerce, international industry associations, and foundations of international companies with local training activities. SIFA aims to create a continental platform for knowledge exchange and private sector engagement in skills development.

African countries are making efforts to harmonise qualification frameworks to facilitate the mobility of skilled labour and graduates. Existing regional qualifications frameworks, spearheaded by regional economic communities and non-governmental organisations, remove restrictions on intra-African mobility of skilled labour by creating comparable qualification frameworks. While only SADC (in 2016) and the East African Community (in 2015 and 2023) have adopted such frameworks to date, ECOWAS and the Intergovernmental Authority on Development are moving in that direction. Joint minimal standards have emerged as flexible, bottom-up initiatives to promote the mutual recognition of qualifications in agriculture and construction between neighbouring countries such as Ghana, Nigeria and Togo (ILO, 2023[122]). To facilitate the regional mobility of graduates, the African Union's Continental Education Strategy for Africa 2016-2025 stresses the need for continental qualifications frameworks that connect regional and national frameworks.

> The African Continental Qualifications Framework (ACQF) – implemented by the African Union, in partnership with the European Union and GIZ – is a ten-level blueprint that connects qualifications frameworks and systems (ACQF, 2023[77]). It aims to enhance comparability and transparency of qualifications, to facilitate the recognition of diplomas and certificates and to promote the mobility of workers and students. The second implementation (ACQF-II) is a promising opportunity for a regionally unified approach to micro-credentials (Castel-Branco, 2023[123]).

University exchange programmes, within and beyond Africa, are crucial to retain highly educated students and attract new ones. Inspired by the European ERASMUS+ programme, intra-African exchange programmes can retain African talent on the continent and attract aspiring skilled workers. African countries can expand and deepen existing initiatives to link university and training, backed by effective educational counselling. Many leading international tertiary institutions are also establishing local campuses, forming collaborative partnerships with African institutions, including exchange programmes, and offering accredited online degrees.

> The EU-Africa: Global Gateway Investment Package – Education and Training programme – integrates students from 35 African countries into the European ERASMUS+ programme (European Union, 2022[89]).

International safeguards can regulate the outflow of skilled workers from strategic sectors such as healthcare. For instance, the health workforce support and safeguards list published by the World Health Organization for 2023 identifies countries with low health workforce density and low coverage of essential health services (WHO, 2023[124]). The United Kingdom has adopted this list in its 2023 code of practice that regulates

international recruitment for health and social care organisations; it excludes 39 African countries from active recruitment (UK GOV, 2023[125]).

Skill mobility partnerships can enhance skills development and circulation. Such programmes offer dual-track training in both origin and destination countries, with the cost of training partially borne by destination countries or employers. While these programmes do not prevent participants from seeking permanent relocation, they emphasise temporary assignments and return initiatives. They also include training components tailored to the skills needed in both the origin and destination countries, not only for labour migrants but also for local populations (AU, 2020[126]).

Notes

1. The Digital Manifesto was piloted in Ethiopia, Mongolia and South Africa.
2. Teaching at the Right Level (TaRL) programmes have been piloted in 12 African countries (Botswana, Côte d'Ivoire, Ghana, Kenya, Madagascar, Mozambique, Niger, Nigeria, South Africa, Tanzania, Uganda and Zambia), reaching over 4 million students in 2022. Evaluations of TaRL programmes found an increase in test scores by between 0.1 and 0.3 standard deviations per student (Carter, 2024[127]).
3. Authors' calculations based on GEM/UNESCO/World Bank (2024[47]) and Angrist et al. (2023[1]).
4. Authors' calculation based on ILOSTAT (2024[128]).
5. Outside of formal learning, there exist non-formal and informal learning. While non-formal learning usually takes place in community-based settings, in the workplace and through the activities of civil society organisations, informal or experiential learning refers to unstructured learning developed in daily work-related, family or leisure activities (UIL-UNESCO, 2012[129]).
6. https://twitter.com/WomenInDataAfri; https://twitter.com/femafricmaths?lang=en.
7. An overview of the evaluations considered for this analysis can be obtained on request.
8. https://www.instituto-camoes.pt/en/activity-camoes/what-we-do/co-operation/programmes-and-projects/featured-projects/programa-de-reforco-de-capacidades-do-sistema-educativo-precase.
9. https://www.instituto-camoes.pt/sobre/comunicacao/noticias/programa-de-apoio-integrado-ao-setor-educativo-de-sao-tome-e-principe-paise-stp-2019-2022.

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Chapter 3

Skills for mining in Southern Africa

This chapter examines skills development with a focus on mining and mining beneficiation in Southern Africa (Angola, Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe). First, the chapter presents the region's educational outcomes to assess the overall skill supply. Second, the chapter examines the mining sector's economic impact, workforce and outlook in the face of changing global demand for minerals, as well as how these relate to the demand for skills in industries that are downstream of mining. Third, it examines the region's current policies that seek to equip workers with in-demand skills and makes recommendations for how to improve those policies.

IN BRIEF

Southern Africa's supply of well-educated and skilled workers is above the African average. The region's educational outcomes are on par with other African regions. A larger share of workers in Southern Africa are in skilled occupations, and more are overeducated while fewer are undereducated than elsewhere in Africa.

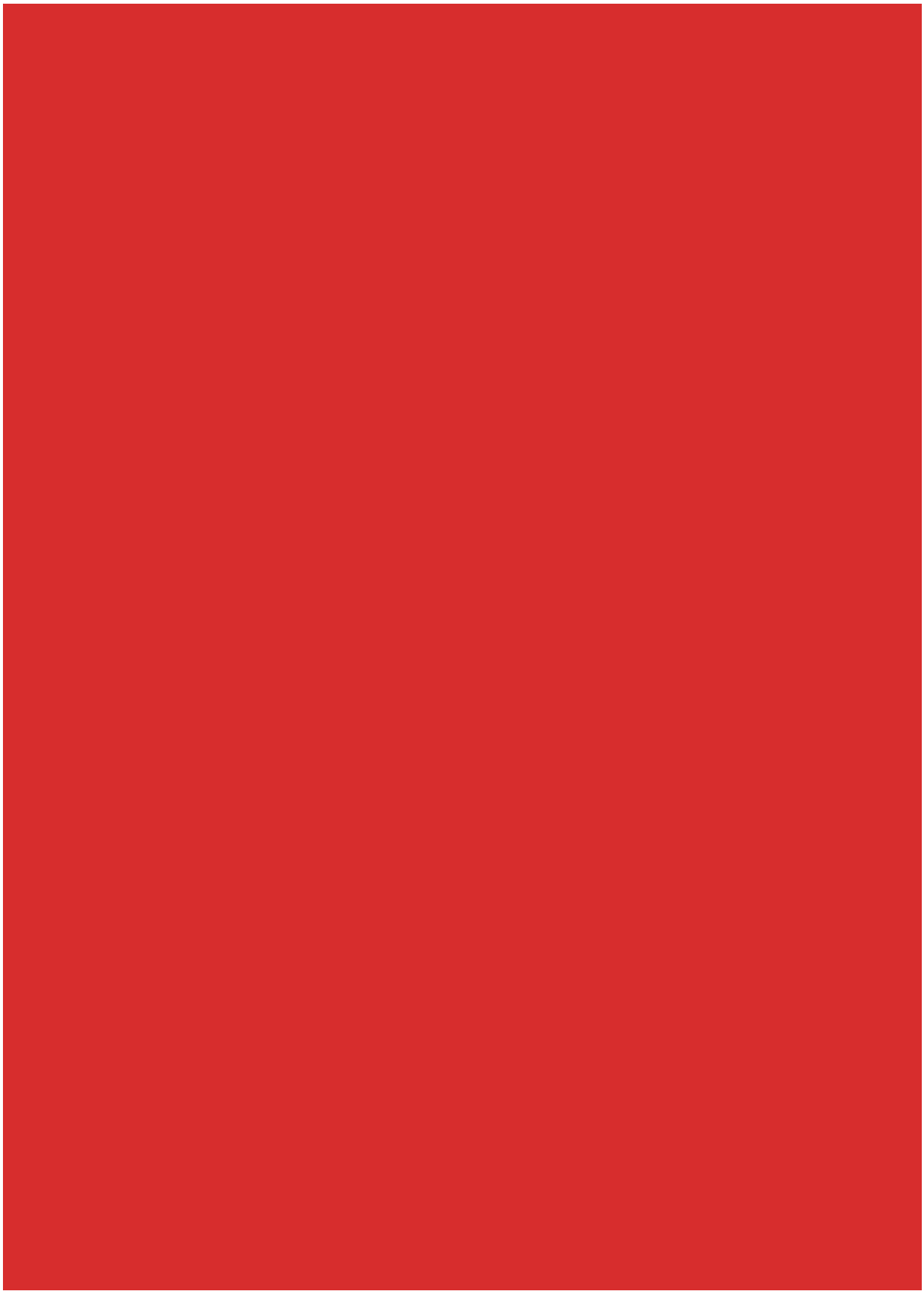
Mining is a priority sector for the region, as it supports economic development and government revenues. However, Southern Africa continues to export mostly mineral resources in raw form. Skill needs in mining and in downstream industries vary by mineral value chain. For example, in South Africa, workers' education levels are lower in non-ferrous than in ferrous ore mining. Yet, in manufacturing, the country's workers in non-ferrous metals tend to have higher education levels than those in ferrous metals.

Most of the sector's workers are in artisanal and small-scale mining, where many jobs are informal and for subsistence, resulting in low levels of social protection and high levels of vulnerability. Mining sector employment is overwhelmingly male-dominated, while women are better represented in artisanal and small-scale mining. Still, female mining workers are often poorer and more vulnerable to exploitation and danger than male workers.

Southern Africa has developed specific industries downstream of mining, such as diamond cutting, steel production, cobalt refining and electric vehicle manufacturing. Yet, the relative lack of skilled workers inhibits the region's development efforts, leading to an underutilisation of capacity in mining-related manufacturing.

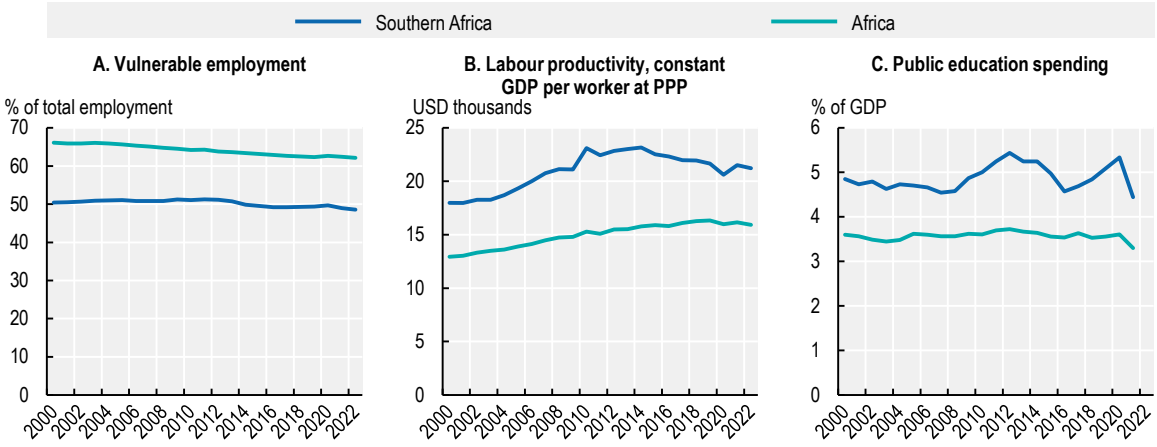
Southern African policy makers can prioritise three policy actions:

1. Ensure that sound national mining policies and legislative frameworks are well harmonised with regional standards and global best practices.
2. Adapt formal mining education to country-specific technical, business and digital skill needs.
3. Target education and training programmes more directly towards women and other marginalised groups.



Southern Africa regional profile

Figure 3.1. **Vulnerable employment, labour productivity and education spending in Southern Africa, 2000-22**



Note: Vulnerable employment includes formal and informal self-employed (own-account) workers and contributing family members but excludes informal salaried employees. As an approximation of informal employment, it is used here to show long-term trends, as time series data on informal employment are missing for most African countries. Labour productivity is measured as the constant gross domestic product (GDP) in 2017 international USD at purchasing power parity (PPP) prices, divided by the population of employed people in thousands.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org/fr/; World Bank (2023[2]), *World Development Indicators* (database), https://databank.worldbank.org/source/world-development-indicators; and IMF (2023[3]), *World Economic Outlook* (database), https://www.imf.org/en/Publications/WEO.

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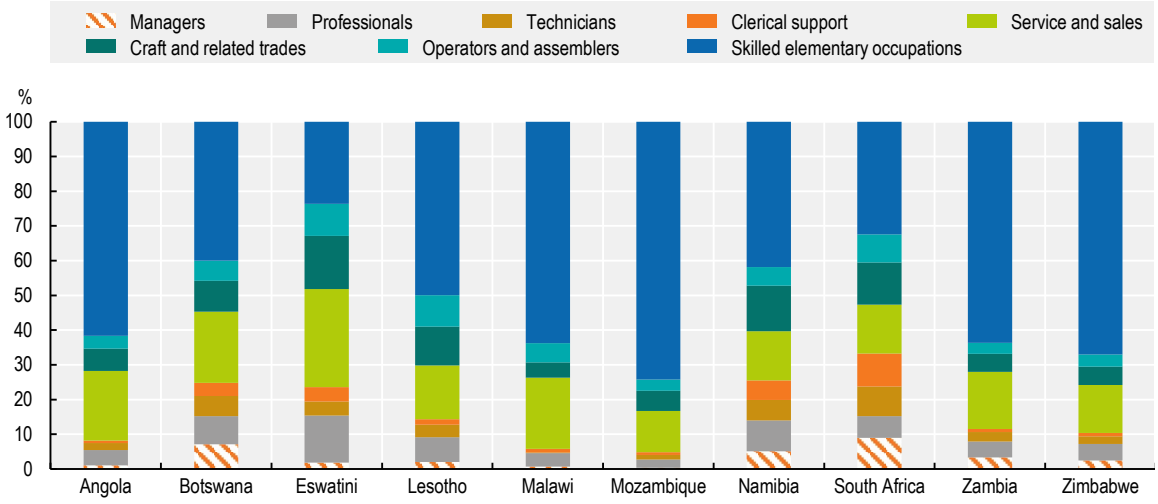
Figure 3.2. **Breakdown of working population by type of occupation in Southern Africa, 2021**



Note: "Technicians" include associate professionals, "Skilled elementary occupations" include skilled agricultural, forestry and fishery workers, and elementary occupations, and "Operators and assemblers" include plant and machine operators and assemblers.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org/fr/.

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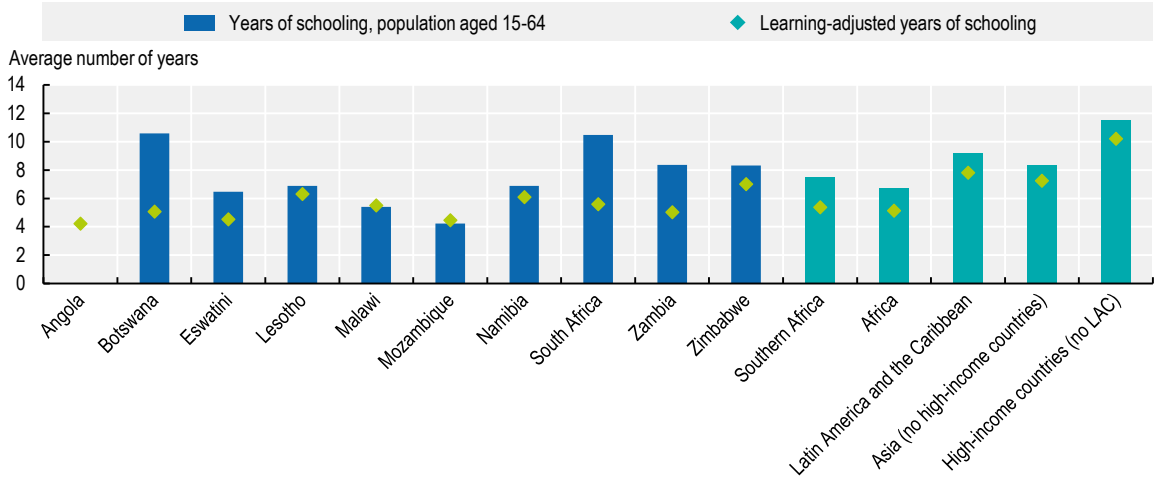
Southern Africa can further raise educational outcomes

Educational outcomes in the region are on par with other African regions, while many highly educated Southern Africans leave the region

Southern Africans spend more years in school than the average for Africa but fewer than in other world regions. On average, Southern Africans complete 7.5 years of schooling. The estimated learning-adjusted years of schooling (see Chapter 1) across Southern Africa was 5.4 in 2020 (Figure 3.3). This is slightly higher than for Africa as a whole but lower than the global average of 7.8. Zimbabwe has the region's highest number of learning-adjusted years of schooling (7), approaching the global average.

Figure 3.3. **Average years of schooling and learning-adjusted years of schooling, 2020**



Note: LAC = Latin America and the Caribbean. Learning-adjusted years of schooling merge the quantity and quality of education into one metric, reflecting that similar durations of schooling can yield different learning outcomes. See Filmer et al. (2020[4]) for the detailed methodology.

Source: Authors' calculations based on World Bank (2023[5]), *Education Statistics – All Indicators* (database), https://databank.worldbank.org/source/education-statistics-%5E-all-indicators.

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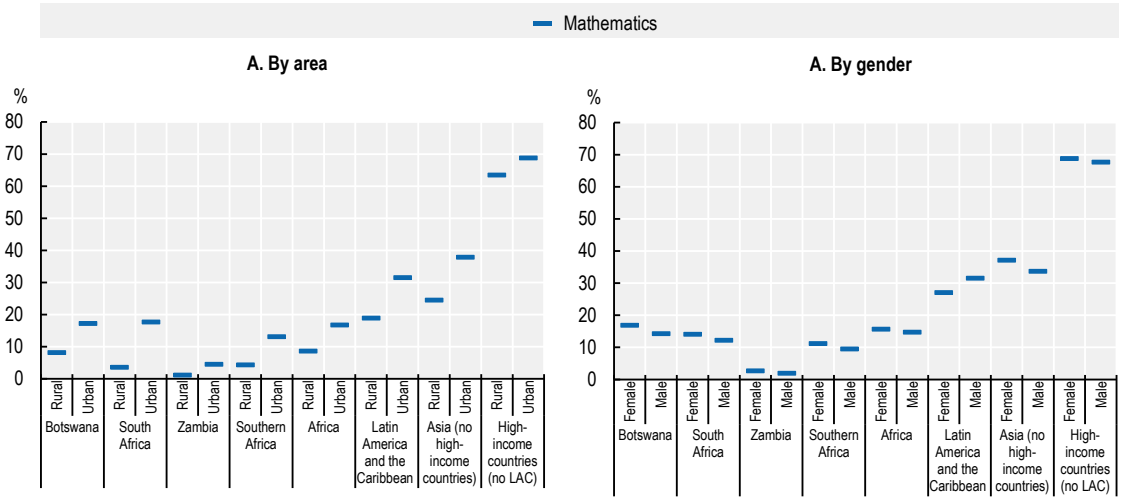
Math achievement scores for Southern Africa are slightly lower than the African average, with slightly higher scores for girls and a large rural-urban divide (Figure 3.4). The average percentage of adolescents achieving proficiency in math for Botswana, South Africa and Zambia is lower than the average for all reporting African countries for both males and females and in both rural and urban areas. The percentage of Southern African students achieving proficiency in math is marginally higher for females than for males, and it is twice as high in urban as in rural areas. The percentage of the region's adolescents in upper secondary school achieving math proficiency is slightly lower than that for Africa as a whole, but the average for the world is nearly three times as high.

Figure 3.4. **Percentage of adolescents in upper secondary school achieving proficiency in mathematics, most recent year observed (2013-22)**



Note: LAC = Latin America and the Caribbean.

Source: Authors' calculations based on UNESCO (2023[6]), *World Inequality Database on Education* (database), https://www.education-inequalities.org/.

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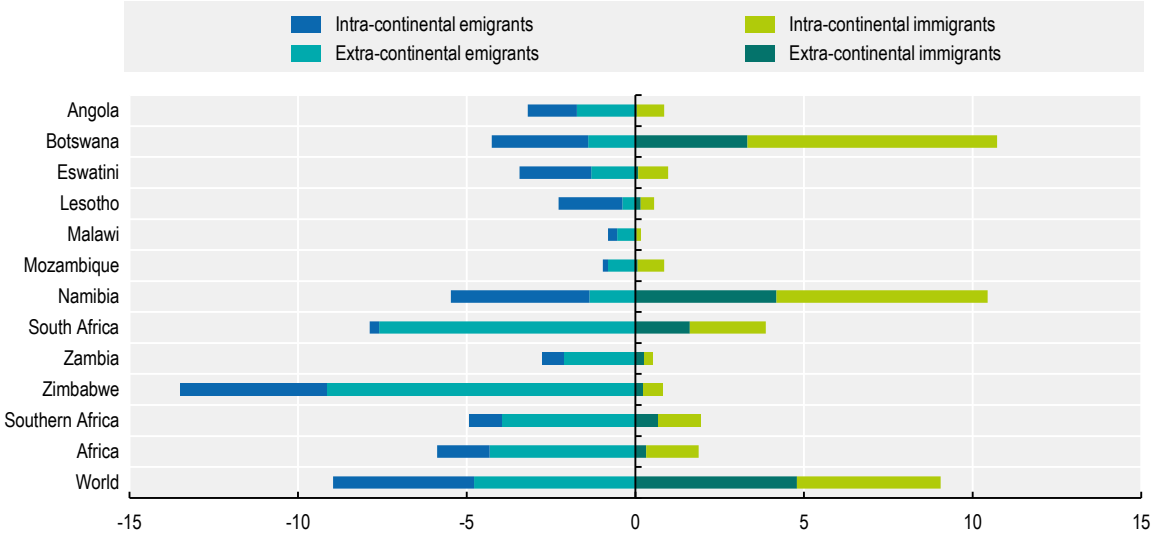
The share of highly educated people who immigrate to the region from outside of Africa is generally lower than the share of Southern Africans who leave the continent. For every extra-continental immigrant to Southern African countries with a tertiary education, six Southern Africans with the same education level leave Africa. Botswana and Namibia are two notable exceptions: both countries have managed to attract far more immigrants from outside of Africa with a tertiary education than the number of people with that education level leaving these countries.

Figure 3.5. **Migrants with tertiary education, origin and destination, 2020**



Note: Migrants per 1 000 inhabitants. Negative numbers show emigration.

Source: World Bank (2023[7]), *Global Bilateral Migration* (database), https://databank.worldbank.org/source/global-bilateral-migration and World Bank Group (2023[8]), *World Development Report 2023*, https://data.unhcr.org/en/documents/details/102109.

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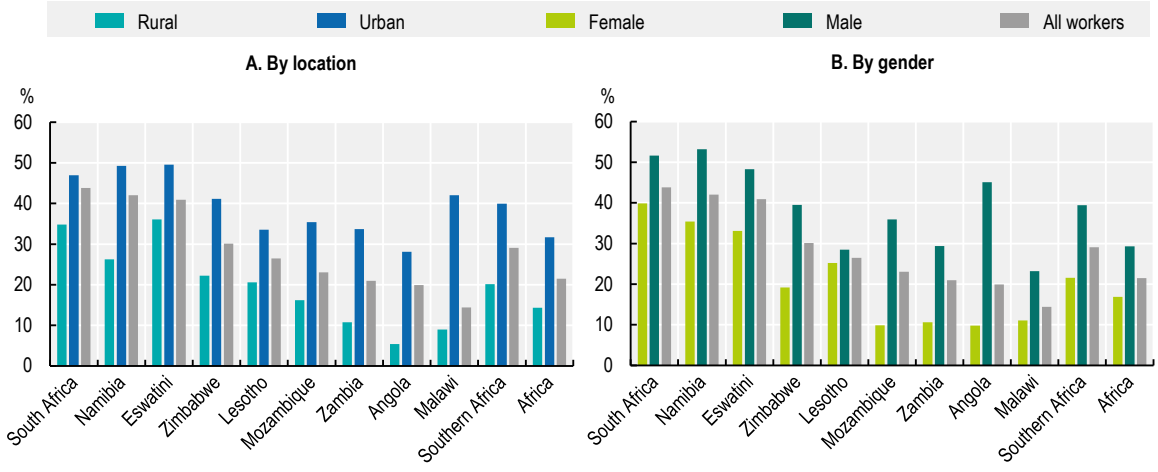
Southern African countries have more workers in skilled occupations than the African average, but gender and rural-urban divides and educational mismatches exist

The share of workers in skilled occupations is higher in Southern Africa than the African average, and their numbers differ across countries and reflect gender gaps. The share of workers in skilled occupations in the region is 29%, compared with 22% for Africa as a whole (Figure 3.6). However, Southern Africa's average hides enormous heterogeneity: the share ranges from 44% in South Africa to 14% in Malawi. While all Southern African countries have a lower percentage of the rural population in skilled occupations than of the urban population, the rural-urban gap ranges from 33 percentage points in Malawi to only 12 percentage points in South Africa. The share of workers in skilled occupations is higher for males than females in Southern Africa, but this gap also varies by country, with a low of 3 percentage points for Lesotho and a high of 35 for Angola. The discrepancy between the slight advantage for girls over boys in math proficiency (Figure 3.4) and the higher share of males in skilled occupations (Figure 3.6) suggests that women may face additional barriers to integrating into skilled labour markets.

Figure 3.6. **Percentage of workers in skilled occupations, by gender and place of residence, 2019 or latest year available**



Note: Data are drawn from nationally representative demographic and health surveys (DHS) collected between 2010 and 2019. Occupational categories were divided into skilled and unskilled occupations as follows: skilled occupations include professional, technical, managerial, clerical and skilled manual work; unskilled occupations include sales, agriculture, household and domestic work, services and unskilled manual labour.

Source: USAID (2019[10]), *Demographic and Health (DHS) Surveys (2010-19)* (database), https://www.statcompiler.com/en/.

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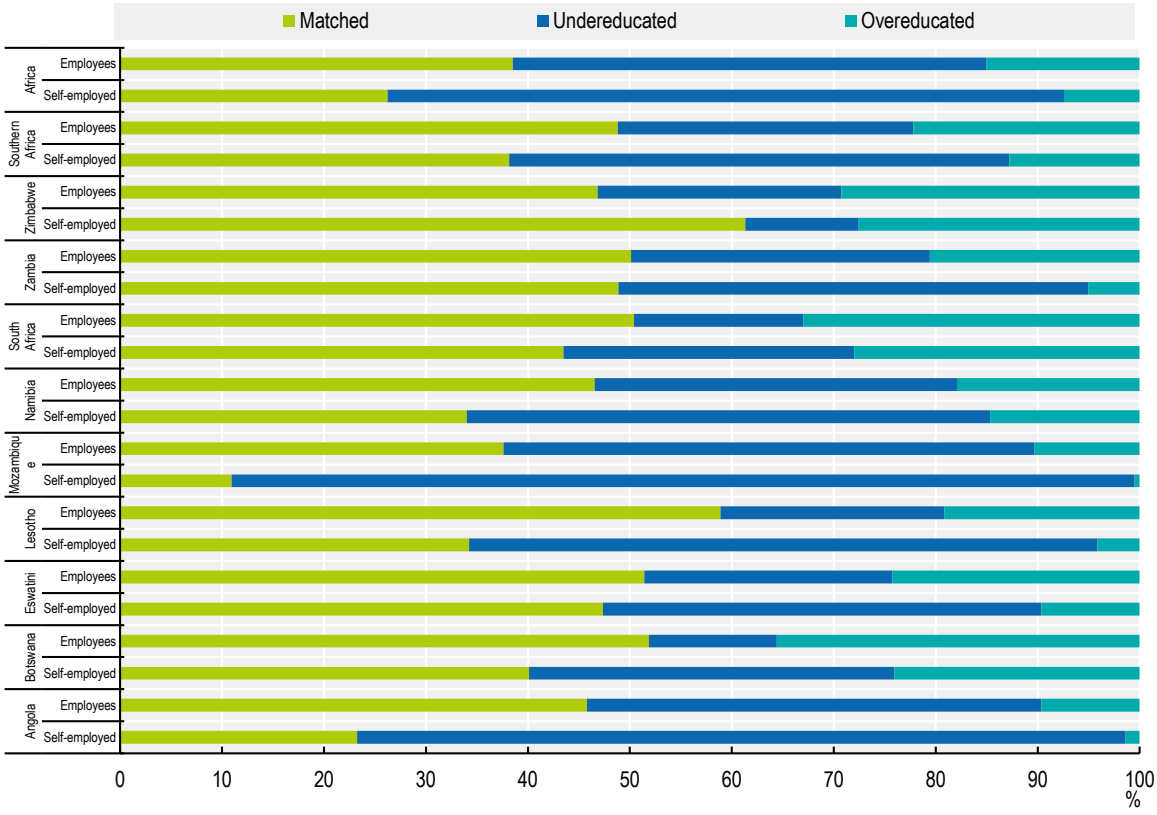
In Southern Africa, the education levels of a majority of workers do not match occupational requirements (Figure 3.7). Compared to African workers overall, Southern African workers – whether men, women, employees or self-employed workers – are less likely to have education levels below occupational requirements and more likely to have education levels above requirements. Self-employed workers in Southern Africa are far less likely to have education levels above requirements (13% of workers) compared with employees (22%) and more likely to have education levels below requirements (49% of workers vs. 29%). The education-occupation mismatch was slightly higher for female workers than male workers, for education levels both below and above requirements.

Figure 3.7. **Percentage of workers who have an equal, higher or lower level of education than required for their occupation, 2022 or latest year available**



Note: (Mis)matches are assessed through the normative approach by comparing educational requirements set out in the International Standard Classification of Occupations (ISCO) for each one-digit ISCO occupational group with the level of education of each person in employment. Calculations are based on data collected in national labour force statistics or other nationally representative household surveys with a module on employment.

Source: Authors' compilation based on ILOSTAT (2023[11]), *ILO Education and Mismatch Indicators* (database), https://ilostat.ilo.org/.

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Southern Africa's mining sector can benefit from demand-oriented skills development

The mining sector is disproportionately important for Southern Africa's exports, government revenue and development. In 2022, exports of fossil fuels and minerals from Southern Africa were 39% of gross domestic product – the highest amount since 2008 – compared to 23% for the rest of the world. Mining in Southern Africa is both an important source of government revenue and a driver of development in other sectors, such as construction, manufacturing and transportation.

The value chains of Southern Africa's mining sector require skills beyond mining. The economic impacts of mining unfold along value chains, from fossil fuel and mineral extraction to mining beneficiation to mining-based manufacturing (Box 3.1). Increasing the value that the mining sector creates for the economy demands developing different kinds of skills:

- **Technical skills unique to mining and mining beneficiation**, such as mining engineering or the operation of mining and smelting equipment.
- **Transversal skills that are relevant in mining and beyond.** Many people within the mining workforce, especially informal workers in artisanal and small-scale mining, are vulnerable to economic precarity or poverty. They can benefit from obtaining some non-mining-related skills that would improve their resilience, such as soft, entrepreneurial and managerial skills.
- **Skills for mining-related manufacturing and other industries**, such as steel production from iron ore and coal, or jewellery production from precious metals and gemstones. These industries can use locally produced mining outputs for value addition if skill supply is available, for instance, workers trained in gem cutting or artisans and technicians in the metal manufacturing sector.

Box 3.1. **Mining, beneficiation and mining-based manufacturing**

The paths that economically useful minerals follow from the time they are extracted to when they reach the final consumers are long, complex and varied. These value chains of fossil fuels and minerals follow three main steps:

1. **Mining** refers to the extraction of fossil fuels and minerals from below the Earth's surface (e.g. mines and oil wells). This is a sector that requires a specialised workforce, such as mining engineers or geologists.
2. **Mining beneficiation** refers to the transformation of fossil fuels and minerals extracted from below the Earth's surface into materials of greater value that serve as inputs into other industries. Examples of beneficiation include oil refining, cobalt smelting and the production of coke and steel. Beneficiation can occur at mine sites, undertaken by the firms running the mines, or elsewhere, sometimes in other countries. Depending on the value chain, activities in beneficiation can vary greatly from those in mining and often require different equipment, occupations and skills.
3. **Mining-based manufacturing** refers to the part of the manufacturing sector that directly depends on the materials derived from mining and beneficiation, such as the manufacturing of steel car parts or copper pipes. While these activities rely on mining, they are almost always carried out by firms with different capabilities and in different locations.

Different mining-based value chains create different demands for skills

A diverse set of fossil fuels and minerals are mined in Southern African countries. Exports of fossil fuels and minerals, in crude, ore and processed forms, accounted for 66% of Southern Africa's exports in 2022; they were also the top exports for all Southern African countries aside from Eswatini and Malawi (Table 3.1). The ten most valuable mined commodities from Southern African countries in 2022 were petroleum, gold, diamonds, copper, coal, iron, platinum, rhodium, palladium and aluminium.

Table 3.1. **Top three exports for Southern African countries, 2022**

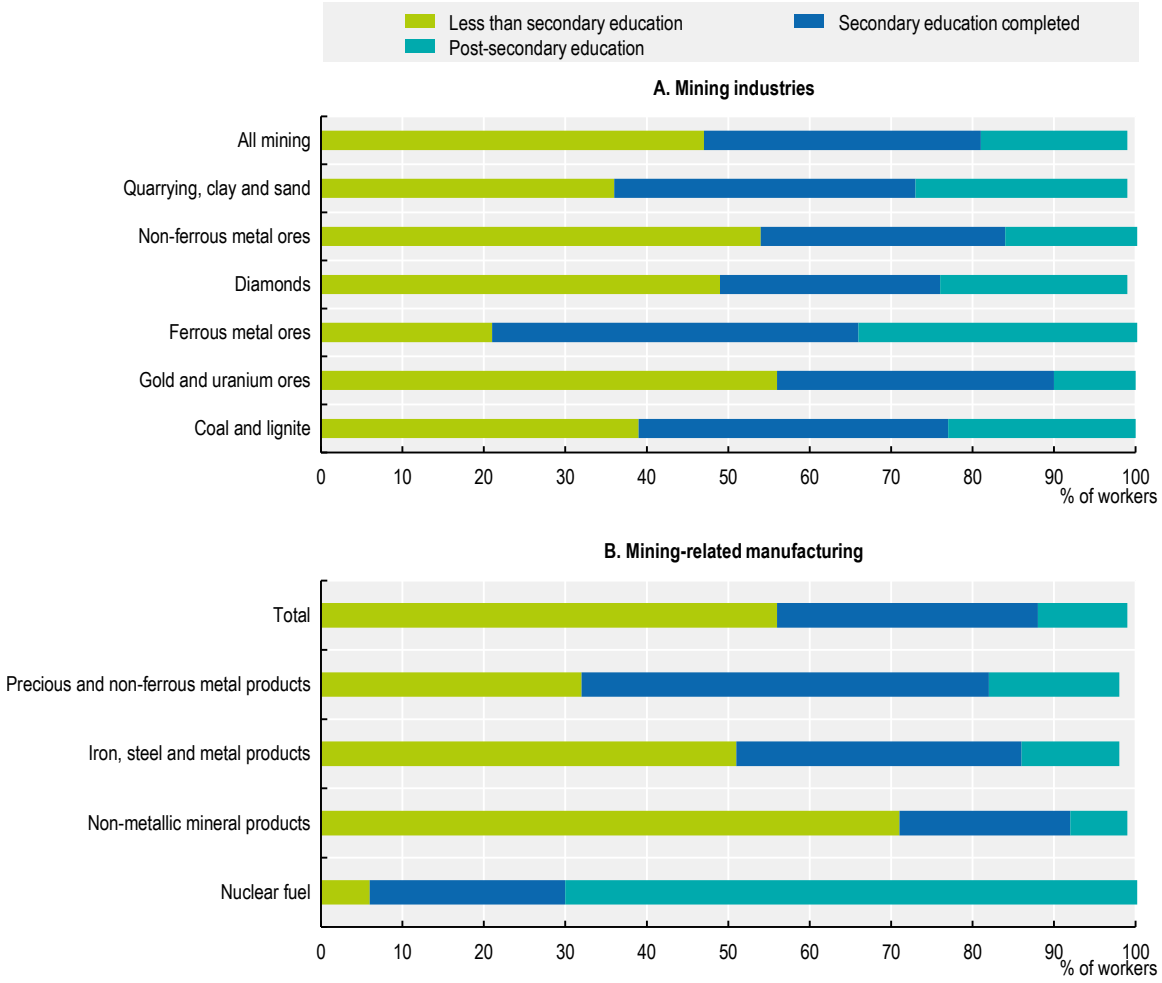
Country	Product	Exports (USD billion)	Exports (% of GDP)	Exports (% of total)	Number of miners (where available)
Angola	Crude petroleum	43.2	35.1	84.2	
	Natural gas	3.8	3.1	7.4	
	Industrial diamonds	2.5	2.0	4.8	
Botswana	Non-industrial diamonds	6.6	32.6	80.1	11 312
	Copper ores	0.4	1.8	4.3	
	Electrical equipment	0.3	1.3	3.2	
Eswatini	Perfume and essential oils	0.5	10.5	25.2	
	Sugar, molasses and honey	0.4	8.0	19.0	
	Chemical products	0.2	4.2	10.1	
Lesotho	Non-industrial diamonds	0.3	13.5	36.8	2 297
	Men's clothing	0.1	4.1	11.1	
	Women's clothing	0.1	3.9	10.5	
Malawi	Tobacco	0.3	2.5	39.2	
	Sugar and honey	0.1	0.9	14.9	
	Oil seeds	0.1	0.9	14.3	
Mozambique	Coal	2.1	11.2	26.7	70 600
	Aluminium	1.4	7.3	17.3	
	Base metal ores	0.8	4.1	9.7	
Namibia	Non-industrial diamonds	1.4	11.0	22.2	16 147
	Uranium	0.7	5.5	11.0	
	Gold	0.5	4.1	8.2	
South Africa	Platinum	17.7	4.4	14.6	445 653
	Coal	12.4	3.1	10.2	
	Gold	9.8	2.4	8.1	
Zambia	Copper	8.8	29.7	68.7	66 478
	Electricity	0.4	1.5	3.5	
	Cement and lime	0.3	1.1	2.5	
Zimbabwe	Gold	2.6	8.1	39.3	245 600
	Nickel ores	1.1	3.6	17.6	
	Tobacco	1.1	3.4	16.7	

Note: Shaded items are products of mining and beneficiation.

Source: IMF (2024[12]), *World Economic Outlook* (database), https://www.imf.org/en/Publications/SPROLLs/world-economic-outlook-databases#sort=%40imfdate%20descending for gross domestic product (GDP) data; CEPII (2024[13]), *BACI: International Trade Database at the Product-Level* (database), www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37 for exports data; and various reports for the numbers of miners.

The education levels of miners vary greatly across different mining-based value chains and across their steps, as South Africa shows (Figure 3.8). Nearly half (47%) of the country's workforce in mining industries have less than a secondary education, but the share differs by type of mineral. Fifty-four per cent of South Africa's non-ferrous ore miners have less than a secondary school education compared with 21% of ferrous ore miners. Of the mining-related manufacturing workforce, 56% have less than a secondary education. Contrary to mining industries, in mining-based manufacturing, non-ferrous metal workers have higher education levels than ferrous metal workers.

Figure 3.8. **Employment by education level in mining and mining-related manufacturing in South Africa**



Source: Authors' calculations based on Statistics South Africa (2010-23[14]), *Quarterly Labour Force Survey* (database), https://www.statssa.gov.za.

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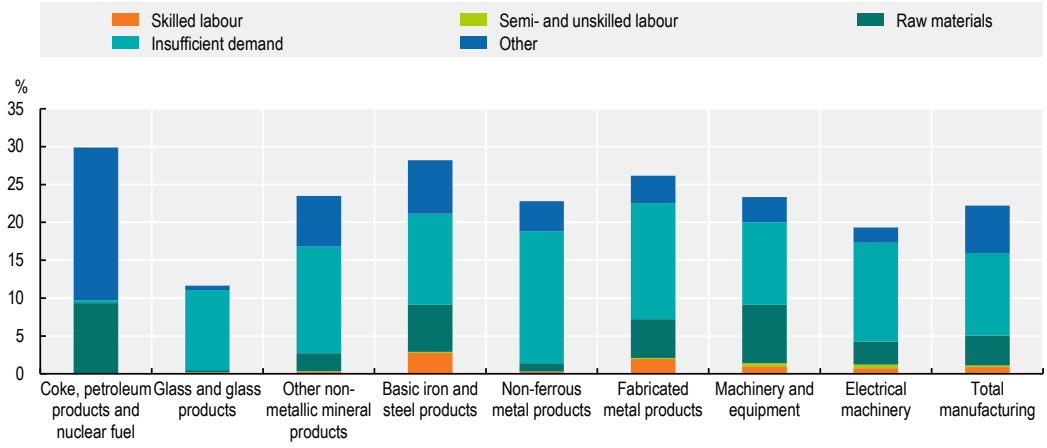
Shortages of workers with the necessary skills represent a key obstacle to the development of beneficiation and downstream industries in Southern Africa. Despite the potential of greater development of industries based on mining (Table 3.2), many of the fossil fuels and minerals produced in Southern African countries, outside of precious metals, are exported as ores or as crude oil, rather than feeding into local transformative industries that are downstream. According to a survey of South African mining experts conducted in 2015, the most cited factor in generating a sustained beneficiation industry was the availability of a workforce with the required technical skills (Tom, 2015[15]). Anglo American, the country's second-largest mining company, involved in coal, diamond and platinum mining, also identified skill shortages as one of the challenges to their efforts to develop a mining beneficiation industry in 2017 (AngloAmerican, 2024[16]), followed by an unreliable power supply, lack of local markets for locally beneficiated products and infrastructure constraints. This issue of skill shortages has persisted in recent years, despite new opportunities for mining beneficiation arising from efforts to decarbonise the global economy (Fabricius, 2023[17]).

Capacity is underutilised in South Africa's mining-related manufacturing as a result of numerous factors, including a limited supply of skilled labour. Data suggest that the country's manufacturing capacity is underutilised across different products (Figure 3.9). This is mostly due to factors unrelated to skills, such as lack of raw materials, low demand, maintenance problems, productivity, or seasonal issues. However, for manufacturing metal products, lack of skilled labour is a significant factor.

Figure 3.9. **Capacity underutilisation in mining-related manufacturing in South Africa, 2021-23 average**



Note: Capacity underutilisation is calculated from the responses to a quarterly survey of large South African manufacturing enterprises. Respondents were asked about the degree of capacity constraint they experience, along with the main causes of this constraint. Their responses were used to calculate a percentage difference between productive output with and without each given factor affecting capacity utilisation.

Source: Statistics South Africa (2023[18]), *Manufacturing: Utilisation of Production Capacity by Large Enterprises*, https://www.statssa.gov.za/publications/P3043/P3043February2023.pdf.

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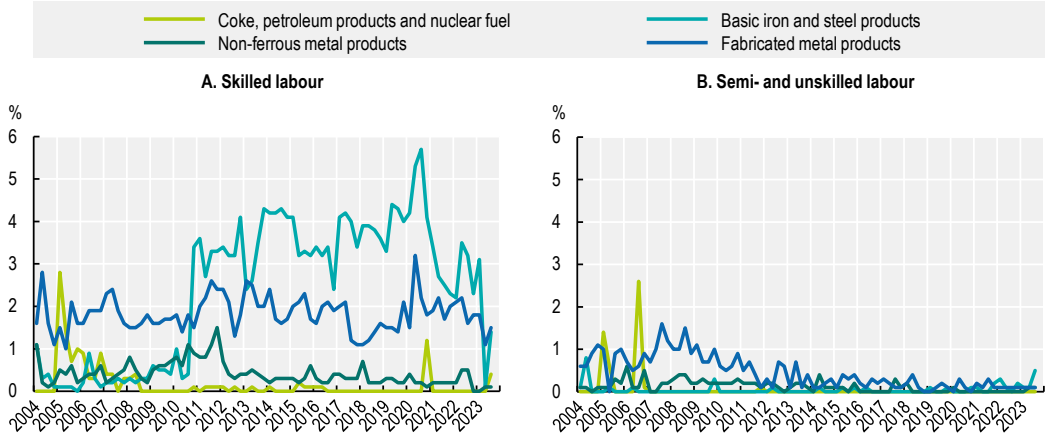
For manufacturing iron and iron products, capacity underutilisation due to lack of skilled labour has historically been significant in South Africa, while lack of semi- and unskilled labour has remained far less important (Figure 3.10). The recent drop in South African under-capacity attributed to skilled labour shortages results from economic difficulties in the post-COVID-19 era in the country that have decreased manufacturing output, such as strikes, floods and power cuts (IMF, 2023[19]). A rebound in regional manufacturing could provoke a return of skilled labour shortages that limits Southern African economic growth.

Figure 3.10. **Capacity underutilisation in mining-related manufacturing in South Africa due to labour shortages, 2004-2023 (% of total capacity)**



Source: Statistics South Africa (2023[18]), *Manufacturing: Utilisation of Production Capacity by Large Enterprises*, https://www.statssa.gov.za/publications/P3043/P3043February2023.pdf.

StatLink https://stat.link/2ug1k5

The demand for skills in the mining sector includes foundational, soft and digital skills

Before looking to enhance the pool of highly skilled workers, Southern African countries may need to ensure that elementary education infrastructure is accessible to miners. Many mining workers, including those in artisanal and small-scale mining, have not completed elementary education and may lack foundational skills such as literacy, numeracy and basic civic education. A standardised achievement test taken by 873 workers from 3 mines in South Africa showed that close to 99% of miners were functionally innumerate (Christoffel Smit and Mji, 2012[20]). Although such skills might not always be necessary for specific tasks, such as digging or sluicing, they are important for workers to improve their situations. Such skills are also necessary for acquiring other technical and soft skills which could help them move to new positions and improve their productivity.

More soft skills can benefit miners. These skills, in particular interpersonal skills, self-awareness, as well as managerial, clerical and legal skills, are generally missing. Both large mining operations with complex structures that operate in international legal environments and artisanal and small-scale mining operations in the informal economy suffer from soft skill shortages. According to Molek-Winiarska and Kawka (2022[21]), soft skills training in communications, team building and self-management skills has succeeded in reducing the stress levels of workers in a large mine. A study of employers in the South African mining sector showed that "generic skills" (e.g. people skills and communication, leadership and teamwork, problem-solving and adaptability, accountability, honesty and integrity, emotional intelligence, and resilient thinking) were regarded as "crucial to the learning process of mining engineering students" (Dipitso, 2023[22]).

Digital skill training can equip workers for new job requirements within the mining sector and beyond. The rise of digital technologies like artificial intelligence (AI), cloud computing and blockchain give mining enterprises ways to enhance efficiency, productivity and safety at work sites. Practical applications include automated drilling, driverless trucks, predictive maintenance with sensors and scanners. Yet, AI and automation may also reshape the task composition of jobs and fully displace some of them. While data on Southern Africa is missing, a study by Acemoglu et al. (2022[23]) on the impact of AI on online jobs and job vacancies in the United States shows that an increase in AI exposure is associated with more AI job vacancies. Increased investment in training for mining-related and transferrable digital skills can both support productivity in mining and improve the employability of mining workers within and outside of the sector.

Skills development for diamond beneficiation, cobalt refining, steel production and minerals for renewable energy could strengthen mining value chains in Southern Africa

Downstream activities in mining value chains could be supported by targeted skills development, in alignment with product complexity. Products made downstream in mining value chains range in complexity from copper wires and sheet metal to motor vehicle parts. Each of the fossil fuels and minerals that are important to Southern Africa is associated with particular beneficiation and production opportunities, with skill demand emerging from the potential employment growth.

Table 3.2. **Beneficiation and downstream activities and in-demand occupations for important mineral value chains in Southern Africa**

Value chain	Mining		Beneficiation		Manufacturing	
	Main ores	Mining activities	Beneficiation activities	Examples of occupations	Final products	Examples of occupations
Aluminium	Bauxite	Refining into alumina, smelting (electrolysis)	Rolling, spinning, casting	Materials scientist, metallurgical/ mechanical/chemical engineer	Construction, consumer durables, aluminium foil	Metallurgist, welder
Coal	Raw coal	Crushing, screening, processing	Fuel, metallurgical coke	Mechanical/ metallurgical engineer	Thermal power, steel production	Machinist, maintenance technician
Cobalt	Cobalt oxide, cobalt sulphate	Pyrometallurgy, hydrometallurgy	Cobalt sulphate/ oxide refining	Chemist, process engineer	Lithium-ion batteries	Materials scientist, chemical engineer
Copper	Copper oxide, copper sulphate	Drilling, blasting	Copper processing: pyrometallurgy, hydrometallurgy, electrorefining	Materials scientist, metallurgical/chemical/ electrical engineer	Solar panels, wind turbines, heating/ cooling systems, electric wires, electric cars	Electrical engineer, solar panel installer, electric vehicle engineer
Diamonds	Diamond-bearing ore obtained from pipe, alluvial or marine mining	Magnetic susceptibility, X-ray luminescence, crystallographic laser fluorescence	Cutting and polishing	Gemcutters (both traditional and using high-tech equipment)	Jewellery, drills, cutting tools	Jewellery designer, jewellery maker
Gold	Amalgam, gold-bearing solution	Amalgamation, cyanidation	Purification with gaseous chlorine, electrolysis or pyrometallurgy	Chemist, process engineer	Jewellery, dentistry, electronic transistors, semiconductor silicon chips	Jewellery designer, jewellery maker, dentist, computer engineer
Iron	Iron ore	Concentrating: obtaining ores richer in iron	Blast furnaces, smelting reduction	Metal making and treatment process operatives	Machinery, construction, agriculture	Engineer
Natural gas	Natural gas	Vertical/horizontal drilling, hydraulic fracturing	Oil, condensate, water, sulfur and carbon dioxide removal, separation of natural gas liquids	Process engineer	Electricity, cooking, heating	Engineer, computer scientist
Nickel	Sulfides, laterites (nickel-bearing ores)	Drilling, blasting	Pyrometallurgy, smelting, hydrometallurgy	Materials scientist, metallurgical engineer, chemical engineer	Stainless steel, batteries, mobile phones	Materials scientist, chemical engineer
Petroleum	Crude petroleum	Drilling	Oil refining: separation, conversion, treatment	Process engineer	Transportation, electricity, heating	Engineer, computer scientist
Platinum	Platinum ore	Blasting and ore crushing, flotation separation, drying, smelting	Refining: separation and purification	Material operator, smelter operator	Automobile exhaust systems, jewellery	Mechanical/ electrical/chemical engineer
Uranium	Uranium-bearing ores	Roasting then hydrometallurgy	Precipitation, refining, conversion to uranium metal, conversion to plutonium	Mechanical maintenance technician, dynamic test engineer	Nuclear power	Chemical/nuclear engineer

Source: Authors' compilation of in-demand occupations based on online job listings.

Southern Africa, particularly Botswana, has potential for skills development in diamond beneficiation

Southern Africa leads the world in the extraction of raw diamonds, while its beneficiation activity is limited. Five of the top ten raw diamond-producing countries are in Southern Africa,[1] and together they represent nearly two-thirds of the value of global production (Damarupurshad, 2023[25]). However, little of the far more lucrative and labour-intensive beneficiation activity, such as diamond cutting and polishing, occurs where the diamonds are extracted. For instance, 90% of the world's cut diamonds are cut and polished in Surat, India, due both to India's history as a former major producer of diamonds and to strong investments from the De Beers corporation (a British corporation with historical ties to South Africa that dominates the global diamond trade). India hosts a workforce of 800 000 highly skilled diamond technicians to serve the demands of a USD 21.3 billion diamond cutting and polishing industry (Polaris Market Research, 2023[26]; Mandal, 2016[27]).

In Botswana, the diamond beneficiation workforce has grown and increased its skill levels, driving up demand for skills development. Since the late 1990s, Botswana has advanced on its priority of creating a diamond hub in Gaborone. Opportunities for employing local semi-skilled labour were identified in the intermediate stages of processing (sorting, aggregation, cutting and polishing), as these stages require neither the substantial long-term capital investments necessary in mining, nor the network of retail outlets and commercial knowledge of the retail step of the value chain. Since 2008, the entirety of the diamonds extracted in Botswana has been sorted and valued in Gaborone in the world's largest sorting and valuing facility that employs 400 people. A Diamond Academy was put in place to train sorters and valuing staff. By 2013, 21 diamond cutting and polishing companies were established in Botswana, employing 3 500 people; with the number of companies reaching 50 in 2023 (Maramwidze, 2023[28]) Success factors of the Botswanan case include the government's strong relationship with De Beers as a global lead firm, government commitment to the sector, a strong focus on capacity building, and political and regulatory stability (Korinek, 2013[29]).[2] Yet, the question remains of whether employment growth in diamond cutting can continue. As the industry expands its use of lasers and computer-assisted cutting and design, it will reduce the labour intensity of the process (Gaywala, 2015[30]).

Zambia is set to exploit the value of cobalt mined in the Democratic Republic of the Congo

Southern African countries are beginning to exploit the strategic potential of cobalt as a vital mineral for electric vehicles (EVs). In 2023, the EV market accounted for 46% of the demand for cobalt in 2023, which was an increase of 22% over 2022. With the further growth of the global EV industry, cobalt demand is set to double by 2030 (Cobalt Institute, 2023[31]). Zambia is seeking to develop local cobalt activities. For instance, the Kobaloni Energy firm aims to build a cobalt sulphate refinery in the country, which will be Africa's first (Bloomberg News, 2023[32]). The refinery would be constructed near the world's eighth-largest cobalt mine, across Zambia's border in the Katanga region of the Democratic Republic of the Congo (DR Congo) (Mining Technology, 2023[33]).[3] With the gradual depletion of cobalt oxide deposits in DR Congo, and as a mineral used in battery manufacturing, cobalt sulphate will play a major role in sustaining the region.

Developing a competitive cobalt industry will require upgrading both technical and green skills. While the Kobaloni project promises a potential 1 000 jobs in Zambia, the jobs hinge on a workforce with advanced technical skills such as in chemical, mechanical and metallurgical engineering. In particular, pyrometallurgy, which uses high temperatures

to separate target metals from waste, is required for processing cobalt sulphides (OECD, 2019[34]) but is a notably polluting activity. There are rising concerns on the global cobalt market around environmental sustainability and safety in its value chains, which is driving further demand for green and health-related skills (Cobalt Institute, 2023[35]; Harvey et al., 2022[36]).

South Africa's and Zimbabwe's legacy in steel production could be revitalised through skilled workers

Due to international carbon pricing, South Africa is shifting towards greener steel production. South Africa's historically well-developed steel industry suffers from the increasing demand for green steel, notably from the European Union. This follows the introduction of the European Union carbon border adjustment mechanism, which will effectively raise taxes on the relatively carbon-intensive South African steel (Yermolenko, 2023[37]). In 2023, the country launched the South Africa Just Energy Transition Investment Plan to invest in both sustainable infrastructure and skills for the green transition. South Africa aims to invest in "green steel" (decarbonising steel production), which would increase green skill demand in the sector, as well as the need to upskill local workers (South Africa, 2022[38]).

While South Africa dominates Southern Africa's steel production, Zimbabwe seeks to regain its former status as a major steel producer. In the post-independence era, Zimbabwe's ZISCO Kwekwe District boasted the largest steelworks in Africa, which used iron ore and limestone from nearby mines to make steel for export to Asia and Europe (Mahove, 2016[39]). The factory stopped all operations in 2008, but in 2024, a new steel plant was built in Manhize by the Chinese-owned Dinson Iron and Steel Company. The plant aims to produce 5 million tonnes of iron and steel annually and employ 10 000 workers (Kutchner, 2024[40]). The new steel plant has already increased the demand for workers and skills in Zimbabwe. To build the plant, 1 500 on-site construction workers were hired (The Zimbabwean, 2023[41]). To enable the launch of its operations in 2024, the plant is recruiting technical staff to work on data capture and in laboratories (Kutchner, 2024[40]).

The green transition will create new demand for skills to use critical minerals in renewable energy, including solar panel manufacturing

Southern Africa has important resources of minerals that are critical for the green transition. These include copper, platinum, manganese, chromium, cobalt, graphite and nickel. By weight, copper is the critical mineral most used in offshore wind and solar photovoltaic panels and the second most used in onshore wind energy after zinc (IEA, 2021[42]). Platinum group metals are crucial for decarbonising the industry. Both manganese and chromium are used in renewable energy technologies. Graphite and nickel are key components in the production of batteries used in electric vehicles (Mo Ibrahim Foundation, 2022[43]). In addition, refining some of these ores within Southern Africa could be cost-competitive with the People's Republic of China (hereafter "China"). For example, according to a study, lithium carbonate in Namibia and manganese sulphate in South Africa should be cheaper to produce per ton than in China (SEforALL, 2023[44]). Due to the abundance of these minerals in Southern Africa, the region has potential for sustainable development by supporting renewable energies through the mining sector and can support the global transition to a greener and sustainable economy.

While the prices of certain critical materials have faltered in recent years, employment in renewable energy and demand for green skills have increased (World Bank Group 2024[24]). In South Africa, the prices of copper, zinc, natural graphite and nickel have dropped; however, between 2022 and 2023, direct employment in renewable energy

surged by 10% (IRENA/ILO, 2023[45]). Accordingly, the mining sector anticipates an uptick in demand for skills in green procurement (i.e. the purchasing of goods that minimises negative environmental impacts), environmental management and regulation, operations, and maintenance to support the transition towards a greener economy (ILO, 2018[46]).

> SolarAid, a charity devoted to rural electrification through solar energy, trains Zambians to become solar panel technicians and to repair old solar lights, extend their life cycles and reduce electronic waste. Currently, over 250 000 solar lights are installed in Zambia, but only 10% of their components can be reused (BMZ/GIZ/KfW, 2024[47]).

Southern African countries have yet to achieve their potential as manufacturers of solar panels. While China continues to dominate the global production of solar panels, South Africa has the capacity to manufacture them due to its high manufacturing added value, good infrastructure and competitive industrial base (SEforALL, 2023[44]). One existing manufacturer in the country is able to produce solar panels on a large scale (Oirere, 2023[48]). In February 2023, a second solar panel assembly plant opened in Cape Town, with an all-woman workforce and a focus on making smaller solar panels using aluminium purchased locally (Cape Business News, 2023[49]). Due to Southern Africa's slow uptake of solar panel manufacturing, the vast majority of the region's jobs in solar energy tend to be in deployment, rather than manufacturing, where significant efforts in skills development are needed (SolarPower Europe, 2023[50]).

Harmonised mining policies and better-targeted education and training can improve skills development for Southern Africa's mining sector

Policy interventions for skills development in the mining sector and related downstream activities cut across three levels. First, policy makers can more directly target mining strategies on skills development in downstream industries in value chains. Second, countries can use the complementarity of private and public sector-led skills development for inclusive creation of productive jobs in Southern Africa's mining sector and in sectors associated to mining. Finally, policies can extend mining-related education and training to under-represented groups, especially women.

National mining strategies can further emphasise downstream value chain potential, in alignment with existing regional frameworks

Southern African countries can more directly focus on developing industries downstream in mineral value chains. Countries in the region that depend on mining have established a number of mining policies and strategies, including on skills development (Table 3.3). However, with the exceptions of Botswana's and Namibia's diamond legislation and Zimbabwe's chromium ore export ban, most policies and strategies do not target skills development in specific mineral value chains. A more strategic focus on developing technical skills needed for occupations in the value chains (Table 3.2) could support the expansion of downstream industries.

Table 3.3. **Examples of mining sector policies and strategies in Southern Africa**

	Policy/strategy	Objective	Legal instruments	Envisioned impacts and implications
Botswana	Diamond beneficiation	To add value within the diamonds value chain within the country and create jobs	Diamond Cutting Act	Increases local employment but creates challenges due to global competition and market dynamics
	Skills development	To enhance the skills of the local workforce to support the mining and beneficiation sector	Specific programmes and required legal backing	Improves local expertise but requires continuous investment and alignment with industry needs
	Investment incentives	To attract companies and encourage them to process minerals locally	Incentives under the Botswana Investment and Trade Centre (BITC)	Potentially increases foreign investment but is dependent on global market trends
Namibia	Minerals Policy of Namibia	To ensure environmental sustainability, promote local beneficiation and attract investment	Minerals (Prospecting and Mining) Act, 1992	Encourages sustainable mining practices and local value addition
	Diamond Act, Precious Stones Act	To regulate the diamond industry and promote local processing	Diamond Act, 1999; Precious Stones Act, 1969	Supports the establishment of local diamond cutting and polishing industries
	Namibian Institute of Mining and Technology (NIMT)	To supply the mining sector with technically skilled workers	Not applicable	Enhances the technical skill set of workers in the mining industry
South Africa	Mineral and Petroleum Resources Development Act (MPRDA)	To ensure equitable access to mineral resources and promote economic growth and mineral resource development	MPRDA, 2002	Regulates exploration and exploitation of minerals, requires mining rights
	Mining Charter (2018)	To facilitate sustainable transformation, growth and development of the mining industry	Broad-Based Socio-Economic Empowerment Charter	Mandates equity stakes, community development, etc.
	Beneficiation strategy	To maximise the returns from mining through the value-added processing of raw materials	Policy documents from the Department of Mineral Resources	Encourages local processing, potentially creating jobs and boosting the economy
	Skills development programmes (Mining qualifications authority, Sector Education and Training Authority)	To provide necessary skills and knowledge for the workforce in the mining and minerals sector	Skills Development Act, 1998; Mine Health and Safety Act, 1996	Enhances safety and efficiency in mining operations, supports community development
Zambia	Zambia's mining policy	To ensure sustainable mining practices, attract foreign investment and enhance local value addition	Mines and Minerals Development Act, 2015, amended in 2022	Sets the legal and regulatory framework for mining activities, including licensing, taxation and environmental compliance
	Mineral Beneficiation Strategy	To boost economic growth through increased local processing of minerals, job creation and technology transfer	Policy documents from the Ministry of Mines and Minerals Development	Encourages the development of local processing industries but requires significant investment and infrastructure development
	Zambia Mining and Environmental Remediation and Improvement Project	To mitigate the impact of mining on the environment and public health, particularly in legacy mining areas	Support from the World Bank and other international partners	Addresses the long-term effects of mining on the environment and community health
	Skills development programmes in the mining sector	To develop a skilled workforce capable of supporting the mining industry, including in beneficiation processes	Collaborations with educational institutions, industry partnerships	Is critical for supporting local beneficiation and ensuring that the Zambian workforce can meet the industry's demands
	Zambia Extractive Industries Transparency Initiative	To promote openness and accountability in the mining sector, particularly in revenue management	Extractive Industries Transparency Initiative Standard, implemented in Zambia since 2009	Enhances investor confidence and public trust in the mining sector
Zimbabwe	Indigenization and Economic Empowerment Act	To increase local ownership and control over the mining sector	Indigenization and Economic Empowerment Act (2007-08)	Creates challenges in foreign investment, affecting capital inflow and technology transfer in the mining sector
	Zimbabwe Mining Development Corporation (ZMDC) training programme	To develop a skilled workforce for the mining industry	ZMDC Act	Improves local expertise but requires consistent funding and industry support
	Minerals Marketing Corporation of Zimbabwe (MMCZ)	To ensure fair trade and value addition in mineral exports	MMCZ Act	Helps stabilise market prices but needs to align with global market trends
	Chromium ore export ban	To promote local beneficiation and value addition	Government policy directives	Faces infrastructural and technological constraints

Source: Authors' compilation based on mining policy documents.

Policies and strategies to develop the mining sector, including its downstream activities, require sufficient legislative support and resourcing. Beyond formulating targeted policies and strategies, implementing them requires the government agencies concerned to have sufficient resources. In Malawi, for example, agencies suffer from inadequately skilled personnel, insufficient training facilities, and poor collaboration with training research institutions (Republic of Malawi, 2023[51]). In response, the country's Mines and Minerals Bill of 2023 introduced new measures to boost skills development and mandated medium- to large-scale mines to submit an employment and training plan, emphasising the participation of women. Although this encourages private sector investment in skills development, the government continues to directly allocate a limited budget for this purpose.

> In South Africa, the Mine Health and Safety Act 29 of 1996 and the Skills Development Act 97 of 1998 establish a comprehensive framework for targeted skills development initiatives. The Skills Development Act incorporates the National Skills Authority and Fund (a levy-grant scheme), Sector Education and Training Authorities (SETAs), labour centres, and the Skills Development Planning Unit.

Regional and international co-ordination on mining strategies and international partnerships have compensated for the absence of a global framework. In the absence of a comprehensive global framework for mining development, Southern African countries have sought to align their policies at continental and regional levels, namely through the Africa Mining Vision and the Protocol on Mining of the Southern African Development Community (SADC). At the global level, Southern Africa's leading mining countries, like Botswana and South Africa, have used their influence in international co-ordination through non-legal fora. In collaboration with development partners, global partnerships have strengthened mining sector governance in Southern African countries. For instance, DR Congo, Malawi, Mozambique and Zambia have joined the Extractive Industries Transparency Initiative (EITI), which supports accountability in the management of mineral resources by requiring the disclosure of information along mineral value chains (AFRODAD, 2023[52]).

> At the 2002 World Summit on Sustainable Development in Johannesburg, South Africa, alongside Canada, successfully advocated for the creation of a global platform aimed at enhancing the development of the mining sector. This initiative led to the formation of the Global Dialogue on Mining/Metals and Sustainable Development (IGF). Subsequently, member countries sought assistance from UNCTAD to establish a more structured, member-driven intergovernmental forum, resulting in the launch of the IGF in 2005 with 25 founding members. Upgrading the IGF's status within the UN's partnership framework could facilitate easier and more organised mobility of skilled workers, thereby reducing skill shortages.

Policy harmonisation under the SADC Protocol on Mining can more directly emphasise regional skills development. In 1997, SADC signed the Protocol on Mining, which entered into force in 2000. Article 4 of the protocol calls for member states to co-operate in upgrading the technological capacity of human resources and providing training facilities (SADC, 2006[53]). To operationalise the protocol, SADC and the Southern Africa Office of the United Nations Economic Commission for Africa developed a framework laid out in the publication *Harmonization of Mining Policies, Standards, Legislative and Regulatory Frameworks in Southern Africa*. The initiative harmonises mineral industrial policies, standards and legal frameworks in the region. In addition to its direct fiscal benefits, the framework seeks to enhance skills training in the mining sector. However, its implementation has been criticised as piecemeal, with only slow progress in mineral resource governance across Southern Africa (AFRODAD, 2023[52]).

Public and private education and training in technical mining skills are complementary in achieving inclusion and forward-thinking skills development

The private sector can be quick in creating a skilled workforce for industries downstream of mining. The example above of diamond cutting in Botswana showed that opening licensing to private mining companies, in collaboration with foreign multinationals, can quickly generate downstream industry activity. However, the example also demonstrated that, without specific government intervention, multinational enterprises can locate production sites anywhere in the world, depending on cost and scale efficiency. In addition, private companies may not be proactive in equipping local workers for technological change, such as the advent of lasers and automation in diamond cutting, and they may bring skilled workers in from abroad when local supply is missing.

Publicly-provided education and training in mining is needed to ensure inclusion and anticipate the upskilling of local workers. Public education and training programmes at tertiary and research institutions can be more easily aligned with a country's priorities for skills development as well as with those of the local population, while aiming to respond to market demand. Zimbabwe, for example, has targeted the development of skills for a critical set of mining-related occupations and has been encouraging the establishment of tertiary institutions with education and training that focus on mining (Table 3.4). Mining-specific public education and training, though perhaps insufficient to make a country a world leader in mining production, is essential for targeting the long-term upskilling of workers and offering talented informal workers, including women, opportunities to pursue specialised technical careers in mining.

Table 3.4. **Tertiary education and training institutions teaching technical mining skills in Zimbabwe**

Institution	Skill provision
Midlands State University, Bindura University of Science and Technology	Degrees in chemical and processing engineering, mining and mineral processing engineering, surveying and geomatics, metallurgy, and geoinformatics and geology
Kwekwe Polytechnic	Tailor-made courses for workers in artisanal and small-scale mining
Institute of Mining Research (partly funded by the government)	Advanced education, training and consultancy services, and research in mineral economics, mineralogy and metallurgy
Zimbabwe School of Mines (a regional school which serves the SADC mining industry)	Technical education, practical training and in-house training for mining personnel
Zimbabwe Diamond Education College (established in 2010 following the discovery of diamond deposits)	Skills to add value to the diamond industry

Source: Zimbabwe Policy Research Unit (2015[54]), "In-depth training needs assessment surveying the Zimbabwe mining sector", https://zepari.co.zw/sites/default/files/2018-03/Policy%20Brief%20in%20depth%20training%20needs%20assessment%20survey%20policy%20brief%20new.pdf.

Mining qualifications authorities (MQAs) can promote training led by the private sector, as is the case in South Africa. MQAs are responsible for the administration and development of mining sector training programmes. For instance, mining companies in South Africa are mandated to pay 1% and 5% of their payrolls as a skills development levy to the MQA and the Mining Charter, respectively. They are also obliged to submit skills development plans and annual training reports to the MQA. Between 2016 and 2020, South African mining companies invested more than USD 360 million per year in developing skills for the country's mining sector (Mineral Council South Africa, 2022[55]).

Entrepreneurship training, school infrastructure near mines and work-integrated training can increase foundational and transversal soft skills for miners. Working in mining, especially for people who start at a young age, can disrupt education and reduce educational outcomes. It is therefore important to provide miners with foundational and

soft skills that are relevant in other sectors and can improve their economic prospects. Entrepreneurship training for workers in artisanal and small-scale mining can be an essential tool to do so (Mkubukeli and Tengeh, 2016[56]). Constructing schooling infrastructure where miners can access it, such as at mine sites, can also help. The company Royal Bafokeng Platinum was obliged under the South African Mining Charter to build an elementary school near its mines (Government Gazette, 2018[57]; Basic Education, 2024[58]). Work-integrated learning, where engineering students spend time in mining companies while working on individual projects, is another effective way to obtain soft skills (Dipitso, 2023[22]).

Education and training can more directly focus on under-represented groups of mining workers, especially women and artisanal miners

Programmes in science, technology, engineering and mathematics (STEM) targeting women can be expanded to ensure women and men graduate from universities not only in similar numbers but with comparable technical skills. Increasing female participation in STEM education is a key means of attaining greater gender parity in management and technical positions in the mining sector, such as engineers, managers, overseers and engine drivers (Cooper, Goliath and Perkins, 2022[59]). In Zimbabwe, the share of females graduating from STEM-focused institutions is lower than the share graduating in humanities (ARUD-CIASA, 2024[60]). Introducing mining-related programmes (e.g. electronic, mining and chemical engineering and renewable energy-related sciences) at women's universities could help women acquire mining skills. One possible university is the Women's University in Africa, created in Zimbabwe to directly tackle the problem of women's restricted access to university education. Policy makers can also contribute by encouraging mining companies to invest in scholarships, vocational training and entrepreneurship support for women.

> In Botswana, the Debswana Diamond Company launched the Mining Suppliers Development Programme in 2020. By improving mining value chain skills such as sales operations and financial management, the programme seeks to develop the capacity and competitiveness of women-owned companies to improve their access to markets and ensure sustainable enterprises (MmegiOnline, 2020[61]).
>
> In South Africa, the Sasol Women in Mining Incubator Programme focuses on promoting women-owned mining businesses through leadership development, intensive entrepreneurial support, financial coaching, and idea and business incubation (WomHub, 2023[62]).

Education and training curricula, national policies and qualifications frameworks can be better tailored towards artisanal and small-scale mining (ASM). According to estimates by DELVE (2024[63]), most mining sector workers in Southern Africa are informal, but the majority of training programmes focus on formal jobs in mining or in public service. Most national mining policies in the region recognise the importance of skills development for ASM; however, only a few have well-defined policy frameworks covering ASM. The Zimbabwe School of Mines (ZSM), provides ASM courses, but Zimbabwe does not provide mining qualifications authorities (MQA) similar to those in South Africa. Government qualification authorities, like South Africa's MQA, can help develop education curricula for both formal and non-formal basic education, as well as formal technical vocational education and training in mining. In addition, governments can provide pools of professionals to offer technical assistance to small-scale mining operations that do not have the scale to be able to hire professional help on their own. South Africa has a Small-Scale Mining Division that assists ASM miners with applying for mining licences, for example, in identifying mineral deposits (Jansen, 2017[64]).

Notes

1. In terms of 2022 production: Botswana (USD 5.0 billion), Angola (USD 2.0 billion), South Africa (USD 1.5 billion), Namibia (USD 1.2 billion) and Zimbabwe (USD 0.4 billion) out of a global production of USD 16.3 billion.
2. Specificities of Botswana – e.g. the monopolistic structure of the diamond sector, the market size and quality of diamonds, and the country's historical, political and demographic characteristics – make it difficult to draw lessons for peer countries.
3. See Chapter 4 for further discussion of DR Congo's critical minerals.

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Chapter 4

Skills for mining in Central Africa

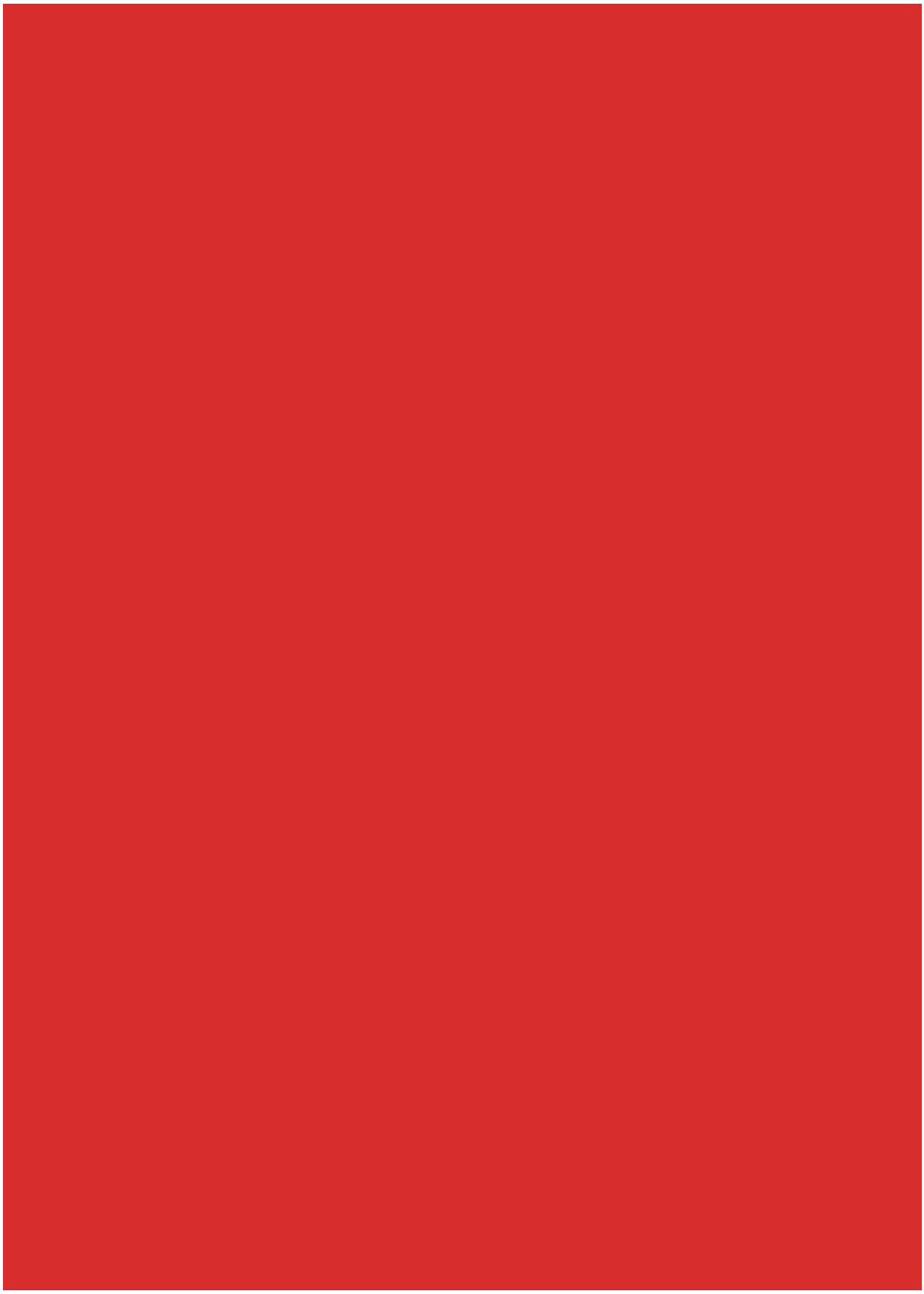
This chapter examines the skills needed to support the development of the mining sector in the nine Central African countries: Burundi, Cameroon, Central African Republic, Chad, Republic of the Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, and São Tomé and Príncipe. It begins by taking stock of levels of education, employment and skills development in the region, before presenting a case study on the skills required in the mining sector to allow Central Africa to take full advantage of the rising global demand for critical minerals. It assesses the skill sets of workers undertaking different types of mining operations, and then analyses how the types of skills needed are changing. Finally, this chapter proposes a range of public policies to ensure the supply of skills better aligns with the demand for skills in the mining and related sectors.

IN BRIEF

Central Africa is experiencing a skills shortage, a situation that contributes to the high proportion of vulnerable (74%) and low-skilled jobs. A mismatch between level of education and employment has also been observed. In 2020, only 18% of young people had completed secondary school, and of these, less than 10% had chosen to undertake technical or vocational education and training (TVET). Furthermore, the quality of learning could be improved: the average learning-adjusted years of schooling stands at 4.5 years, compared with 5.1 years for the rest of Africa.

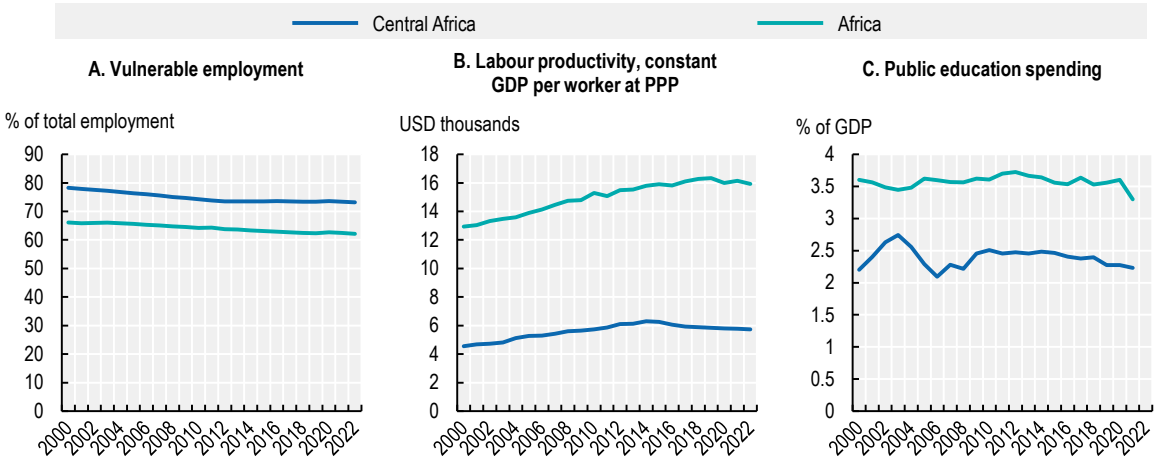
The region boasts large reserves of strategic minerals that could be harnessed to meet growing global demand. It accounts for almost 70% of the world's cobalt production, 30% of tantalum production and 20% of manganese production. The lack of skilled workers, infrastructure and effective governance is holding back local mineral processing and job creation. Skills development would help the region integrate into value chains. It would also make it possible to train the workforce on new technologies and facilitate adaptation to climate-change-associated risks.

To better align skills with jobs, policy makers will need to focus on four priority measures: 1) implementing national and regional strategies based on reliable data to anticipate demand; 2) stimulating public–private co-operation to improve TVET; 3) developing training programmes for artisanal and small-scale mining (ASM) workers; 4) strengthening governance for better resource allocation.



Central Africa regional profile

Figure 4.1. **Vulnerable employment, labour productivity and education spending in Central Africa, 2000–2022**



Note: Vulnerable employment includes formal and informal self-employed (own-account) workers and contributing family members but excludes informal salaried employees. As an approximation of informal employment, it is used here to show long-term trends, as time series data on informal employment is missing for most African countries. Labour productivity is measured as the constant gross domestic product (GDP) in 2017 international USD at purchasing power parity (PPP) prices, divided by the population of employed people in thousands.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org; World Bank (2023[2]), *World Development Indicators* (database), https://databank.worldbank.org/source/world-development-indicators; and IMF (2023[3]), *World Economic Outlook* (database), https://www.imf.org/en/Publications/WEO.

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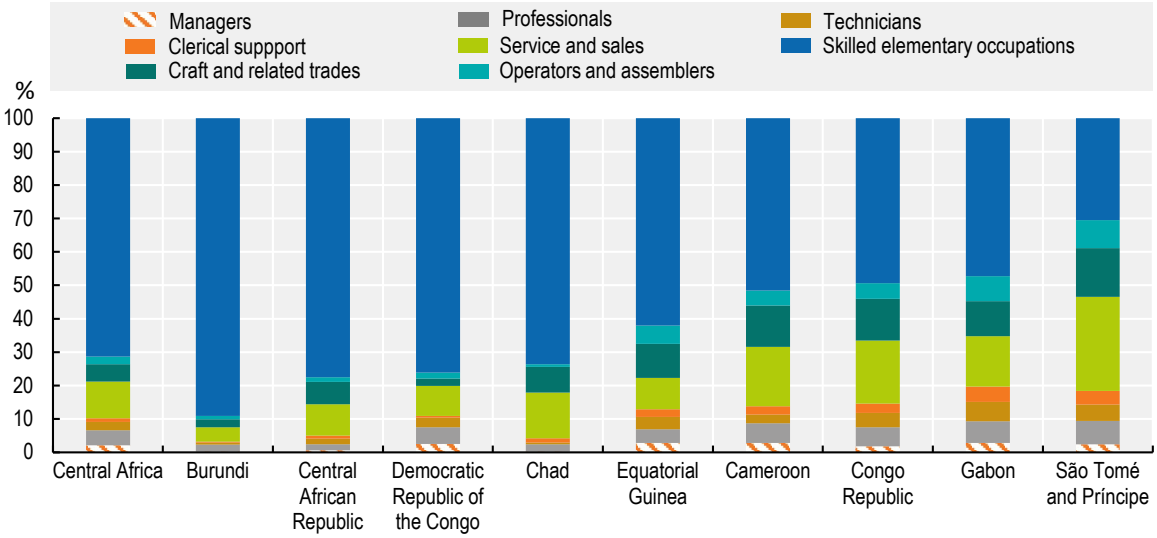
Figure 4.2. **Breakdown of working population by type of occupation in Central Africa, 2021**



Note: "Technicians" include associate professionals; "Skilled elementary occupations" include skilled agricultural, forestry and fishery workers, and elementary occupations; and "Operators and assemblers" include plant and machine operators and assemblers.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org/.

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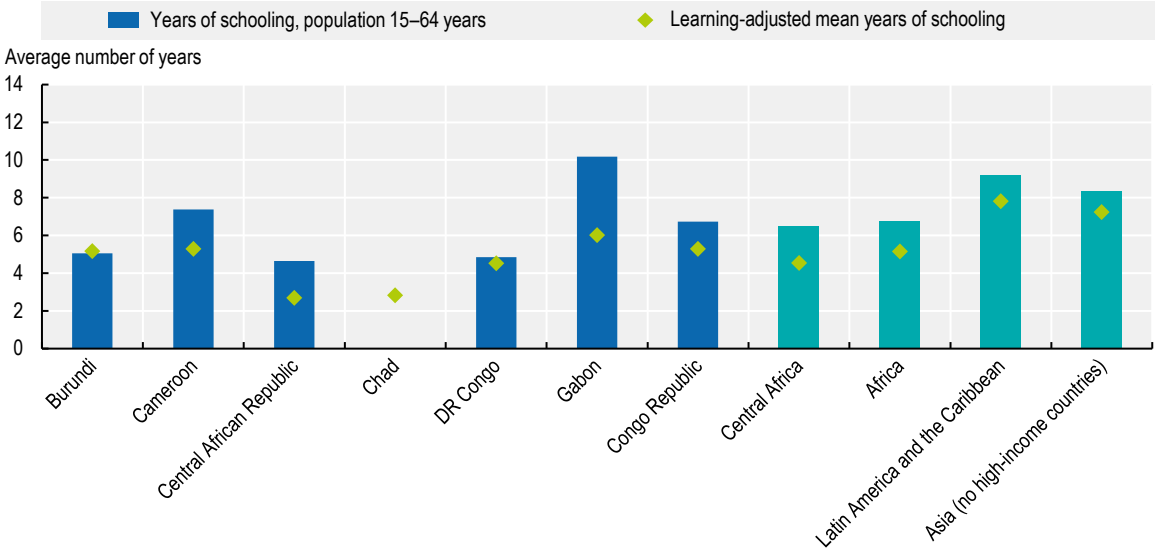
Central African countries are facing a major skills shortage, which has resulted in a preponderance of low-skilled jobs and widespread informality

The level and quality of education are generally lower in Central Africa than in other regions of the continent. The average years of schooling is 6.4 years across Central Africa; higher than West Africa (5.5 years), but lower than the rest of the continent (6.7 years). However, when the average number of years of schooling is adjusted to account for the quality of learning, this average falls to 4.5 years in Central Africa, compared with 5.1 years for the continent as a whole. This figure ranges from 6 years in Gabon to 2.6 years in the Central African Republic (Figure 4.3). By 2020, the number of young people who had completed secondary or higher education had risen to 18%, compared with 9% in 2000 (AUC/OECD, 2021[4]). Moreover, on average, only 8% of secondary school students are enrolled in vocational training programmes, ranging from 19% in the Democratic Republic of the Congo (hereafter "DR Congo") and Cameroon to less than 2% in Chad and the Republic of the Congo (UNESCO Institute for Statistics, 2023[5]). Differences between genders and between rural and urban areas contribute to gaps in basic skills (Figure 4.4).

Figure 4.3. **Average years of schooling and learning-adjusted years of schooling, 2020**



Note: Learning-adjusted years of schooling merge the quantity and quality of education into one metric, reflecting that similar durations of schooling can yield different learning outcomes. See Filmer et al. (2020[6]) for a detailed methodology.
Source: Authors' calculations based on World Bank (2023[7]), *Education Statistics* (database), https://databank.worldbank.org/source/education-statistics-%5E-all-indicators.

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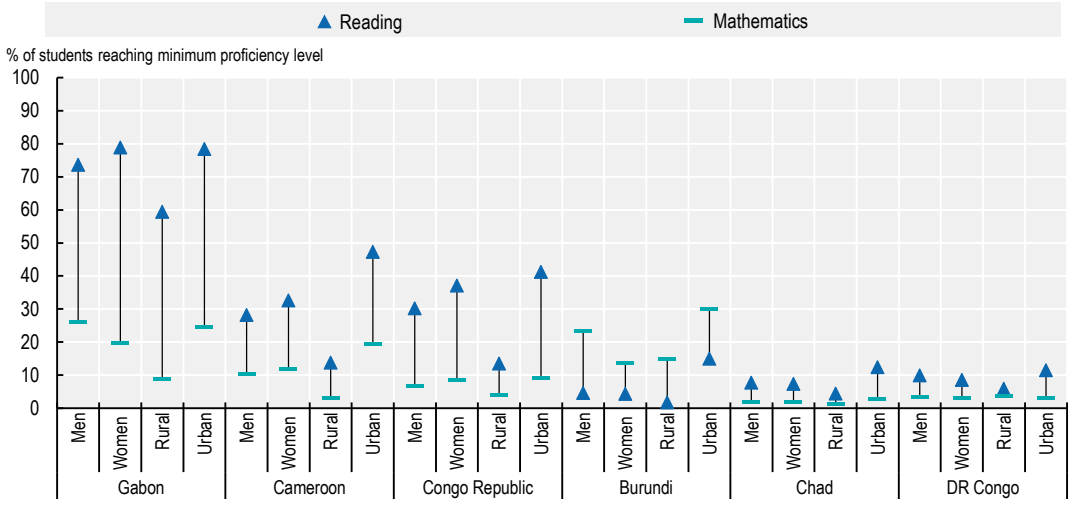
Figure 4.4. **Percentage of adolescents in lower secondary school achieving proficiency in reading and mathematics, most recent year observed (2013-22)**



Source: Authors' calculations based on UNESCO (2023[8]), *World Inequality Database on Education* (database), https://www.education-inequalities.org/.

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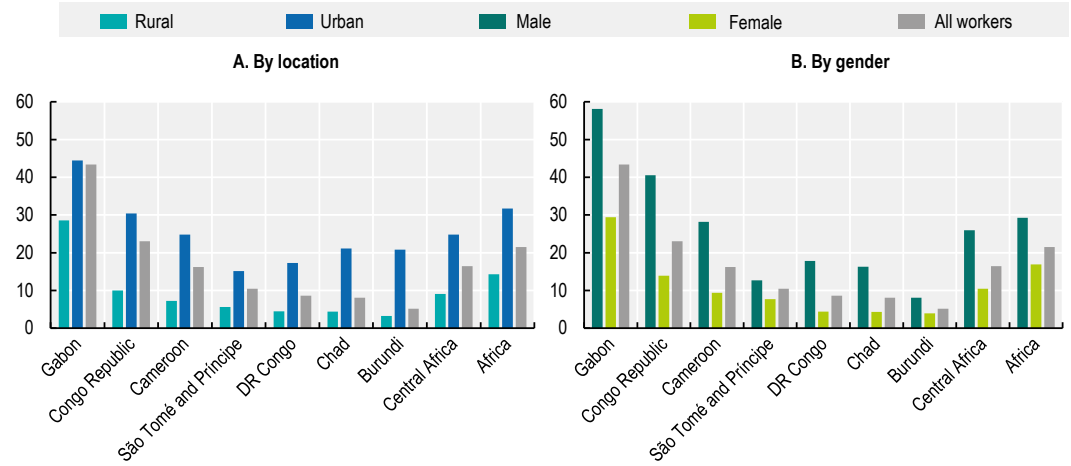
Most jobs in the region remain low-skilled and informal. Jobs in agriculture, forestry and fishing accounted for more than half (57%) of all jobs in Central Africa in 2021 (compared with 74% in the early 2000s). The share of jobs in retail and wholesale, meanwhile, rose considerably, from 9% to 20% over the same period. In 2021, 74% of workers were in vulnerable employment (self-employed or unpaid family workers), and almost 95% were in the informal sector. The share of skilled workers ranges from an average of 43% in Gabon to less than 10% in the DR Congo and Chad. The majority of women workers and rural workers are employed as unskilled workers (Figure 4.5). Labour productivity remains low (around USD 5 700 per worker in 2022) and below the level in other African regions (USD 16 000 on average).

Figure 4.5. **Percentage of workers in skilled occupations, by gender and place of residence, 2019 or latest year available**



Note: Data are drawn from nationally representative demographic and health surveys (DHS) collected between 2010 and 2019. Occupational categories were divided into skilled and unskilled occupations as follows: skilled occupations include professional, technical, managerial, clerical and skilled manual work; unskilled occupations include sales, agriculture, household and domestic work, services and unskilled manual labour.

Source: Authors' calculations based on United States Agency for International Development (USAID)/DHS (2023[9]), *Demographic and Health Surveys (DHS) Program* (database), https://dhsprogram.com/.

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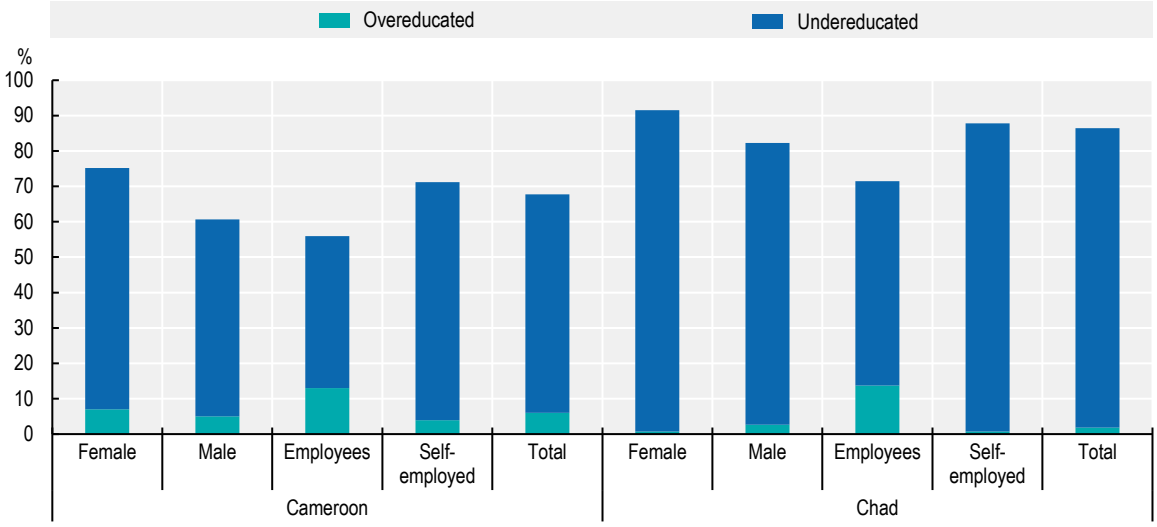
Despite the dominance of low-skilled jobs, the majority of workers do not have the required level of education for their occupation. In Cameroon 61% of workers and in Chad 84% of workers are employed in jobs for which they are underqualified (Figure 4.6). Women and self-employed workers are more likely to be underqualified for their job. A small proportion (around 13%) of salaried workers have a higher level of education than required for their occupation. This finding is echoed in other surveys: in the Republic of the Congo, 49% of young people do not have the required level of education and 24% consider themselves underqualified for their current occupation (Morsy and Mukasa, 2019[10]).

Figure 4.6. **Percentage of workers who have a higher or lower level of education than required for their occupation, 2022 or latest year available**



Note: Mismatches are assessed using the normative approach, by comparing the educational requirements for each occupational group set out in the International Standard Classification of Occupations (ISCO) with the educational level of each person with that occupation. Calculations are based on data available from national labour force statistics or other representative household surveys with an employment component.

Source: Compiled by the authors based on ILOSTAT (2023[1]), *ILO Modelled Estimates*, (database), https://ilostat.ilo.org/.

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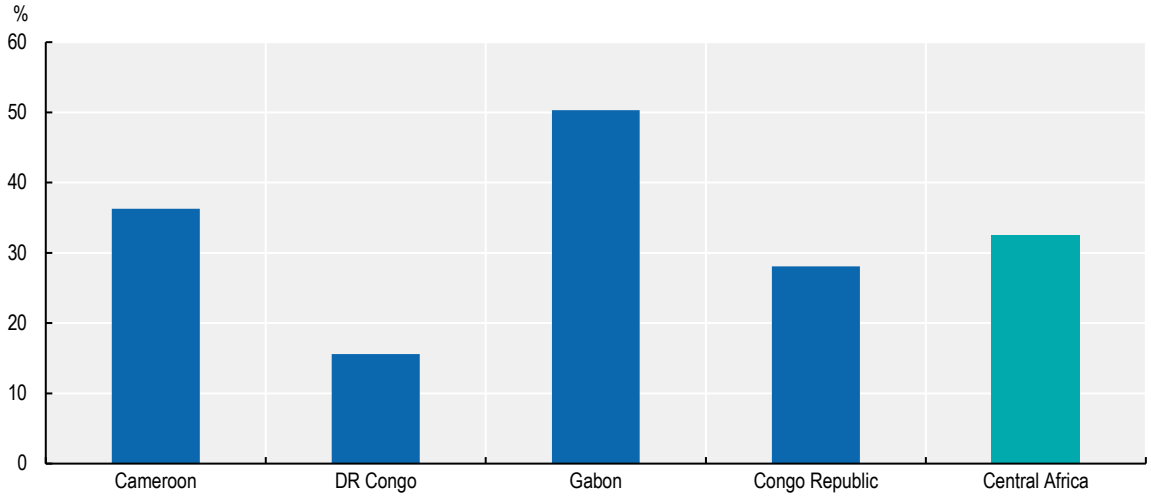
New skills and knowledge, which could help transform the economic sector, are distributed unequally. This includes digital skills: in Gabon, for example, over 50% of respondents are able to use a mobile bank account without the help of a third party, compared with 15% in the DR Congo (Figure 4.7). Similarly, around 60% of respondents in Cameroon, Gabon, the Republic of the Congo, and São Tomé and Príncipe had heard of climate change, yet this figure drops to 17% among those with no education. Awareness of climate change also differs between people who live in rural areas (49%) and those who live in urban areas (66%) (Afrobarometer, 2023[11]).

Figure 4.7. **Percentage of respondents able to use a mobile bank account without the help of a third party**



Source: Demirgüç-Kunt et al. (2021[12]), *The Global Findex Database* (database), https://www.worldbank.org/en/publication/globalfindex.

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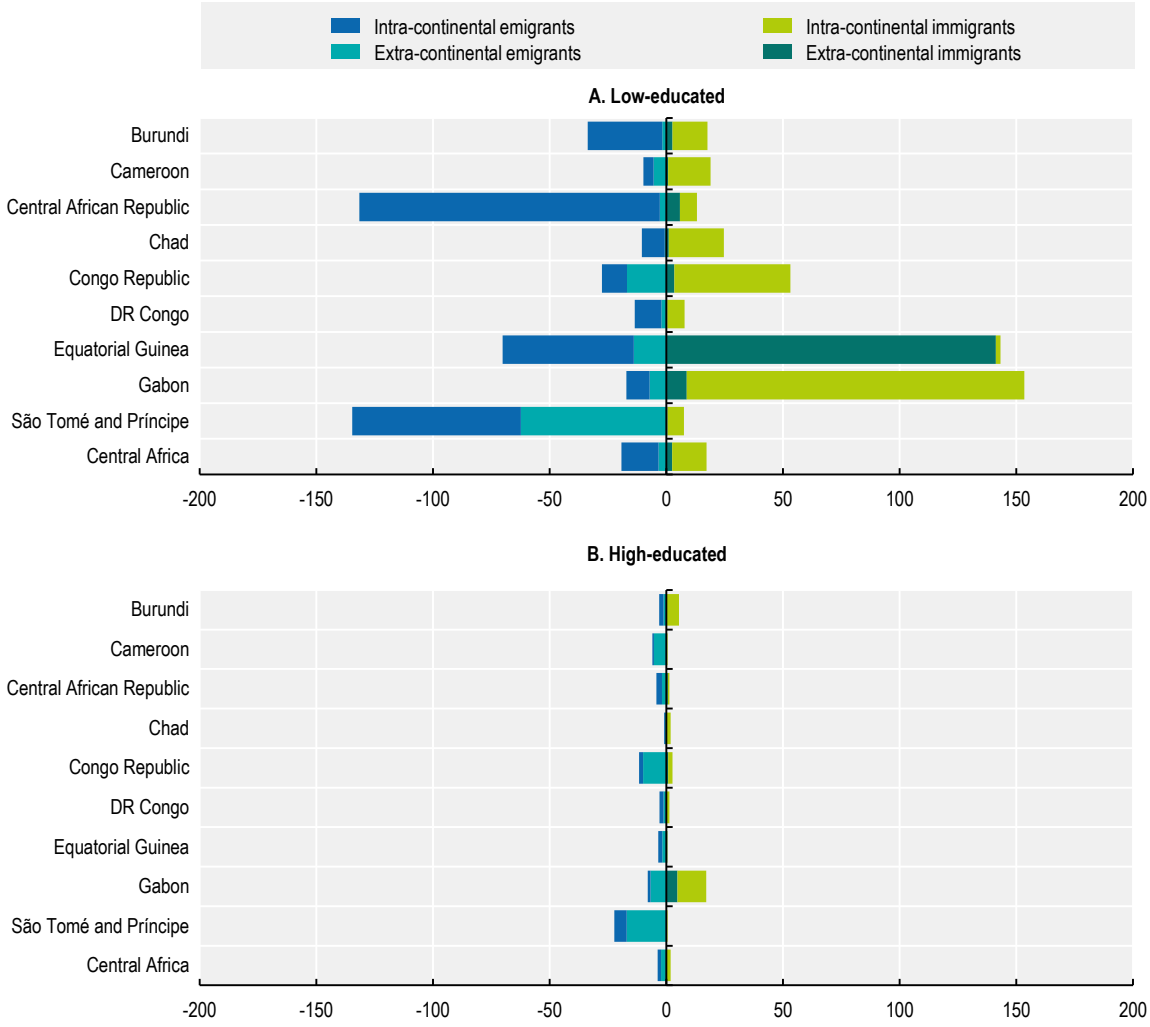
Central African countries struggle to retain highly skilled migrants, who often leave Africa, while less-skilled migrants remain in Central Africa or on the continent. In 2020, 45% of Central Africans with secondary or lower education ("poorly educated") lived in another African region, compared with 38% in another Central African country and 17% on another continent. Among those with higher education ("highly educated"), 61% lived on other continents, 24% in another African region and only 15% in another Central African country (World Bank, 2023[13]). Gabon, Equatorial Guinea and the Republic of the Congo attract poorly educated migrants, mainly to exploit their natural resources. Only Gabon attracts a higher share of skilled migrants, most of whom come from the rest of the continent (Figure 4.8).

Figure 4.8. **Migrants by level of education, origin and destination, 2020**



Note: Migrants per 1 000 inhabitants. Negative numbers show emigration. "Low-educated" refers to individuals with secondary or lower education. "High-educated" refers to those with tertiary or higher education.

Source: World Bank (2023[13]), *Global Bilateral Migration* (database), https://databank.worldbank.org/source/global-bilateral-migration.

StatLink https://stat.link/uoi9sd

The region has significant mineral wealth to supply global demand, but little of the material extracted is processed locally due to a lack of skills and infrastructure

Critical minerals are a strategic resource for the development of Central Africa

Against a backdrop of growing global demand, Central Africa has significant strategic mining resources. Its mineral deposits, among the largest and most diverse in the world, are a strategic resource for many industries. The DR Congo holds the majority (47%) of the region's proven mineral reserves, followed by Gabon (17%), the Central African Republic (11%) and Cameroon (9%) (Romel Touka, 2015[14]). According to official statistics, 55 different minerals are present in the DR Congo's subsoil, but only 12 are actually mined. Central Africa ranks among the world's leading producers of cobalt, tantalum, copper and manganese, all of which have been identified as critical minerals for the energy transition (Table 4.1; Box 4.1).

Table 4.1. **Minerals extracted in Central Africa**

Country	Minerals and extractive-sector products extracted in 2021 (percentage of world production/world ranking)	
Burundi	• Tungsten (<1%, 11/20) • Gold (<1%, 73/97) • Tantalum (<1%, 12/14)	• Niobium (<1%, 10 /11) • Rare earth (<1%, 9/10) • Tin (<1%, 20/22)
Cameroon	• Oil (<1%, 49/101) • Natural gas (<1%, 59/94) • Gold (<1%, 73/97)	• Diamond (industrial) (<1%, 16/17) • Aluminium (<1%, 40/41)
Central African Republic	• Diamonds (gemstone) (<1%, 12/19) • Gold (<1%, 74/97)	• Diamond (industrial) (<1%, 13/17)
Chad	• Oil (<1%, 42/101)	
Equatorial Guinea	• Oil (<1%, 40/101)	• Natural gas (<1%, 45/94)
Gabon	• Manganese (20%, 2/32) • Oil (<1%, 33/101)	• Natural gas (<1%, 69/94) • Gold (<1%, 86/97)
DR Congo	• Cobalt (69%, 1/18) • Copper (9%, 3/57) • Tantalum (29%, 1/14) • Diamond (industrial) (24%, 2/18) • Diamond (gemstone) (2.5%, 6/19) • Tin (<1%, 6/22) • Gold (<1%, 27/97)	• Oil (<1%, 63/101) • Tungsten (<1%, 13/20) • Zinc (<1%, 37/53) • Silver (<1%, 54/69) • Manganese (<1%, 31/32) • Niobium (<1%, 4/11)
Republic of the Congo	• Oil (<1%, 31/101) • Natural gas (<1%, 65/94) • Copper (<1%, 42/57) • Gold (<1%, 88/97)	• Zinc (<1%, 49/53) • Iron (<1%, 53/53) • Diamond (industrial) (<1%, 15/17)

Note: Data not available for São Tomé and Príncipe.

Source: (Reichl and Schatz[15]), *World Mining Data 2023*, https://www.world-mining-data.info/wmd/downloads/PDF/WMD2023.pdf.

Box 4.1. **Change in global demand for critical minerals, and implications for Central Africa**

The energy and digital transitions are having a significant impact on demand for minerals. These transitions have led to a rise in demand for "critical" minerals, i.e. those needed to produce technologies such as digital equipment, electric cars, solar panels, wind turbines and other low-carbon power-generation systems. While the International Energy Agency (IEA) lists 33 critical minerals,[1] there is no universally agreed definition, given that every country or organisation has different strategic priorities (Hendriwardani and Ramdoo, 2022[16]). Projections based on international commitments to carbon neutrality suggest that by 2040, demand will rise more than three-fold for cobalt (+221%), 2.5-fold for copper (+185%), two-fold for zinc (+110%), seven-fold for manganese (+609%) and eight-fold for tantalum (+700%) (IEA, 2023[17]).

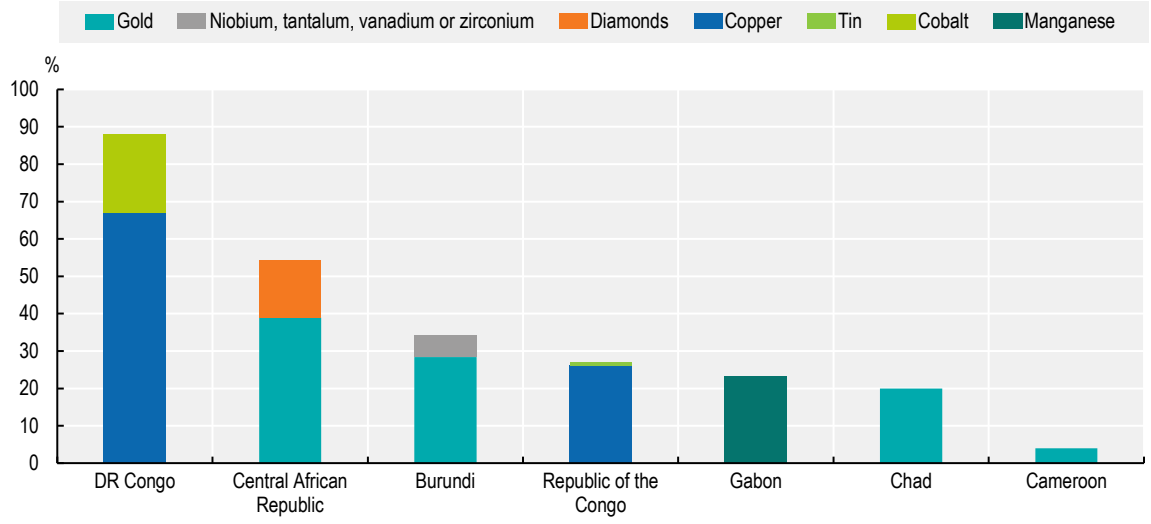
Given its significant deposits of critical minerals (Table 4.1), Central Africa intends to take advantage of these opportunities (Bazilian, 2023[18]), but is struggling to develop a local mineral processing industry, mainly due to a lack of skills and infrastructure, and weak governance (ECA, 2011[19]). Since 2022, the African Union – in partnership with the African Development Bank (AfDB) and several United Nations agencies – has been working on the African Green Minerals Strategy. This strategy aims to complement existing mining development policies by encouraging the strategic exploitation of critical minerals – including 14 priority minerals[2] – based on four pillars:

Box 4.1. **Change in global demand for critical minerals, and implications for Central Africa *(continued)***

1. Advancing mineral development (conducting feasibility studies and implementing infrastructure).
2. Developing human capital and technological capacity by identifying the skills needed to integrate into value chains (mining, processing and manufacturing new technologies).
3. Building regional value chains to advance natural resource-based industrialisation and access to larger markets through the African Continental Free Trade Area (AfCFTA).
4. Promoting mineral stewardship (AfDB, 2022[20]).

The mining sector accounts for a significant share of the region's revenues and exports, and is an integral part of national job creation strategies. Mining revenue accounts for 9.4% of Central Africa's GDP, compared with just 2% for Africa as a whole. The DR Congo makes the largest contribution to the region's total revenue, accounting for around 29% of GDP. Copper and cobalt account for almost 90% of the country's exports. Similarly, minerals account for over 50% of exports from the Central African Republic and at least 30% from Burundi (Figure 4.9). Mining operations are less labour-intensive, but more capital-intensive, than other sectors. In 2017–2021, job creation linked to investment in the extractive sector stood at 1.3 jobs per USD million invested, compared with 3.8 jobs created per USD million invested in manufacturing (AUC/OECD, 2023[21]). However, indirect employment, particularly in artisanal and small-scale mining (ASM), is between three and six times greater than direct employment and represents a strategic challenge for the region (Östensson and Roe, 2017[22]).

Figure 4.9. **Minerals as a share of total exports from Central African countries, 2022**



Source: CEPII (2024[23]), *BACI: International Trade Database at the Product-level* (database), www.cepii.fr/cepii/fr/bdd_modele/presentation.asp?id=37.

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Most critical mineral production, however, is exported and not processed locally. At the global level, the People's Republic of China (hereafter "China") dominates mineral processing, refining 73% of cobalt, 40% of copper, 59% of lithium, 67% of nickel and 95% of rare earth minerals (IEA, 2021[24]). The lack of infrastructure and governance, as well as the high cost of skilled labour and services, have hampered the development of mineral processing in Central Africa. To illustrate: despite being the world's leading producer of cobalt, the DR Congo ranks seventh among cobalt-refining countries and accounts for just 1% of global supply, after Madagascar (2%) and ahead of Morocco (1%) (Bazilian, 2023[18]). Similarly, Gabon, the world's second-largest producer of raw manganese, has only been processing the ore since 2015 thanks to the creation of the Moanda Metallurgical Complex (Fliess, Idsardi and Rossouw, 2017[25]).

The Africa Mining Vision and the African Green Minerals Strategy each propose a roadmap for better integration into value chains. The African Union's Africa Mining Vision, published in 2009, provides a framework for the strategic use of minerals to improve: i) the collection of high-quality geological data ii) the quality of contract negotiations iii) the governance of the sector iv) the management of the financial resources generated; v) infrastructure and vi) the development of ASM. This framework stresses the importance of human capital development and skills acquisition (Box 4.2), but its implementation has been slow and too few stakeholders are aware of its existence. The implementation of the African Green Minerals Strategy since 2022 has injected new political momentum into efforts to harness the growing demand for critical minerals for regional industrialisation (Box 4.1).

Box 4.2. **Skills development under the 2009 Africa Mining Vision**

The Africa Mining Vision is a collaboration between the United Nations Economic Commission for Africa (UNECA), the African Development Bank (AfDB), the African Union, the United Nations Conference on Trade and Development (UNCTAD) and the United Nations Industrial Development Organization (UNIDO). It seeks to harness mining resources for industrialisation.

In terms of skills, the Africa Mining Vision aims to:

1. Nurture human resource development through supporting skills acquisition, facilitating research and development, and building knowledge networks between academia, the private sector, governments and other stakeholders.
2. Facilitate the transfer of technology and skills from multinational to national companies.
3. Create training centres of excellence and better align certifications and standards.
4. Mobilise financing from pan-African banks to train engineers and technicians specialised in mineral exploration, mining, processing and trading.

Source: African Union (2009[26]), *Africa Mining Vision*, https://au.int/sites/default/files/documents/30995-doc-africa_mining_vision_english_1.pdf.

The skills shortage contributes to weak local recruitment by foreign investors

The development of the mining industry is mainly driven by the influx of foreign investment. Mining production is mainly controlled by multinationals,[3] a trend encouraged by the pro-investment policies introduced in the 1980s and 1990s (Radley, 2023[27]). In the DR Congo, foreign direct investment (FDI) flows have mainly targeted mining, with

a 17-fold increase between 2002 and 2012, from USD 188 million to USD 3.3 billion. However, it is not uncommon for national companies (Table 4.2) to have a stake in the subsidiaries of foreign mining companies, enabling them to collect dividends from the profits generated. In Gabon, Société Équatoriale des Mines has a 40% stake in Compagnie Minière de l'Ogooué (COMILOG), the country's top manganese producer. Similarly, in the DR Congo, the state holds the Kamoa-Kakula Copper Complex jointly with two foreign companies: Ivanhoe Mines (Canada) and Zijin Mining (China) (Wagner, 2023[28]).

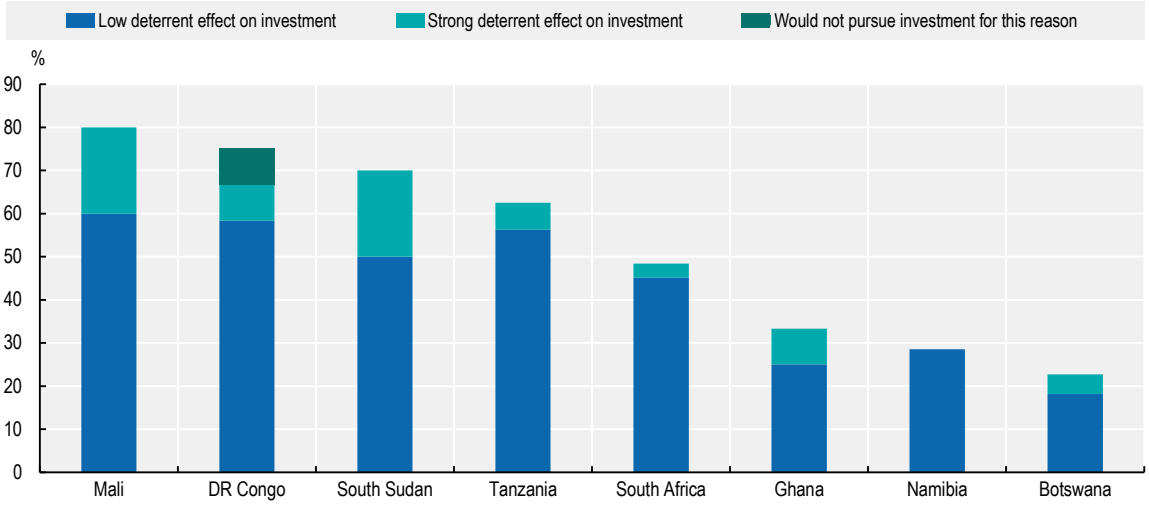
Table 4.2. **National public mining companies in Central Africa**

Country	Mining company	Date created
Burundi	OBM	2016
Cameroon	SONAMINE	2020
Central African Republic	ORGEM	2009
Chad	Société Nationale des Mines et de la Géologie (SONAMIG)	2018
DR Congo	GECAMINES	1967
Equatorial Guinea	Sociedad Nacional de Minas y Canteras (SMC)	2023
Gabon	Société Équatoriale des Mines (SEM)	2011
Republic of the Congo	Directorate General of Mines and Geology	2005

Note: São Tomé and Príncipe has no state-owned mining companies.
Source: Compiled by the authors.

The prevalence of low-skilled workers in the sector is holding back investment and local recruitment. Some investors are put off by the lack of qualifications among the local labour force. This may drive them to recruit foreign workers. Nearly 75% of investors surveyed cite the lack of locally available skills as a barrier to investment in the DR Congo (Figure 4.10). In Cameroon, the evidence shows that the lack of local skills has pushed Chinese companies in the gold-mining sector to employ workers from China, while the majority of local staff are employed as drivers, excavator operators, guards and, occasionally, geological technicians. Consequently, although mining investment has increased employment opportunities for local people, these opportunities are limited to jobs with less responsibility and lower pay than those entrusted to foreign workers (Weng et al., 2015[29]).

Figure 4.10. **Share of mining companies citing lack of skills as a barrier to investment, 2022**



Source: Mejía and Aliakbari (2023[30]).

StatLink https://stat.link/fcxzgd

To make their workforce more employable, governments in the region are increasingly emphasising the local content of mining operations. To increase opportunities for local capacity building, the majority of Central African governments have recently amended their local content policies (local sourcing requirements for foreign investors in terms of goods and services, personnel, financing, etc.) through their mining code reforms. Local content policies now impose local recruitment and subcontracting quotas and obligations related to training and skills development (AMLA, 2024[31]). In the DR Congo, for example, the 2018 mining code introduced local recruitment requirements (Table 4.3). Foreign investors must organise training to enable workers to acquire the skills needed to hold managerial and executive positions within ten years of starting commercial production (IGF, 2021[32]). However, certain requirements that set specific levels (e.g. recruitment quotas not supported by appropriate training policies, or local sourcing obligations) can introduce distortions that deter investors (Korinek and Ramdoo, 2017[33]; OECD, 2016[34]).

Table 4.3. **DR Congo employee quota by job category (2018 Mining Code)**

	Project phase		
Job category	**Exploration**	**Development and construction**	**Trading**
Managers	20%	25%	60–70%
Senior managers	30%	35%	70–80%
Skilled workers	60%	40%	80–90%
Manual workers	80%	85%	90–100%

Source: IGF (2021[32]), *Impact of New Mining Technologies on Local Procurement in the Democratic Republic of the Congo*, International Institute for Sustainable Development, https://www.iisd.org/system/files/2021-12/impact-new-mining-technologies-democratic-republic-congo-en.pdf.

The prevalence of artisanal and small-scale mining (ASM), the main source of employment in the sector, represents a major challenge for skills development

Most jobs in the mining sector are in ASM, which is often informal. On a global scale, ASM employs the majority of the mining industry's workforce (around 25% of tin, tantalum and diamond production; 80% of sapphire production). More than 2.6 million people are employed in ASM in Central Africa, including: 2 million in the DR Congo; 310 000 in Chad; 200 000 in the Central African Republic; 44 000 in Cameroon; 34 000 in Burundi; 15 000 in Equatorial Guinea; and 10 000 in Gabon (DELVE, 2024[35]). In the DR Congo, artisanal miners produce around 13% to 20% of the world's cobalt supply (OECD, 2019[36]). On average, 80% to 90% of artisanal and small-scale miners worldwide work informally. As a result, this sector is associated with many social risks (Box 4.3).

Box 4.3. **Difficulties faced by ASM workers**

Workers' pay is generally low and also differs by gender. While a male miner earns an average equivalent to USD 15.38 per week, women's earnings are more difficult to assess. Ore washing, for example, provides them with a share of pre-washing production, which is estimated at between 0.5 and 4 pans, depending on the workload.

Artisanal workers face a number of health and safety risks, including:

- Landslides due to unstable excavations.
- Serious injuries due to a lack of safety equipment (helmets, safety boots, etc.).

Box 4.3. **Difficulties faced by ASM workers *(continued)***

- Occupational illnesses linked to exposure to toxic substances or mineral dust. In Central Africa, for example, the use of mercury to separate gold from other ores often exceeds the maximum exposure threshold of 1.0 µg/m set by the World Health Organization (WHO).
- Musculoskeletal problems due to the demanding nature of the work carried out under difficult conditions.
- Accidents linked to the use of unsafe tools and machinery.
- Mental health problems due to stressful and dangerous working conditions.

Human rights violations are also common in the sector. Children's involvement in mining remains high in Central Africa. In the DR Congo, for example, at least 40 000 children work in the cobalt mines of the Katanga region in extremely dangerous conditions, without adequate safety equipment and for meagre wages (UNCTAD, 2020[37]). The expansion of industrial cobalt and copper mines has also led to artisanal mine workers and local populations being forcibly evicted, as well as violence and arson (Amnesty International, 2023[38]).

Source: Chuhan-Pole, Dabalen and Land (2020[39]), *Mining in Africa : are local communities better off*, http://documents.worldbank.org/curated/en/517391487795570281/Mining-in-Africa-are-local-communities-better-off; Goltz and Barnwal (2019[40]), *Mines: The local wealth and health effects of mineral mining in developing countries*, https://doi.org/10.1016/j.jdeveco.2018.05.005.

These jobs often rely on low-skilled workers and occupations requiring basic skills. ASM workers mainly use basic tools and equipment for the extraction and initial processing of minerals. They are organised into teams of 10 to 20 miners who work together in a specific zone, on the surface or underground, accompanied by support teams (Rupprecht, 2015[41]). In the Central African Republic, a study of over 330 artisanal gold and diamond mining sites shows that the majority of workers perform support tasks (excavation, washing, sorting, transport, etc.), with women accounting for around a third of the workforce. However, there are gender differences in the division of labour. Women mainly wash, transport or sort ore, while men mainly excavate it (Jaillon and De Brier, 2019[42]).

The informal, sometimes seasonal, nature of these activities limits training opportunities, especially for women. Artisanal mine workers often undertake other livelihood activities, such as farming. Although there are some formalised ASM communities (that set up co-operatives, or obtain operating licences), they often lack the incentives, funding and skills to comply with the requirements of formal operations (Table 4.4). Moreover, they often do not benefit from national strategies for incubating or promoting small and medium-sized enterprises, which limits the expansion of their operations and their formalisation. Women generally face additional barriers linked to prevailing social norms, which prevent them from accessing better-paid work and training initiatives (McQuilken et al., 2024[43]).

Table 4.4. **Skills required by workers to improve the productivity of ASM in Central Africa**

Skills required	Example tasks	Types of skills
Geological knowledge	Map reading, sampling and exploration techniques	Technical
Mining methods and techniques	Identifying mine access, underground mining, rock-fracturing techniques	Technical
Mine surveys, sampling and grade control	Determining the location of underground works	Technical
Mineral processing	Crushing and grinding, sifting, classification and separation of ores	Technical
Waste management	Disposal of waste rock and tailings	Technical
Health, safety and environmental management	Sanitation, first aid equipment and training, risk identification and control measures	Technical
Understanding legal requirements	Understanding financial, environmental, social and mining laws and regulations	Managerial and soft
Business management skills	Estimating the amount of precious material contained in the raw mining material, business management	Managerial and soft

Source: Produced by the authors based on Rupprecht (2015[41]), "Needs Analysis for Capacity Building of Artisanal Miners in Central Africa", https://www.saimm.co.za/Conferences/BM2015/045-Rupprecht.pdf.

Capacity building will be crucial to increase local processing and adapt to technological developments and climate change

A broad set of skills is needed to integrate downstream segments of critical mineral value chains

Acquiring the technical skills needed to process and add value to minerals is a priority for countries in the region. The mining sector provides three main categories of jobs, which require related skills.

- Specific jobs account for around 30% of the workforce. They can be found in all segments of the value chain, and require specific technical skills for exploration, feasibility studies, mining operations, processing, adding value, etc. (Table 4.5).
- Cross-functional jobs account for 40% of the workforce and are present throughout the process. They include, for example, civil engineering and electrical installation work, machine operation, industrial maintenance and general safety.
- Administrative or support roles account for around 30% of the workforce and allow companies to operate effectively. Key examples include roles in management, general services (secretarial, accounting, finance, human resources), legal services, communications and inventory management.

Table 4.5. **Technical skills and occupations required in critical mineral value chains with a strong presence in Central Africa**

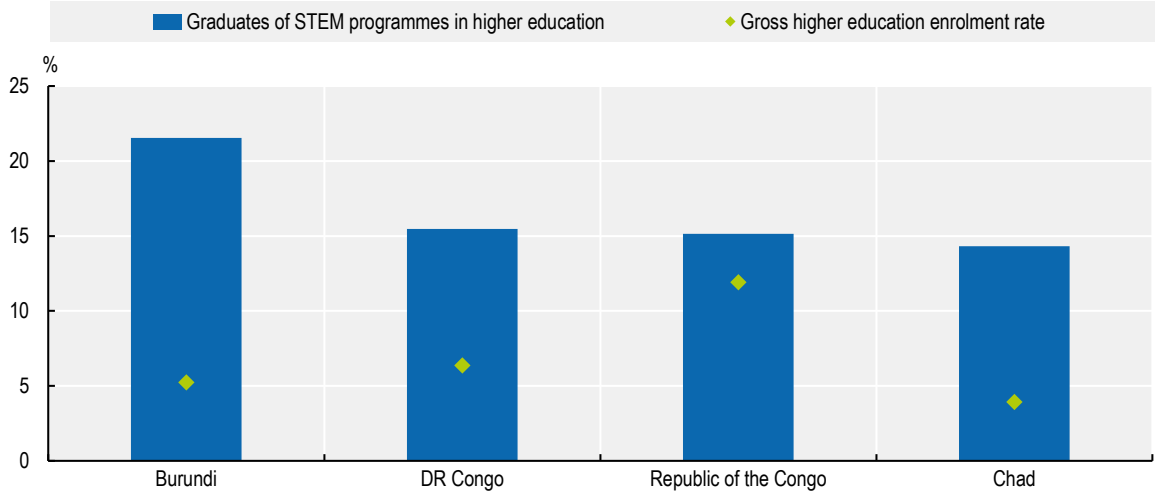
Mineral	Skills and occupations required by segment			Alloys and finished products
	Extraction	Treatment and adding value	Processing	
Cobalt	Pyrometallurgy, hydrometallurgy	Chemists and process engineers	Materials science, chemical engineers	Lithium-ion batteries
Copper	Drilling, blasting	Materials science, metallurgical/chemical/electrical engineers	Electrical engineering, renewable energy engineers, electric vehicle engineers	Photovoltaic solar panels, wind turbines, heating/cooling systems, electric wires, electric cars
Manganese	Crushing, flotation, grinding, gravity separation method, electrolysis, hydrometallurgy, pyrometallurgy	Metallurgical engineers, laboratory technicians, flotation specialists, chemists	Chemical and metallurgical engineers, lithium-ion battery engineers, mechanical and materials engineers, civil engineers	Steel, lithium-ion cells and batteries, rails and beams for the construction industry, sheet metal for automobile bodywork
Tantalum	Blasting, grinding, gravity separation method, electromagnetic and electrostatic processes, hydrometallurgy and pyrometallurgy	Metallurgical engineers, chemists, flotation specialists	Materials engineers, metallurgical engineers, high-tech, electrical and electronics engineers	High-capacity capacitors (smartphones, computers, automotive), medical technology (implants and surgical instruments), superalloys for turbines, aircraft engines and nuclear reactors

Source: CA Mining (2024[44]), *Mineral Processing Jobs In Africa*, https://mining-recruitment-jobs.com/mineral-processing-africa/; Glencore (2024[45]), *Zinc*, https://www.glencore.ch/fr/was-wir-tun/metalle-und-mineralien/zink; The Raw Material Outlook (2021[46]), *Raw Material Outlook Platform*, https://www.rawmaterialoutlook.org/; ISE (2024[47]), *Prix, occurrence, extraction et utilisation du tantale*, https://fr.institut-seltene-erden.de/.

Business, entrepreneurial and soft skills will also be important for the development and local ownership of mining activities. In Central Africa, few private national operators are active in the mining sector. Setting up a local company or accessing management positions in foreign companies requires high-level managerial skills. Interpersonal and language skills, as well as adaptability, sometimes play a more important role than technical skills in the recruitment of local people by foreign mining companies (Rubbers, 2020[48]). In addition, some local managers noted their lack of skills in relation to project set-up and financing (Le Bec, 2012[49]). Finally, soft skills such as communication, leadership, teamwork and problem-solving are essential on extraction sites in order to maintain a safe working environment and take effective decisions to prevent accidents.

Integration into downstream segments of value chains requires the development of advanced skills in science, technology, engineering and mathematics (STEM). Battery production and maintenance, for example, require advanced STEM skills (including chemistry, mechanical engineering and electrical engineering) (AfDB, 2022[20]). Yet, at present, the number of graduates from higher education STEM programmes remains low in Central Africa. In the countries for which data are available, the higher education enrolment rate is below 15%, and less than 20% of higher education students are enrolled on STEM courses (Figure 4.11).

Figure 4.11. **Percentage of STEM graduates and gross higher education enrolment ratio, 2015–2023 average**



Note: Gross enrolment ratios represent the total number of students enrolled in higher education, expressed as a percentage of the total population in the five-year age group following completion of secondary education.
Source: UNESCO (2023[5]), *Institute for Statistics* (database), http://data.uis.unesco.org.

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If mining activities are to modernise, local skills must adapt. The growing use of new technologies will impact workers differently depending on their skill level and will require them to adapt their skills. The number of large-scale operations adopting new technologies and semi-mechanised artisanal mines is increasing in some regions (IPIS/USAID, 2022[50]). While the adoption of these new technologies can improve mine efficiency, worker safety and environmental performance, this can only happen if local workers are properly trained. As illustrated by the case of the Kibali gold mine in the DR Congo (Box 4.4), the mechanisation of activities presents a risk for the local low- or semi-skilled workforce due to the replacement of certain positions, such as transporters or rock crushers (Rupprecht, 2017[51]). It should be noted, however, that at the same time, new, better-paid jobs will be created in highly skilled occupations (information technology and engineering).

Box 4.4. **The Kibali gold mine in the DR Congo: a case study of modern mining**

The Kibali gold mine has invested in a fully automated system, optimising the volume of labour required.

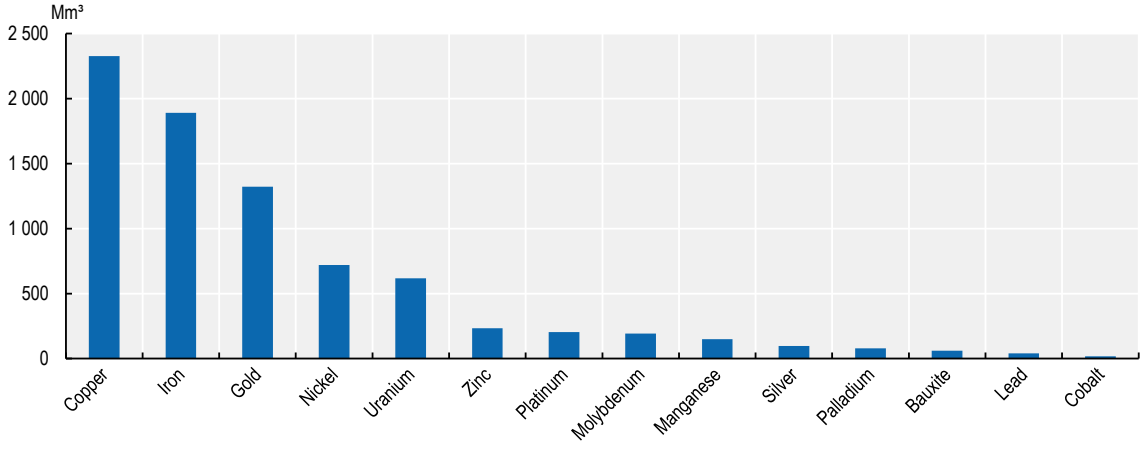
- An automated ore handling system, the only one of its kind in Africa, including driverless loaders and a single haulage drive, speeds up transport with minimal losses.
- Drones monitor shafts and inventory on the surface, and the system is controlled from a secure control room, enabling the safe management of loaders operating at depths of up to 800 metres.
- The mining company has invested in training local people to fill new positions. However, it employs only six people at its Kibali offices, given that most of its activities are managed from abroad.

Source: IGF/IISD (2019[52]), *New Tech, New Deal*, https://www.iisd.org/system/files/publications/new-tech-new-deal-technology.pdf?q=sites/default/files/publications/new-tech-new-deal-technology.pdf.

New skills are needed to manage climate change-associated risks and support the sustainable development of the sector

Anticipating climate change-associated risks requires the acquisition of specific skills. Extreme events (fluctuations in temperature and precipitation) put significant pressure on the integrity of mining operations, particularly open pit slopes and tailing storage facilities. Tailing dam failures can have disastrous consequences (Bellois, 2022[53]). The increased frequency and intensity of heat waves can also reduce employee productivity and safety (Nunfam et al., 2019[54]). Climate change has already had a negative effect on the workforce at mining sites. In Chad, for example, climate-related hazards are pushing people who depend on agriculture into ASM (GEF/UNEP, 2022[55]), which is exacerbating water stress. In the DR Congo, the southern region is more exposed to the risk of drought, with a 50% increase in the frequency of drought periods predicted by 2100 (USAID/SWP, 2022[56]). This is likely to have a major impact on local production of copper, the most water-intensive mineral (Figure 4.12). It is therefore essential that the workforce acquire the new skills needed to implement tailored practices and monitor risks more closely.

Figure 4.12. **Global water scarcity footprint by mineral**



Note: The water scarcity footprint is calculated by multiplying global water consumption by the Water Stress Index, as defined by Meißner (2021[57]).

Source: Produced by the authors based on Meißner (2021[57]), *The Impact of Metal Mining on Global Water Stress and Regional Carrying Capacities – A GIS-Based Water Impact Assessment*, https://doi.org/10.3390/resources10120120.

StatLink https://stat.link/gujdih

Green skills can help monitor and mitigate the environmental impacts of mining in Central Africa. Mining has environmental effects that are direct (degradation of soils, rivers and biosystems) and indirect (degradation due to infrastructure construction and the influx of rural populations attracted by employment opportunities) (Gourdon, Kinda and Lapeyronie, 2024[58]). In Central Africa, these indirect effects are having a significant impact on areas with high levels of biodiversity, such as the lowlands of Cameroon-Gabon and of eastern DR Congo (Edwards et al., 2013[59]). Green skills can provide an effective way of monitoring and addressing these impacts (measuring air and water quality, managing waste and protecting biodiversity) (Mining Qualifications Authority, 2018[60]).

Abandoned mines can be a source of physical, chemical and biological hazards, which create a need for green skills specific to the local context. Phytoremediation (the use of living plants to absorb pollution and purify contaminated soil, air and water) is an ecologically and economically viable solution and it would be worth developing skills in this area at the regional level. However, the nature of the pollutants produced varies depending on the ore and the context (in Cameroon, radioactive deposits of Uranium-235;

in the DR Congo, mercury (Hg), which affects crops, soils and aquatic sediments). These wide-ranging risks and effects call for skills and tailored knowledge; however, the fact that these are scarce is likely to hamper the protection of natural ecosystems (UNESCO, 2019[61]; Odoh et al., 2019[62]).

Developing new skills in related sectors such as renewable energies will help reduce the sector's carbon footprint while cutting production costs. Electricity supply accounts for 10% to 25% of the total cost of a mining project and may have to compete with other economic activities and household consumption (McMahon, Banerjee and Romo, 2016[63]). Given that power outages are common in the region (10.2 power outages per month on average between 2013 and 2019, compared with 7.6 for the African continent as a whole[4]), mining companies often resort to polluting and less-efficient means of power generation, such as diesel and heavy fuel oil (Alova, 2018[64]). However, projects based on clean energy seem to be on the rise: in the DR Congo, a public–private partnership between Kamoa Copper and Société Nationale d'Electricité (SNEL) aims to increase the supply of hydroelectric power (Mining Review Africa, 2021[65]).

Central African governments have several policy levers at their disposal to strengthen skills and promote better positioning within mining value chains

National and regional strategies, underpinned by reliable data, support skills development and help anticipate changes in demand for these services

Local skills development must be supported by national and regional strategies to promote integration into value chains. Countries in the region are beginning to develop regional and continental co-operation mechanisms, notably through the implementation of the African Continental Free Trade Area (AfCFTA), in order to strengthen their position within global value chains. In 2022, the DR Congo and Zambia signed a bilateral agreement with a view to creating a regional electric vehicle battery manufacturing industry (AfDB, 2022[20]). The cross-border project will be implemented in two special economic zones (Katanga province in the DR Congo and Copperbelt province in Zambia) (Box 4.5). The production of electric cars and solar panels is also driving demand for rare earth minerals; significant reserves can be found in South Africa, Burundi and Malawi. Closer regional co-operation would make it easier to identify each country's position within value chains, so as to target the skills that need to be developed (AfDB, 2021[66]).

Box 4.5. **African Centre of Excellence for Advanced Battery Research in DR Congo**

The African Centre of Excellence for Advanced Battery Research (CAEB), opened in Lubumbashi in April 2022, trains technicians for a plant that will manufacture batteries and electric cars "made in the DR Congo". Affiliated with the polytechnic schools of the University of Lubumbashi, the CAEB is the product of co-operation between the DR Congo and Zambia, which together contain almost 70% of global copper and cobalt reserves.

The centre offers Master's-level courses focused on research and innovation in materials chemistry, process engineering, waste management and battery design. This initiative is designed to meet growing international demand, thereby contributing to the development of the battery industry on the African continent. The CAEB is working with the University of Zambia and the Copperbelt University, in partnership with the private sector, to identify skills and research needs, and design relevant training programmes.

Collecting relevant data would make it possible to better anticipate the demand for skills in the mining sector and to assess the potential for transfer to other sectors. High-quality employment data would help clarify skills needs, develop strategic plans to strengthen these skills, and identify opportunities in related sectors (infrastructure, local equipment manufacturing, etc.). This approach has proved particularly successful in Chile, where the Mining Skills Council conducts surveys of mining project managers from the feasibility stage onwards to identify skills gaps (AfDB/BMGF, 2015[67]). Most Central African countries currently lack an operational mechanism to anticipate skills needs, often due to a lack of co-ordination between ministries (Werquin and Foka, 2020[68]). However, national initiatives are emerging for specific projects:

> In the Republic of the Congo, the Ministry of Technical and Vocational Education and Training is working with international partners to set up a national employment observatory to collect accurate data that will be used to develop tailored training programmes (Nzaou, 2020[69]).
>
> In the DR Congo, an apprenticeship programme, funded by local mining companies and targeting young people aged 15–17 years working in ASM, offers six-month training courses in sectors identified using data collected on local needs (IT, mechanics, welding, metallurgy, livestock farming, hairdressing and sewing) (PACT, 2020[70]).

Fostering co-operation between the public and private sectors can improve the supply, quality and relevance of technical and vocational education and training

It is crucial to improve the supply of training and the quality of TVET. The creation of mining schools and training centres dedicated to mining-related occupations bears witness to the desire to increase the number of skilled workers in Central Africa. In Cameroon, for example, the School of Geology and Mining Engineering, which opened in 2011, trains engineers to specialise in the management of prospecting, exploration and mining projects (Table 4.6). At present, however, evaluations of TVET providers in the region reveal weaknesses linked to a lack of funding, outdated teaching methods and materials, and a shortage of adequately qualified teachers (Werquin and Foka, 2020[68]). Enhancing the quality of training courses requires a gradual increase in the number of courses on offer, coupled with an increase in the number and expertise of trainers. Technical skills (e.g. STEM) and soft skills (e.g. leadership, communication or complex problem-solving) should be covered.

Table 4.6. **Examples of mining training institutions in Central Africa**

Country	Public training	Private training
Cameroon	• École de géologie et d'exploitation minière (School of Geology and Mining Engineering) • Institut des mines et des industries pétrolières (Institute of Mining and Petroleum Industries)	• Institut supérieur de pétrochimie et d'ingénierie mathématique (Higher Institute of Petrochemistry and Mathematical Engineering) • Institut universitaire des sciences pétrolières et de management (University Institute of Petroleum Sciences and Management) • Gulf-Field Higher Institute of Petroleum, Mining, Business and Management Sciences
Gabon	• École des mines et de métallurgie de Moanda (Moanda School of Mining and Metallurgy)	• Université Libreville Nord (Libreville Nord University) • Université continentale de Libreville (Continental University of Libreville) • Institut supérieur saint Paul de Libreville (Higher Institute of Saint Paul of Libreville) • Institut supérieur Théopolis (Théopolis Higher Institute) • Institut supérieur d'ingénierie (Higher Institute of Engineering) • Université des sciences et techniques de Masuku (Masuku University of Science and Technology) • Institut universitaire de technologie (University Institute of Technology)
Equatorial Guinea	• Institut supérieur des mines et géologie de Boké (Boké Higher Institute of Mining and Geology)	• École supérieure d'ingénierie de Yattaya (Yattaya College of Engineering)
DR Congo	• Haute école des mines et de l'industrie (School of Mining and Industry)	• Centre de formation aux métiers de mines (Mining Training Centre)
Republic of the Congo	• Centre des métiers de mines (Mining Training Centre)	• N/A

Source: Compiled by the authors.

Co-operation between TVET institutions and stakeholders in large-scale and ASM operations boosts skills development. Strengthening partnerships between TVET institutions and the private sector improves the relevance and quality of teaching and training (Werquin and Foka, 2020[68]).

> Since 2015, the Gabonese government has focused on developing local infrastructure and skills to enable manganese to be processed locally. The creation of Moanda School of Mining and Metallurgy, in co-operation with the private sector (COMILOG) and European universities, will help to achieve to this objective (EU, 2013[71]). Of the 102 graduates from the classes of 2016–2021, 92 are working in the mining sector, including 50 at COMILOG (Gabon Review, 2022[72]).
>
> In DR Congo, the Kamoto Copper Company (KCC), which operates in the copper and cobalt sector, works with local technical training institutions to offer 50 students a two-year apprenticeship programme aligned with their training programmes (Hako, 2023[73]).

Training ASM workers helps to improve their productivity, promote women's employment and encourage sustainable development in the sector

Building the capacities of ASM workers helps to improve their working conditions and productivity. The success of the skills development programmes for ASM workers is a function of: i) site-specific training programmes ii) adequate consultation with miners and the local community before designing and planning programmes iii) trainers who are recognised within the community iv) objectives for improving production and minimising health and environmental impacts that are feasible and cost-effective v) technical, regulatory and financial support from local governments and vi) a long-term presence enabling in-depth monitoring, flexible implementation and consistent engagement with communities (Stocklin-Weinberg, Veiga and Marshall, 2019[74]).

> In the DR Congo, the Project for the Responsible Supply of Tin, Tungsten and Tantalum, implemented by the non-governmental organisation (NGO) Pact in

> partnership with the government and the private sector, provides training for ASM workers to increase safety and productivity, and facilitate the formalisation of artisanal mining sites. From 2021 to 2024, the project has trained more than 7 200 miners, 400 government officials and 700 community members to strengthen the application of the 2018 mining code (PACT, 2024[75]).

Investment in green skills by international partners and local governments can reduce the environmental impact of mining and create jobs. For example, Belgian Development Co-operation is funding tertiary-level mobility programmes focusing on sustainable mining practices in geology in Burundi, the DR Congo and the Republic of the Congo (Kingdom of Belgium, 2022[76]). Cleaning up abandoned mines can also improve public health, environmental conditions and productivity, through the development of green skills.

> Central African countries could take inspiration from the World Bank's Mining and Environmental Remediation and Improvement Project in the Copperbelt region of Zambia, which aims to restore abandoned and polluted mining areas by creating green income streams. This initiative focuses on improving local skills, restoring contaminated soil and raising public awareness of the risks of pollution (World Bank, 2016[77]).

Awareness-raising programmes reduce discrimination and make it easier for women to access training courses. Such training courses in turn enable women to participate in mining, and open the door to higher-skilled and better-paid jobs (team supervisor, accounting, land surveying or engineering work, machine operation, gem sorting, etc.).

> In the Central African Republic, a project launched by the United States Agency for International Development (USAID) in partnership with women's organisations involved in ASM has set up an Innovation Fund for women. Aimed at strengthening women's involvement in artisanal diamond mining, it is supporting 120 women to undertake training to enable them to participate in prospecting, earth works (especially terracing and backfilling) and diamond trading (Mutemeri et al., 2023[78]).

Strengthening governance is one way to ensure that resources are better allocated to skills

Improving revenue mobilisation and reinvesting the revenue from mining resources can help finance training. Africa's mineral-rich countries have a mixed record when it comes to mobilising mining revenues. Better continental and international-level co-ordination of tax policies in the mining sector would improve the mobilisation of mining revenues. Indeed, African countries as a whole lose an average of USD 450 million to USD 730 million a year in corporate tax revenues due to tax avoidance by multinational mining companies (Albertin et al., 2021[79]). The application of international standards can help improve governance. Examples include the standards laid down by the Extractive Industries Transparency Initiative, under which participating countries "commit to disclose information along the extractive industry value chain".[5] Training local officials, with the support of international partners, can help achieve these goals (ATAF/IGF/OECD, 2022[80]). Central African countries can also learn from other mineral-rich countries about how to improve the allocation of mining resources.

> Botswana, for example, spends 42% of mineral revenues on education and training, a choice that has significantly improved local skills over the past three decades (AfDB, 2016[81]; Korinek, 2014[82]).
>
> In the Republic of the Congo, the National Support Fund for Employability and Apprenticeship created in 2019 partially finances its activities (support for labour market integration and training) by collecting an apprenticeship levy from companies (FONEA, n.d.[83]).

International partners can support the mobilisation and allocation of funding for skills development. Funds from international donors support the implementation of TVET policies in Central Africa.

> In the Republic of the Congo, for example, the government and the AfDB are planning to build two training centres for 7 500 young people in the mining, timber and forestry sectors through the Skills and Human Resource Development Project (AfDB, 2024[84]).
>
> Since 2014, the Development Minerals Programme jointly implemented by the Organisation of African, Caribbean and Pacific States and the European Union (OACPS-EU) has supported workers from over 325 ASM co-operatives to undertake training and enter formal employment. Covering Cameroon, Guinea, Uganda and Zambia, this programme has supported skills development (environment, health, safety) and provided training on co-operative governance, business planning and the legal obligations of artisanal miners (PNUD, 2023[85]).

Implementing and monitoring local content policies can also support skills development, provided they do not distort local markets. The judicious use of local content policies focused on employee training can be worthwhile, if implemented in co-ordination with other skills development policies (Korinek and Ramdoo, 2017[33]). Encouraging a minimum annual investment in training, in partnership with local TVET universities and technical centres, may offer a win-win solution. Indeed, these policies can improve the productivity of foreign companies given that they involve developing the skills of workers who are familiar with local contexts. Central Africa could learn from examples elsewhere on the continent and improve how these policies are monitored (AfDB, 2016[86]).

> In Angola, for example, companies in the extractive sector are required to spend USD 0.15 per barrel of oil produced on training Angolan staff. In South Africa, companies must spend 5% of their annual wage bill on human resource development (Ramdoo, 2016[87]).

Developing local skills and using new technologies can facilitate the certification of Central African mines and improve due diligence in the sector. Developing local skills can make it easier to obtain certification for projects, as doing so demonstrates their compliance with environmental, social and governance (ESG) criteria.

> In the cobalt sector, the Mutoshi pilot project, a public–private partnership initiative launched in 2019 in the DR Congo, has trained artisanal workers in the sector and enabled them to organise into co-operatives (Johansson de Silva, Strauss and Morisho, 2019[88]). Aligned with the OECD Due Diligence Guidance (OECD, 2016[89]), this project has improved supply chain transparency and increased productivity and incomes for trained workers (Shumsky, 2020[90]).
>
> In Burundi, the programme to strengthen due diligence in the supply of tin, tungsten and tantalum, also aligned with OECD recommendations, has been making use of new technologies since 2019. Employees of the Burundi Office of Mines and Quarries have been trained to use electronic tools to collect data in real time, thus improving transparency in the sector (PACT, 2022[91]).

Notes

1. IEA lists 33 critical minerals: Arsenic, Boron, Cadmium, Chromium, Cobalt, Copper, Gallium, Germanium, Gold, Graphite, Hafnium, Indium, Iridium, Lead, Magnesium, Manganese, Molybdenum, Nickel, Niobium, Palladium, Platinum, Rare-earth elements (Neodymium, Dysprosium, Praseodymium and Terbium, among others), Selenium, Silicon, Silver, Tantalum, Tellurium, Tin, Titanium, Tungsten, Vanadium, Zinc, Zirconium (IEA, 2023[93]).

2. Artisanal and small-scale mining focuses on the following critical minerals: Aluminium, Cadmium, Chromium, Cobalt, Copper, Iron/Steel, Graphite, Lithium, Manganese, Nickel, Platinum, Rare Earths, Vanadium, Zinc, (AfDB, 2022[20]).
3. Nearly two thirds of Africa's total mining production is controlled by two multinationals: Glencore (Switzerland) and Anglo American (South Africa). The share of African mining production controlled by China is around 28% for copper, 82% for bauxite, 41% for cobalt and 40% for uranium (Ericsson, Löf and Löf, 2020[92]).
4. Authors' calculations based on (World Bank, 2024[94]).
5. https://eiti.org/our-mission.

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Chapter 5

Digital skills in East Africa

This chapter analyses how digital skills affect jobs and productivity in East Africa (Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Seychelles, Somalia, South Sudan, Sudan, Tanzania and Uganda). First, the chapter outlines the region's overall educational outcomes, occupational structures and migration trends. Second, it analyses the supply of, demand for and provision of digital skills. Third, the chapter discusses the expansion of Internet access and digital education, country-specific skill provision and regional integration of digital skills development as priority policy recommendations.

IN BRIEF

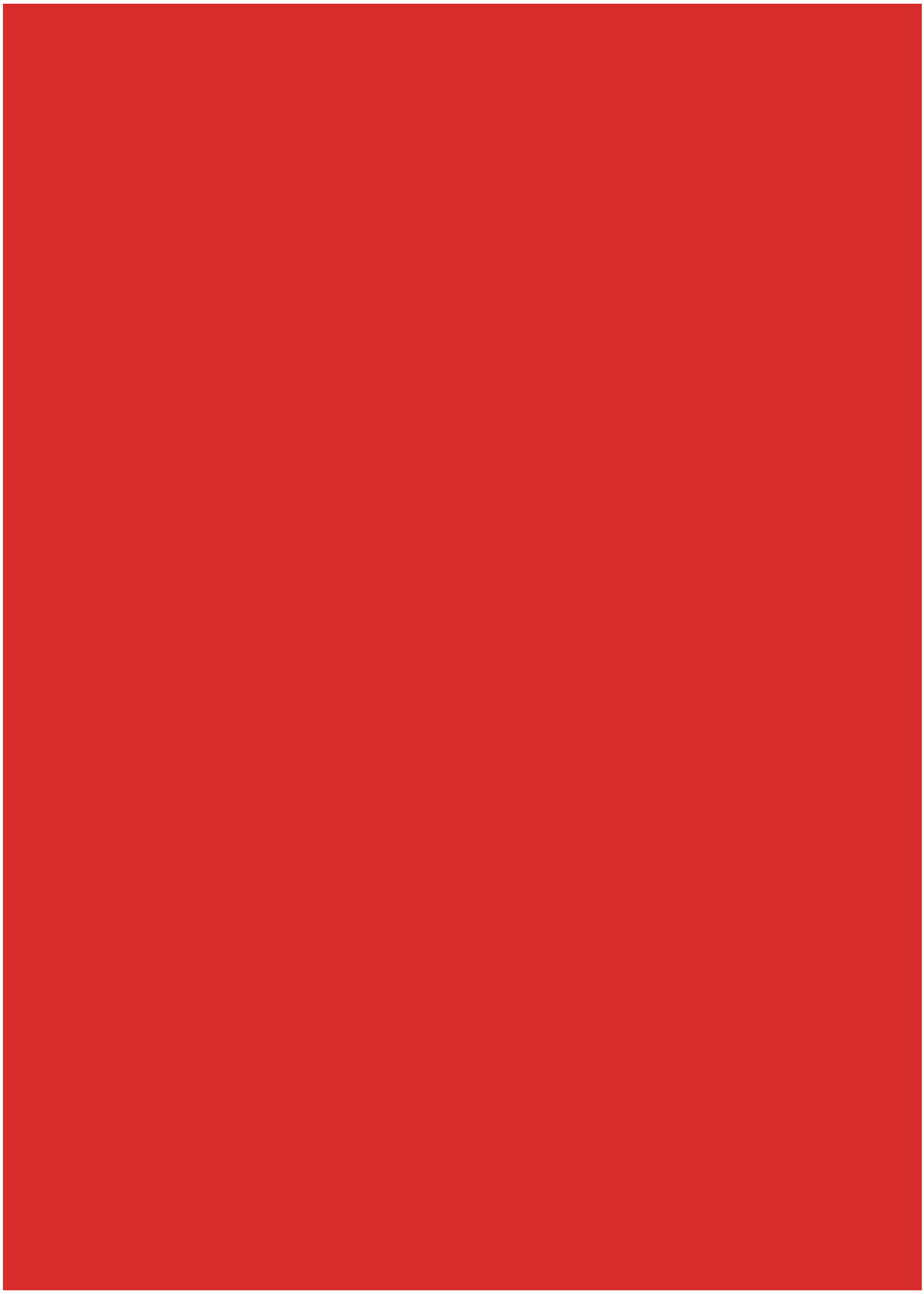
East Africa can make better use of its economic growth for skills development. The region's labour productivity is below the African average, even though East Africa boasts the fastest economic growth of all the continent's regions. Over three-quarters of workers are in unskilled occupations in agriculture and trade. The average duration of schooling is 6.7 years – the same as for Africa as a whole. Learning-adjusted years of education vary widely across the region, ranging from 2.5 years in South Sudan to 9.7 years in Seychelles.

The unprecedented development of digital skills has provided an opportunity to boost productivity in East Africa, but progress has been highly uneven. The digitalisation of firms and economies has driven both the supply of and demand for basic digital skills in most East African countries. Intermediate and advanced skill supply and demand remain confined to specific sectors, like finance, health, energy, agriculture, transport and infrastructure. Specialised and digital entrepreneurial skills are lacking throughout the region, with Nairobi as an exception. A rise in digital service exports is creating a growing demand for intermediate and advanced digital skills from online labour.

Digital skill provision varies widely across East African countries. Countries where digitalisation has advanced are now offering specialised and sector-specific digital skills, especially through technical and vocational training and education institutions. However, barriers like low enrolment in science, technology, engineering and mathematics persist. Access to training remains unequal throughout the region, with a lack of focus on providing skills to informal workers, women and youth.

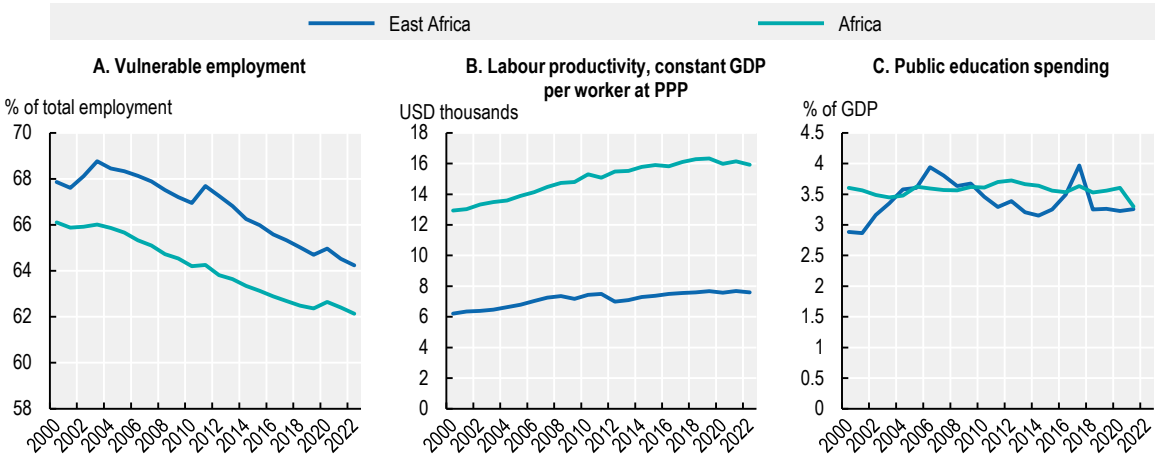
Policies to improve digital skills development in East Africa can focus on three priorities:

1. Expand Internet access and integrate digital skills into education to increase the supply of and demand for basic digital skills
2. Target intermediate and advanced digital skill provision towards country-specific needs and global demand
3. Enhance regional integration of digital markets, infrastructure and skill provision to improve conditions for digital skills development and digital entrepreneurship.



Regional profile

Figure 5.1. **Vulnerable employment, labour productivity and education spending in East Africa, 2000-22**



Note: Vulnerable employment includes formal and informal self-employed (own-account) workers and contributing family members but excludes informal salaried employees. As an approximation of informal employment, it is used here to show long-term trends, as time series data on informal employment are missing for most African countries. Labour productivity is measured as the constant gross domestic product (GDP) in 2017 international USD at purchasing power parity (PPP) prices, divided by the population of employed people in thousands.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org/fr/; World Bank (2023[2]), *World Development Indicators* (database), https://databank.worldbank.org/source/world-development-indicators; and IMF (2023[3]), *World Economic Outlook* (database), https://www.imf.org/en/Publications/WEO.

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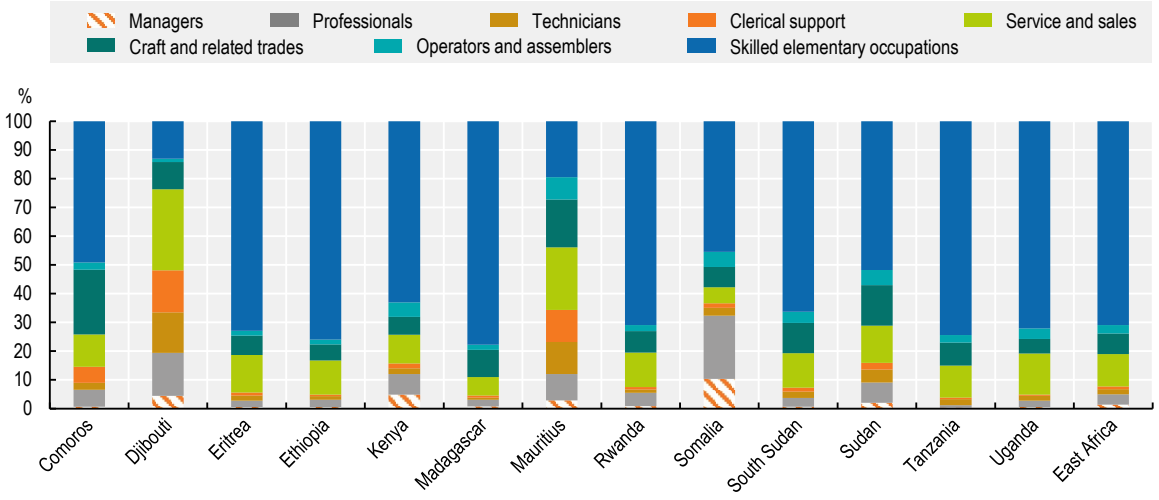
Figure 5.2. **Breakdown of working population by type of occupation in East Africa, 2021**



Note: "Technicians" include associate professionals, "Skilled elementary occupations" include skilled agricultural, forestry and fishery workers and elementary occupations, and "Operators and assemblers" include plant and machine operators and assemblers. No data were available for Seychelles.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org/fr/.

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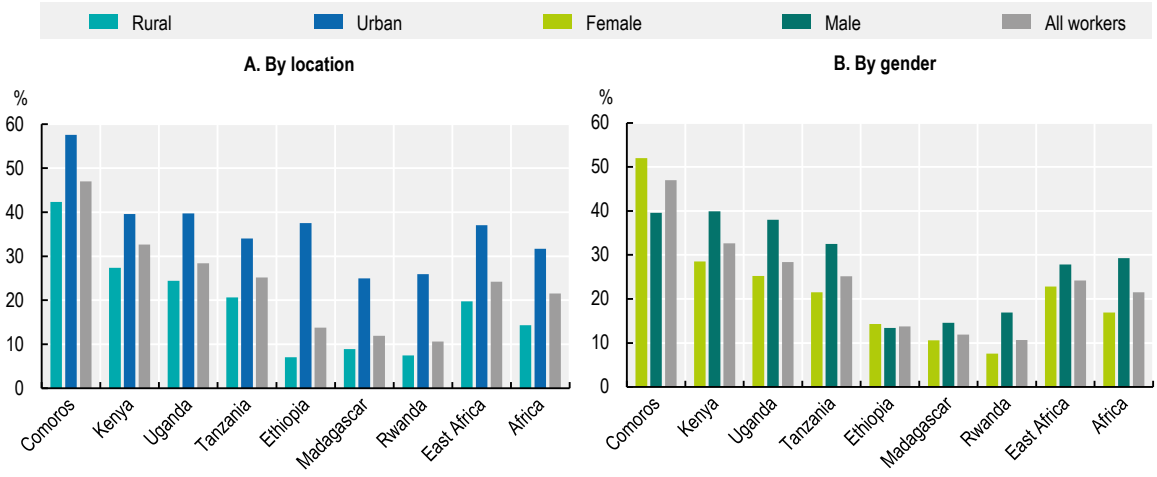
Most workers in East Africa are in vulnerable employment and unskilled occupations, and the quality of education varies widely across countries

Despite significant economic growth, East Africa's labour productivity is below the African average, and the region has a high rate of vulnerable employment. East Africa continues to be the African region with the fastest economic growth (4.9% in 2020-22, compared to 4.4% for Africa as a whole). Yet, labour productivity has stagnated for more than 15 years, increasing only marginally from USD 7 057 per worker in 2006 to USD 7 608 in 2022. This is the second lowest value of all African regions, only above Central Africa at USD 5 712, and less than half of the African average of USD 15 902. In 2021, 65% of workers in East Africa were in vulnerable employment (self-employed or unpaid family workers) (Figure 5.1), compared to 33% for North Africa and 75% for West Africa.

The great majority of workers in East Africa are in unskilled occupations in agriculture and trade, while rural-urban and gender divides vary widely across countries. About 76% of workers in East Africa are in unskilled occupations. The agriculture, forestry and fishing sector continues to employ by far the most workers (58% in 2021, down from 70% in 2000), followed by retail and wholesale trade (11%) and manufacturing (6%) (Figure 5.3). Rural-urban divides are starkest in Ethiopia, Rwanda and Madagascar (where the shares of workers in skilled occupations are 31, 18 and 16 percentage points (pp) higher, respectively, in urban than in rural areas). Gender divides are highest in Uganda (where the share of male workers in skilled occupations is 13 pp higher than female), Kenya (11 pp) and Tanzania (11 pp).

Figure 5.3. **Percentage of workers in skilled occupations, by gender and place of residence, 2019 or latest year available**



Note: Data are drawn from nationally representative demographic and health surveys (DHS) collected between 2010 and 2019. Occupational categories were divided into skilled and unskilled occupations as follows: skilled occupations include professional, technical, managerial, clerical and skilled manual work; unskilled occupations include sales, agriculture, household and domestic work, services and unskilled manual labour.

Source: USAID (2019[5]), *Demographic and Health (DHS) Surveys* (2010-19) (database), https://www.statcompiler.com/en/.

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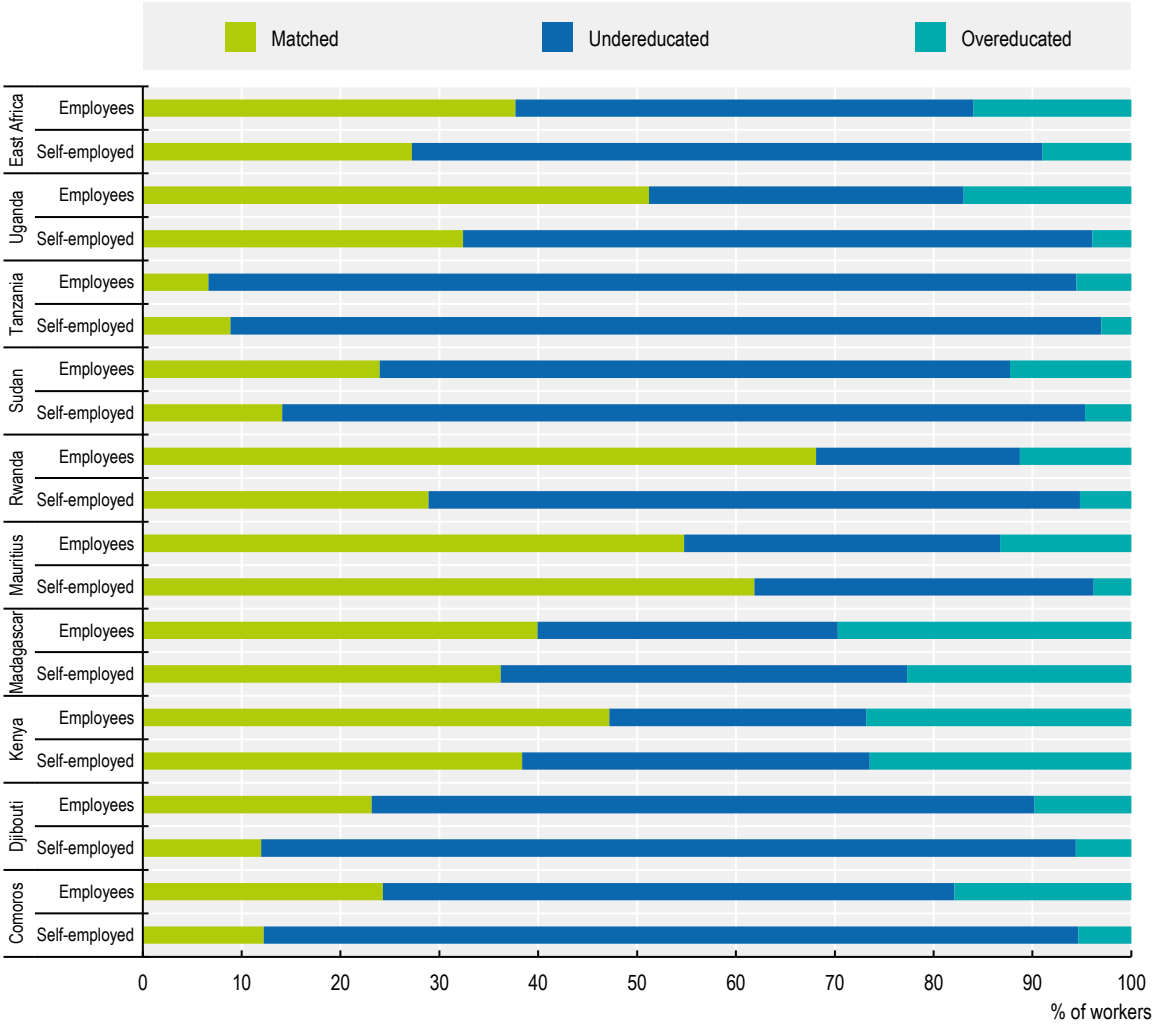
The majority of workers in East Africa do not have the levels of education required for their occupations. Undereducation is particularly stark in Comoros, Djibouti, Sudan and Tanzania. Under- and overeducation affect women and men across the region to similar extents (59% vs. 55% for undereducation; 12% vs. 11% for overeducation). However, self-employed workers are much more likely to be undereducated than salaried employees

(64% vs. 46%), while the latter are more likely to be overeducated (9% of self-employed workers vs. 16% of employees) (Figure 5.4).

Figure 5.4. **Percentage of workers who have an equal, higher or lower level of education than required for their occupation, 2022 or latest year available**



Note: (Mis)matches are assessed through the normative approach by comparing educational requirements set out in the International Standard Classification of Occupations (ISCO) for each one-digit ISCO occupational group with the level of education of each person in employment. Calculations are based on data collected in national labour force statistics or other nationally representative household surveys with a module on employment. No data were available for Eritrea, Ethiopia, Seychelles, Somalia and South Sudan.

Source: Authors' compilation based on ILOSTAT (2023[6]), *ILO Education and Mismatch Indicators* (database), https://ilostat.ilo.org/.

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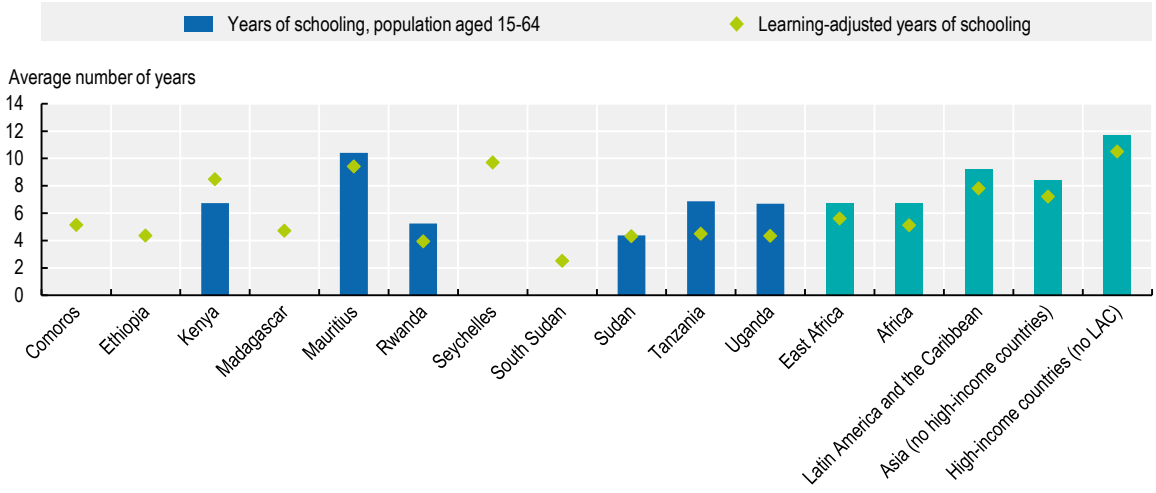
The level and quality of education in East Africa are on par with the African average; however, lacking data may mask stark differences within the region.

- The average duration of schooling is 6.7 years in East Africa, the same as for Africa as a whole. Adjusted for the quality of education, however, the duration decreases by over one year, to 5.6 years. This is half a year above the adjusted value for the continent (5.1 years), but around 2 years below developing Asia (7.2 years) and Latin

America and the Caribbean (7.8 years). Given missing data for Djibouti, Eritrea and Somalia, the region's actual average could be significantly lower (Figure 5.5).

- Learning-adjusted years of education vary widely across the region, from just 2.5 years in South Sudan to 9.7 years in Seychelles (Figure 5.5). The percentage of adults aged 15 and over found to be illiterate in South Sudan and Ethiopia were 68% and 48%, respectively, compared to 4% and 9% in Seychelles and Mauritius.
- If education systems could be improved to a point where all children reach a basic level of fundamental skills (corresponding to Level 1 of the international PISA test), the gross domestic product (GDP) of East African countries would increase by an average of 4% per year by 2100, equivalent to a total added value of USD 26 trillion.

Figure 5.5. **Average years of schooling and learning-adjusted years of schooling, 2020**



Note: LAC = Latin America and the Caribbean. Learning-adjusted years of schooling merge the quantity and quality of education into one metric, reflecting that similar durations of schooling can yield different learning outcomes. See Filmer et al. (2020[7]) for the detailed methodology. No data were available for Djibouti, Eritrea and Somalia.

Source: Authors' calculations based on World Bank (2023[8]), *Education Statistics – All Indicators* (database), https://databank.worldbank.org/source/education-statistics-%5E-all-indicators.

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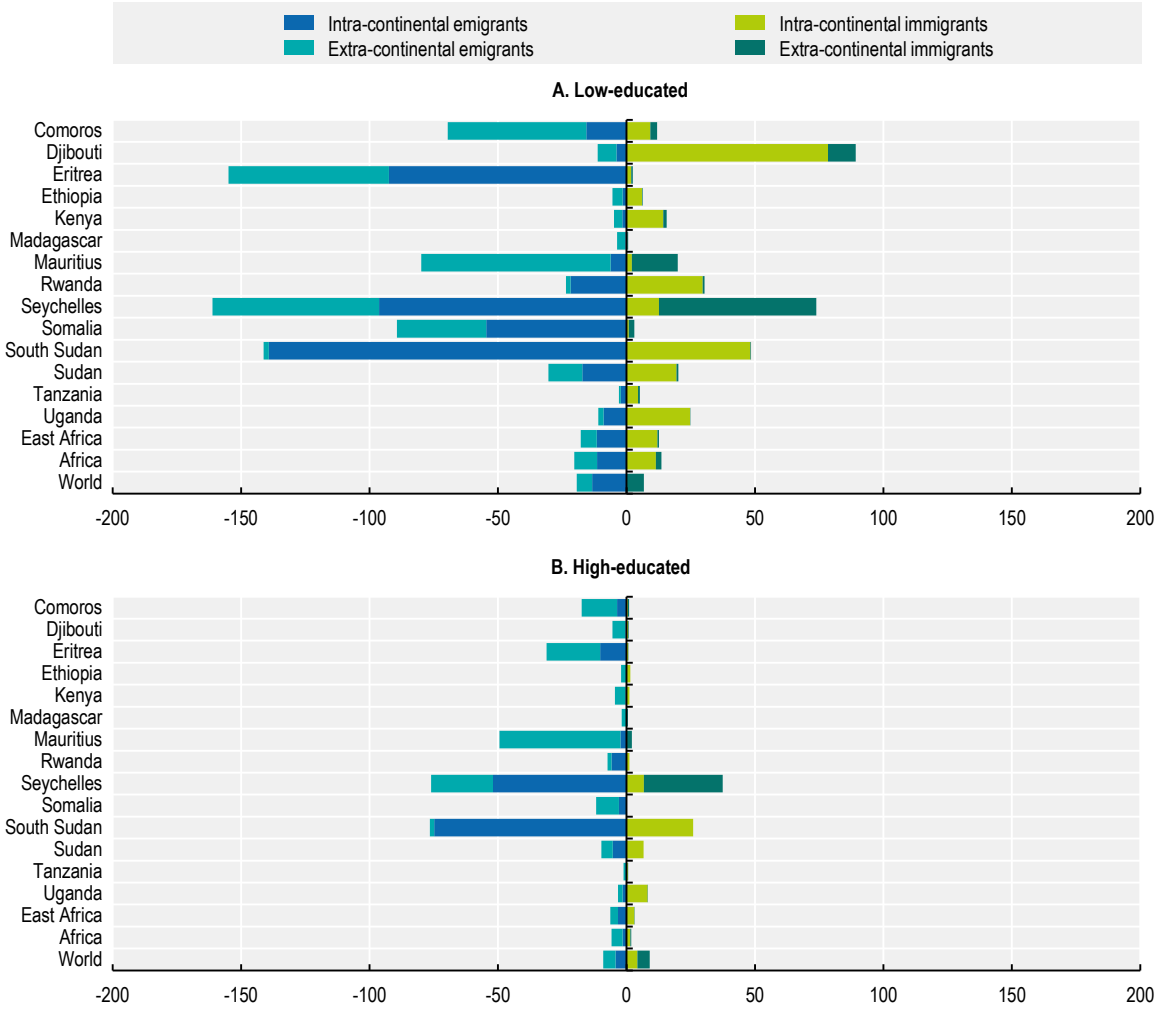
East Africa has the greatest rate of highly educated emigration in Africa, and Seychelles has the most non-African immigrant workers. With more than 2 million tertiary-educated ("highly educated") East Africans residing abroad in 2020, the region has the highest rate in the continent (Chapter 1). Seychelles has the highest rate of highly educated emigration in the region. The country is also the top destination for migrant workers immigrating from outside the continent. East African emigrant workers with secondary education or less tend to come from Seychelles, Eritrea, South Sudan and Mauritius, in that order (Figure 5.6).

Figure 5.6. **Migrants by level of education, origin and destination, 2020**



Note: Migrants per 1 000 inhabitants. Negative numbers show emigration. "Low-educated" refers to individuals with secondary or lower education. "High-educated" refers to those with tertiary or higher education.

Source: World Bank (2023[9]), *Global Bilateral Migration* (database), https://databank.worldbank.org/source/global-bilateral-migration and World Bank Group (2023[10]), *World Development Report* (2023), https://data.unhcr.org/en/documents/details/102109.

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Digital skills development is advancing in East Africa but unevenly across countries

The digital economy has grown fast in some East African countries, but lacking global market integration and uneven digital adoption reveal the need to further develop digital skills in the region. East Africa has made digitalisation core to its overall development agenda, with Kenya standing out as a continental forerunner (Dupoux et al., 2022[11]). While digitalisation has been progressing fast in many countries, the region's aspirations to tap into global digital markets, through business process outsourcing, for instance, have mostly not materialised. The adoption of productivity-enhancing digital technologies has remained patchy across the region. Shortages of and gaps in digital skills are in part responsible for these missed opportunities (Caribou Digital Institute, 2024[12]; Melia, 2020[13]).

Digital skills development in East African countries is highly diverse, depending largely on their readiness to adopt information and communications technology (ICT).

ICT readiness refers to a country's pre-conditions for developing its digital economy and closely relates to its overall level of digital skills development. ICT readiness depends on digital access, uptake and associated skill provision (Cisco, 2024[14]; UNCTAD, 2021[15]). East African countries can be divided into three clusters, according to their digital economic advancement (see AUC/OECD (2023[16]) (Table 5.1):

- **Cluster 1: Kenya, Uganda, Tanzania, Rwanda and Ethiopia.** These countries have larger GDP and GDP growth, high Internet access rates, explicit digital economy strategies, and significant untapped human capital. As their economies digitalise, the demand for digitally skilled workers is projected to grow fast. These countries' capital cities have sizable digital entrepreneurship ecosystems.
- **Cluster 2: Mauritius and Seychelles.** Mauritius is an upper-middle-income country, and Seychelles is a high-income country. Both have relatively small populations and advanced human capital, digital and complementary infrastructure, mature digital policies, and governance.
- **Cluster 3: Comoros, Djibouti, Eritrea, Madagascar, Somalia, South Sudan and Sudan.** These countries offer relatively fewer market opportunities and face significant ICT readiness barriers, often exacerbated by conflicts.

Table 5.1. **East African countries clustered according to digital economy advancement**

Country	Internet access and digital usage			Market size			Digital indexes		ICT Readiness					
	Access to Internet (% of population aged 15+) (most recent year, 2013-22)	Share of people capable of using a mobile money account without help (2021)	Share of population that can afford 1 GB of mobile data monthly (%) (2018)	Population (in thousands, 2023)	GDP in PPP dollars per capita (2023 or most recent year)	Real GDP Growth rate (%) (most recent year, 2013-22)	Wiley's Digital Skills Gap Index world ranking (out of 134) (2021)	Oxford Insights' Government AI Readiness Index ranking (out of 193) (2023)	ICT skills base (0-100)	Digital infrastructure (0-100)	Investment (0-100)	Inflows to tech startups (USD million)	Business environment (0-100)	ICT policy/ strategy (0-100)
Cluster 1														
Kenya	50.8	57.6	55.3	51 539	6 603	4.8	70	101	23	38	62	564	54	59
Uganda	30.8	42.3	25.1	45 484	3 185	6.4	100	132	..	..	..	38	..	..
Tanzania	19.9	28.7	31.4	63 343	3 570	4.7	111	137	20	25	34	..	53	48
Rwanda	12.6	..	23.2	13 499	3 156	8.2	80	84	..	..	..	126	..	..
Ethiopia	10.0	..	5.7	105 707	3 754	6.4	119	140	20	33	24	..	39	58
Cluster 2														
Mauritius	64.1	9.9	90.7	1 261	29 882	8.7	55	61	..	..	..	..	..	..
Seychelles	..	..	60.6	100	41 180	8.9	..	..	..	..	..	..	..	..
Cluster 3														
Comoros	32.7	..	13.6	991	3 456	2.6	..	181	..	..	..	..	..	..
Somalia	17.9	..	..	16 051	1 996	2.4	..	183	..	..	..	..	..	..
Madagascar	12.8	12.1	0.4	29 766	1 900	4.0	123	162	..	..	..	..	..	..
South Sudan	4.9	..	..	15 013	433	0.5	..	191	..	..	..	..	..	..
Djibouti	..	..	..	1 030	7 157	3.2	..	155	..	..	..	..	..	..
Eritrea	..	..	..	3 453	1 832	3.8	..	190	..	..	..	..	..	..
Sudan	..	..		47 895	3 600	-2.5	..	177	..	..	..	..	..	..

Note: AI = Artificial intelligence. GB = Gigabyte. GDP = Growth domestic product. PPP = Purchasing power parity. ICT = Information and communication technology.

Source: Oxford Insights (2023[17]), *Government AI Readiness Index* (database), https://oxfordinsights.com/ai-readiness/ai-readiness-index/; Demirgüç-Kunt et al. (2022[18]), *The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19* (database), https://doi.org/10.1596/978-1-4648-1897-4; AUC/OECD (2021[19]), *Africa's Development Dynamics 2021: Digital Transformation for Quality Jobs*, https://doi.org/10.1787/0a5c9314-en, for the share of the population that can afford 1 gigabyte of mobile data monthly; Wiley (2021[20]), Digital Skills Gap Index 2021, https://dsgi.wiley.com/; Choi, Dutz and Usman (2020[21]), *The Future of Work in Africa: Harnessing the Potential of Digital Technologies for All*, https://documents1.worldbank.org/curated/en/511511592867036615/pdf/The-Future-of-Work-in-Africa-Harnessing-the-Potential-of-Digital-Technologies-for-All.pdf, for ICT Readiness scores. Data on Inflows to tech startups are sourced from the literature.

The supply of and demand for different levels of digital skills vary across East African countries, depending on the advancement of a country's digital economy. Digital skills can be divided into three levels: basic (e.g. smartphone use and e-mail), intermediate (e.g. use of multiple devices and professional social media) and advanced (e.g. web design, data science) (Chapter 1). Overall, East African countries with lower ICT readiness have a lower supply of and demand for digital skills. For example, Tanzania scores 3.3 out of 10 on Wiley's Digital Skills Gap Index 2021,[1] but only 1.7% of its youth are employed in digital skill-reliant work, compared to 3.2% in Kenya and 5.6% in Nigeria (Makaro, 2023[22]).

Digital skill supply is rising across most East African countries, while advanced and entrepreneurial skills remain scarce

Fast Internet access and adoption of digital applications like mobile money has increased the digital skill supply in some East African countries. The arrival of fast Internet in several countries in the region has allowed informal workers to develop digital literacy (Choi, Dutz and Usman, 2020[21]). East Africa also boasts world-leading registration figures for mobile money accounts (1 106 per 1 000 adults vs. 600 for Africa, 533 for developing Asia and 245 for Latin America and the Caribbean) (StearsData, 2024[23]). In Madagascar, the recent graduation of hundreds of new software engineers (Ericsson, 2024) coincided with its expansion of 4G and 5G networks. However, where access to broadband and smartphones is limited, digital literacy and related skill supply are also limited (Gottschalk and Weise, 2023[24]). High Internet costs reduce households' and firms' adoption of digital technologies. The share of the East African population who can afford one gigabyte of mobile Internet data was only a third (34%) in 2020 (AUC/OECD, 2021[19]). As a result, workers in many East African countries have scarce basic digital skills: 33% of Mauritius' population over 15 years old possess basic skills, compared to 16% in Djibouti and 4% in South Sudan.[2]

The improving supply of digital skills can facilitate productivity gains in organisations across East Africa. These skills include digital literacy and data analytics in public, private and third sector organisations (TradeMarkAfrica, 2023[25]; Choi, Dutz and Usman, 2020[21]). Notably, e-commerce platforms can boost the productivity of the region's farmers and small traders, by helping them access new customers, share insights and improve their use of digital applications such as mobile money and social media (Caribou Digital Institute, 2024[12]; Begazo, Blimpo and Dutz, 2023[26]).

> Productivity among Uganda's 27 000 health workers improved following the government's introduction of the mTrac mobile application that facilitated the development of digital literacy and related skills (Bastos de Morais, 2017[27]).

Low investment in research and development (R&D), low science, technology, engineering and mathematics (STEM) enrolment, and limited university infrastructure are hampering the supply of advanced digital skills across the region. From 2000-16, East Africa spent only 0.27% on R&D, far below the African Union's Agenda 2063 target of 1% and much farther below the OECD countries' 2.5% (AUC/OECD, 2019[28]). This contributes to the shortages of advanced digital skills, including quality engineering talent (Mia, 2024[29]; Dupoux et al., 2022[11]; UNESCO/Huawei Technologies, 2022[30]). In addition, the low tertiary enrolment in STEM subjects, higher enrolment costs for students, and a relative lack of STEM-related educators with up-to-date knowledge and pedagogic skills contribute to a short supply of digital skills. Ill-equipped local universities and educational institutions (e.g. lacking powerful computers and servers) also play a role (Choi, Dutz and Usman, 2020[21]). However, well-designed and resourced initiatives can counter this trend (Box 5.1).

Box 5.1. **Advancing artificial intelligence and high-end digital skills in Seychelles**

Seychelles Innovation HUB, launched in 2018, has become the epicentre of the island nation's artificial intelligence (AI) ecosystem and an incubator for start-ups and entrepreneurs. The hub has attracted significant private sector interest, assisted by Seychelles' reputation for regulatory discipline and ranking as Africa's third best for ICT readiness and 68th in the Global AI Readiness Index 2020. Firms that have joined the hub include Accenture, with its AI-focused innovation centre, and financial technology (fintech) companies, such as CoinFlex, Prime XBT and LetsExchange. Seychelles' fintech sector boasts two unicorns, KuCoin and Scroll, with a market capitalisation of approximately USD 945 million and USD 4.8 billion, respectively (CoinMarketCap, 2024[31]; CoinBrain, 2024[32]). The hub's Generative AI section hosts Travizory, a Seychellois technology pioneer credited with digital tools compliant with the International Civil Aviation Organization and the United Nations Security Council. This firm aims to improve data protection and Internet access through AI, so far serving over 4 million passengers by allowing easy verification of nearly 15 million documents.

Source: Mia (2024[29]), "Seychelles' thriving artificial intelligence ecosystem", https://capmad.com/technology-en/seychelles-thriving-artificial-intelligence-ecosystem/.

Digital entrepreneurial skills are in short supply in most East African countries. Digital startups are creating a wide range of digital products (applications and software, digital media, fintech, e-commerce, tourism, and sport) (Begazo, Blimpo and Dutz, 2023[26]; Bosson et al., 2022[33]). However, with the exception of Kenya, digital entrepreneurial skills (i.e. an understanding of how to operate and grow a digital venture and how to do so in a given local context) are limited across East African countries. The lack of such skills stems from the typically limited size and maturity of digital entrepreneurship ecosystems. As a result, experienced mentors are similarly scarce, limiting the development potential of young digital entrepreneurs (Friederici, Wahome and Graham, 2020[34]).

The digitalisation of East African firms and economies is driving the demand for digital skills, especially basic skills

As East Africa's economies have digitalised, the demand for digital skills has risen. About 87% of African business leaders identify digital literacy for enhancing productivity as a priority area for further investment (Dupoux et al., 2022[11]). Larger corporations, governments and start-ups have driven the demand for digitally skilled workers across East Africa. Key sectors include fintech, education, health, energy, agriculture, transport and infrastructure, information technology (IT) and business process outsourcing, international trade, tourism, manufacturing, forestry and land management, and building and construction (IFC, 2024[35]; Sandbox, 2024[36]; IFC, 2021[37]). The imperative to digitalise work processes to enable remote working and service delivery during the COVID-19 pandemic accelerated this trend. Projections indicate that Kenya and Rwanda will require, respectively, USD 1.5 billion and USD 0.3 billion to train their existing workforce in digital skills and USD 1.3 billion and USD 0.2 billion to train new workers over the 2019-30 period.

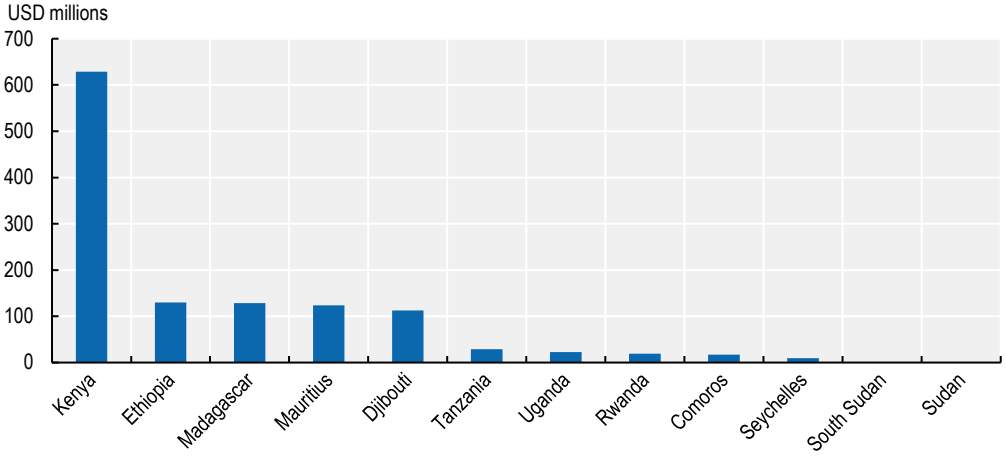
Demand is greatest for basic digital skills, while intermediate and advanced skill demand is growing more slowly and in specific sectors. In Kenya, for example, 32.7 million jobs are projected to require digital skills by 2030: 65% (21.4 million jobs) with basic digital skills, 29% (9.6 million jobs) with intermediate digital skills and 5% (1.7 million jobs) with advanced digital skills. The corresponding figures for Rwanda's smaller but fast-growing

market are 6.5 million jobs requiring digital jobs by 2030, with 69% (4.5 million jobs) at the basic level, 29% (1.9 million jobs) at the intermediate level and 1.5% (0.1 million jobs) at the advanced level (IFC, 2021[37]). Madagascar is projected to create 140 000 jobs requiring digital skills by 2027 (IFC, 2024[35]). In Mauritius, the tourism industry is demanding advanced digital skills, specifically for web designers.

The lack of advanced digital workers, such as software engineers, is hampering the growth of digital firms in the region. Increased demand for intermediate and advanced digital skills arises from new digital ventures, for instance, in fintech (Mauritius Africa FinTech Hub, 2024[38]). Digital enterprises typically depend on highly skilled, creative knowledge workers, including software engineers, designers, product developers, project managers, data scientists, social media managers as well as entrepreneurial workers. However, software engineers, who would be able to build compelling digital products, master coding languages, co-shape a venture's strategy and lead teams of junior developers, are often unaffordable or inaccessible for local digital firms. Some local ventures resort to recruiting talent from high-income countries or outsourcing software development (mostly to India and sometimes to Europe) but typically at a significant cost (Friederici, Wahome and Graham, 2020[34]).

Increased digital service exports indicate a growing demand for East African workers with intermediate and advanced digital skills, working remotely for firms around the world. East African digital service providers (e.g. for customer support) have created a demand for digitally skilled remote workers (Melia, 2020[13]). In Kenya, the regional leader, ICT services generated significant export revenue (USD 629 million) in 2019 (UNCTADstat, 2023[39]), with an additional 1 million business process outsourcing jobs expected by 2028 (Mwangi, 2023[40]). Four other countries also generated significant export revenues from ICT services in 2019-20: Ethiopia (USD 123 million), Madagascar (USD 128 million), Mauritius (USD 124 million) and Djibouti (USD 113 million) (Figure 5.7). Sought-after digital skills include intermediate (e.g. web design, social media account creation) and advanced (e.g. software engineering).

Figure 5.7. **Export of services in information and communications technology by selected East African countries**



Source: Authors' calculation based on UNCTADstat (2023[39]), *FDI Online Database* (database), https://unctadstat.unctad.org/datacentre/.

StatLink StatL https://stat.link/snjmex

Job displacements due to digital upskilling and automation are likely to affect East Africa to only a limited extent. East Africa's formal labour markets are not immune to the

risks of outdated skills and large-scale job displacements associated with automation, AI and increasing digital skills requirements. However, the effects of these developments are expected to be modest, as they are unlikely to replace as many jobs in East Africa as in more industrialised areas of the world (Choi, Dutz and Usman, 2020[21]). In furniture production in Kenya, for example, data indicate that robots will become more cost-competitive than workers in 2034, 11 years later than in the United States, due to lower labour costs and higher operational costs for robots (Banga and Willem, 2018[41]).

East Africa's advanced economies provide more specialised digital skills, while inclusive provision is missing throughout the region

Digital skills training varies greatly in depth and specialisation across East African countries. Desk research across all East African countries suggests that digital skills training opportunities are heavily concentrated in Cluster 1 and Cluster 2 countries. A wide array of public and private, local and international funders and providers are offering digital skills training (Table 5.2). The region's growing population of STEM and ICT graduates, particularly in Cluster 1 countries, further reflects this increased focus (World Bank, 2023[42]; UNESCO/Huawei Technologies, 2022[30]).

Table 5.2. **Examples of digital skills training providers in East Africa**

Provider	Country	Target	Digital skill level	Partners	Impact/outcome
Local universities and tertiary institutions					
AI Center of Excellence	Kenya	Professionals	Advanced	Several, e.g. Huawei	Upskilling the workforce
Jomo Kenyatta University	Kenya	Students, faculty	Advanced	Several, e.g. IBM, Chandria	Public education
Strathmore University (private)	Kenya	Students, faculty	Advanced	Several, e.g. Standard Chartered	Public education
Uganda Institute of Information and Communications Technology	Uganda	Students	Intermediate, advanced	Several	Public education
Rwanda Coding Academy	Rwanda	Students	Intermediate, advanced	N/A	Public education
Digital multinational enterprises					
Cisco Networking Academy, Digital Transformation Centres	Kenya	Students, youth, faculty	Basic, intermediate, advanced, (certification)	UNDP Eritrea, Eritrean Workers, ITU	104 978 trained
Andela	Kenya, Rwanda, Uganda; online	Students, employers	Advanced	N/A	100 000 targeted
Microsoft Development Centres	Kenya, Nigeria, Uganda; boot camp	Students, teachers, juniors, faculty, youth	Advanced	Cisco Systems, Safaricom, Nestle.	Career readiness and capacity, curriculum, tech capabilities.
Huawei DigiTalent, DigiTruckproject	Kenya, Ethiopia; internship, online	Youth, rural, adult learners, professionals, women	Basic, intermediate, advanced, (certification)	Government, United Nations, Academia, ICOG Anyone Can Code	1 000+ trained
Google Hustle Academy	Ethiopia, Ghana, Madagascar, South Sudan, free virtual boot camp	Youth, employers	Basic, intermediate, advanced	N/A	1 000 trained
Local digital enterprises and private sector					
Rift Valley Tech Training Institute	Kenya	Students	Intermediate	N/A	5 000 trained
Fikrcamp	Ethiopia, Somalila; boot camp	Youth	Basic, intermediate, advanced, soft	Ridwan Tukale co-founder	186 trained
LP Digital	Tanzania; three-month online, free	Youth, women, students, entrepreneurs	Basic, intermediate	N/A	56 trained

Table 5.2. **Examples of digital skills training providers in East Africa *(continued)***

Provider	Country	Target	Digital skill level	Partners	Impact/outcome
Maendeleo Foundation	Uganda; virtual	Girls, teachers, professionals	Basic, intermediate, advanced, soft (storytelling)	N/A	100 girls, 50 teachers, 100 parents
Meta Boost Ethiopia	Ethiopia; online	Small and informal enterprises		Ministry of Public Service and Labor and Skills, Summer Media	7 000 trained
International partnerships and not-for-profits					
African Institute for Mathematical Sciences Rwanda (AIMS Rwanda)	Rwanda	Students	Advanced	N/A	Public education, 47% female students
Carnegie Mellon University-Africa	Rwanda	Students	Advanced	Government of Rwanda	N/A
Tecnológico de Monterrey, Mercer and Malagasy universities	Madagascar	Youth, women	Advanced	IFC, World Bank's PRODIGY project, Malagasy Government	6 000 employees, including youth and women trained
GaroBits School (for graphic and web design)	Somalia (Puntland State)	Youth	Intermediate	Shaqadoon Organization, Garowe. European Union, United States	200 trained

Note: N/A = Non-applicable.
Source: Authors' compilation.

Most technical and vocational education and training (TVET) institutions that offer digital skills training are in Cluster 1 and Cluster 2 countries and focus on applying digital skills to various technical sectors. Among the 14 TVET institutions identified for the present analysis,[3] only 2 were in Cluster 3 countries (Madagascar and Sudan). Across the 12 countries in Clusters 1 and 2, most (9) integrated digital skills in training courses targeting technical skills in a variety of sectors and occupations, especially in automotive (4), engineering (4) and electronics (3). TVET programmes run by local universities, tertiary education institutions, development partners and not-for-profits tend to offer intermediate and advanced digital skills training to young people, while private sector programmes address a wider audience for skills ranging from basic to advanced, notably through online training.

Digital skill provision tailored to children is scarce, and women are often under-represented. Primary school teachers often lack the capacity necessary to help children gain basic digital skills, for instance, in Somalia (Khalif, 2023[43]) and Uganda (UNDP, 2023[44]). Women represent only 30% of the region's ICT graduate population, a major source of digital skill supply (Begazo, Blimpo and Dutz, 2023[26]). In Kenya, for example, although 41% of students surveyed across the country's universities were women, just 17% were pursuing degrees in science and technology subjects (Mbogho, 2017[45]). Fewer than 20% of digital sector workers in Kenya are female.

> The #SheGoesDigital programme offers a 40-day training course in social media and digital marketing to financially disadvantaged Kenyan women, followed by internships with relevant companies.
>
> The Indo-Africa Internship Programme selects promising East African IT graduates, prioritising young women, for three- to six-month internships with Indian companies (ITC, 2018[46]).

While scarce, entrepreneurship training and apprenticeships provide workers with practical, relevant digital skills. Training offered within mainstream educational curricula can close gaps in the region's supply of entrepreneurial skills and analytical capabilities with regard to digital technologies, for instance, the ability to apply data and insights to real-world decision-making (Dupoux et al., 2022[11]; Choi, Dutz and Usman, 2020[21]).

However, Kenya (UNESCO/Huawei Technologies, 2022[30]), Madagascar (IFC, 2024[35]) and Uganda (Choi, Dutz and Usman, 2020[21]) have been found to be lacking in this regard. Apprenticeship programmes can equip workers with in-demand digital skills, but limited policy support and incentives often result in low private sector participation in those programmes (UNESCO/Huawei Technologies, 2022[30]). Exceptions are Kenya,[4] Rwanda[5] and Uganda,[6] which have established national apprenticeship programmes. Such training programmes have been shown to effectively enhance the job prospects of participants, leading to a decrease in unemployment rates and an increase in earnings (David and Schoar, 2021[47]).

> Digital (web design and digital graphics) and entrepreneurial skills, gained from Strathmore University incubation centre, iBiz Africa, helped Nairobi-based Purpink to grow into a successful, award-winning business. The company, which offers customers co-created personalised gifts via its digital platforms, is expanding to other Kenyan and East African cities, including Kampala (Strathmore University, 2024[48]).
>
> The Digital Opportunity Trust's Digital Jobs Programme provides training, including through peer mentors, to over 1 000 participants in software products that are in demand in the Tanzanian workplace and via online freelancing. Several programme participants saw their monthly income grow by 20% due to new digitally enabled work opportunities (DOT Tanzania, 2024[49]).

Green digital skills training for specific entities is growing in importance. Continuing digitalisation of the green sector is expanding demand for workers with green digital skills or with skills for building sustainable digital solutions (INCO Academy, 2024[50]). Data centres, smart grids, digital wind farms, digital hydropower stations and operational efficiency applications are examples of entities that require workers with data analytics and specific engineering skills. Green digital skill certificate programmes offered freely by Microsoft and LinkedIn-backed INCO Academy (2024[50]), for example, are equipping trainees, typically from digital backgrounds, with complementary green-specific skills to facilitate access to green jobs.

> Jomo Kenyatta University's agricultural incubator seeks to train a digitally skilled green labour force to achieve global competitiveness and thrive in the 21st-century digital landscape (JKUAT, 2024[51]).

East African countries require specific strategies to develop digital skills based on national levels of supply and demand

Beyond expanding Internet access, East African countries can benefit from country-specific digital skills development strategies that determine targeted skill provision and promote regional collaboration. East African countries have already implemented wide-ranging digital policies (Table 5.3), including those afflicted by conflict (Box 5.2). To reap the maximum benefits of digital skills development for jobs and productivity, East African countries can pursue three complementary policy priorities:

1. Expand Internet access and integrate digital skills into education to increase the supply of and demand for basic digital skills.
2. Targeting intermediate and advanced digital skill provision towards country-specific needs and global demand.
3. Enhance regional integration of digital markets, infrastructure and skills development to improve conditions for digital skills development and digital entrepreneurship.

Table 5.3. **Digital policy and regulatory frameworks in East Africa**

	Cluster 1					Cluster 2		Cluster 3						
Framework	Kenya	Uganda	Tanzania	Rwanda	Ethiopia	Mauritius	Seychelles	Comoros	Somalia	Madagascar	South Sudan	Djibouti	Eritrea	Sudan
National ICT Policy/Master plan	x	x		x								x		
Digital Economy Strategy/Vision	x	x			x	x	x	x		x		x		
National Skills Development Policy	x	x	x	x		x	x			x			x	x
Digital Transformation or Innovation Roadmap/ Blueprint/Masterplan		x		x	x	x						x		
Digital Skills/Talent Action Plan				x	x									
Science, Technology, and Innovation Policy	x	x	x	x		x	x	x	x	x	x	x	x	x
TVET policy	x		x	x			x	x	x			x	x	x
Basic skills and digital literacy policy	x		x				x	x					x	
Recognition of prior learning					x									
Demand-driven curricula	x	x										x		
ICT labour market system	x		x		x								x	
Youth empowerment policy	x													
Pedagogy and faculty	x		x		x			X		x				
Industrial attachment and internships			x	x	x							x	x	
Incentives for the private sector	x											x		

Source: Authors' compilation.

Box 5.2. **Digital skills policies in least developed countries affected by conflict in East Africa**

Somalia is beset by low literacy rates, limited Internet access and teacher training deficiencies. The COVID-19 pandemic, however, catalysed innovation in distance learning programmes (UNESCO, 2023[52]).

South Sudan lacks a dedicated ICT Act, ICT in Education/EdTech Act or competency framework for teachers. However, its revised national education strategy, development strategy and curriculum framework cover digital skill provision (Republic of South Sudan, 2017[53]). The framework aims to integrate ICT into the curriculum from early childhood to Grade 8 and to develop competencies such as critical and creative thinking, communication, and multimedia digital and soft skills (Republic of South Sudan, n.d.[54]).

Sudan's vision for education prioritises electronic education and investments to develop computer labs in schools, but no digital competency framework or STEM focus exists. The country's COVID-19 response supported digital learning and requisite digital skills training for teachers (UNESCO, 2022[55]).

Expanding Internet access and integrating digital skills into education can increase the supply of and demand for basic digital skills in East Africa

Greater Internet access, market regulations and digital infrastructure investments are foundational to increasing East Africa's digital skill supply and demand. For digital skills, in-country supply and demand are closely interconnected and depend on the degree of digital transformation in specific sectors and in the country overall. Given the significant spillover effects on productivity, expanding Internet access to excluded populations is

a priority for all East African countries. Internet access could be made more affordable through enhanced competition and better management of public telecom assets, including more transparent rules on licensing and market dominance, infrastructure access and sharing (Begazo, Blimpo and Dutz, 2023[26]). In addition, digital infrastructure investments can also attract both local and international private investments, as well as contributions from development partners (Dupoux et al., 2022[11]).

> Regional digital infrastructure projects, such as the African Development Bank's USD 2 billion investment or the World Bank's USD 130 million Eastern Africa Regional Digital Integration Project Series, promise to drive down digital access costs through economies of scale.

Integrating digital skills training into early childhood education is cost-effective, especially if financed through innovative funding approaches. East Africa's constrained fiscal space and debt profile (particularly in Comoros, Djibouti, Ethiopia, Kenya and South Sudan) demand difficult trade-offs in the provision of digital skills (AfDB, 2023[56]). Investments in early childhood education is an essential first step for such countries, as it allows them to address the high demand for basic and intermediate skills (Chapter 1). As a financing option, innovative funding approaches can be effective by mobilising blended finance from public, private and international partners (see Table 5.4 for examples of such policies).

> Since 2021, UNICEF has been testing digital learning solutions across 93 learning centres in remote areas of Sudan. Their methods include stories and videos to explain the exercises to children, backed with digital equipment such as solar-powered tablets. Results show that participants outperformed traditional learners in learning outcomes by 1.7 times (UNICEF, 2023[57]).
>
> The Madagascar-based start-up Jirogasy is collaborating with Aceleron, a United Kingdom developer of circular economy lithium-ion batteries, to deliver solar-powered Madagascan-built computers to 10 000 children a year across schools in Madagascar and East Africa (Envirotech, 2021[58]).

Table 5.4. **Examples of inclusive digital skills development initiatives in East Africa**

Focus	Programme/country	Funder	Impact
Universal basic digital literacy	Digital Ambassador Programme, Rwanda	Government	Deployed 110 digital ambassadors, trained 67 627
Digital skills via lifelong learning	Digital Skills @ Your Local Library project (2021-23), Uganda	Enabel Belgium	Over 22 000 youth, 50% female
Digital education capacity building for universities	Strengthening Higher Education initiative, Ethiopia	Mastercard Foundation	Reached 800 000 students and 35 000 instructors in 50 public universities with 2 model digital courses
Digital skills for refugees	Universal Digital Acceleration Programme (2023-28), Uganda	World Bank	Essential digital skills and related skills for over 1.5 million refugees
Universal digital literacy	Leaving No One Behind in the Digital Era, Uganda	UN Capital Development Fund	Digital literacy skills for 1 million Ugandans by 2024
Expansion of digital skills	Digital Foundations Project, Djibouti (USD 10 million)	World Bank	Reducing connectivity costs
	Extending the mobile money service Mvola to the unbanked, Comoros	IFC	The unbanked gained digital literacy via affordable access
	Digital Jobs Programme and Digital Ambassadors (2013-present), Tanzania	Digital Opportunity Trust	Trained over 30 000 youth from disadvantaged backgrounds and 400 youth leaders in digital skills
	Daring to Shift project (2019-23), Tanzania	Canadian Government	Digital literacy and work readiness skills to over 1 000 youth, including women, and 40 000 community members
Digital skills development	Support for ICT-backed education, Somalia	UNESCO	Facilitated access to digital skills and relevant policy development

Source: Authors' compilation.

Effective school-to-work initiatives can both improve youth's digital skills development and fill firms' labour shortages. Internships and on-the-job training can be win-win strategies for firms and students: they expose youth to higher level skills, and they can address shortages in the digital sector, such as in active digital hubs in Nairobi. Cluster 1 countries increasingly promote such programmes. Cluster 3 countries, such as Somalia, particularly need such skills development partnerships to help reduce skill mismatches and facilitate students' transition into graduate jobs (Aylaw, 2023[59]).

> Kenya's President Digital Talent Program is designed to develop future government leaders skilled in digital technology. Over a 12-month period, interns receive specialised training in digital skills and project management, gaining practical experience with 10 months in government roles and 2 months in private firms (UNESCO/Huawei Technologies, 2022[30]).

Intermediate and advanced digital skill provision can be targeted towards country-specific opportunities and global demand

Data-driven skill assessments can inform policy makers of intermediate and advanced digital skills gaps. Demand for intermediate and advanced digital skills arises mainly from high-productivity sectors and global markets. Strengthened labour market information systems and dedicated analysis of job vacancy data can help policy makers identify emerging skill needs and gaps (Chapter 2). Digital skills are particularly well suited to be assessed through big data and job vacancy data. East African policy makers can use these approaches to identify digital skill gaps in priority sectors and determine the most effective digital skill provision measures at the national level (e.g. sensors and AI in agriculture, machine learning in fintech).

> Mauritius' Strategic Plan 2030 foresees the development of an advanced digital ecosystem and "technopreneurial" spirit through funding 50 yearly scholarships in blockchain technology (Republic of Mauritius, 2020[60]).

Targeting TVET can expand the digital skill supply. Policy support for TVET institutions can contribute to meeting the demand for digital skills training opportunities. Additional support for TVET and secondary education institutions can greatly increase the region's supply of intermediate digital skills (IFC, 2021[37]). International partners can help create or improve accredited TVET courses aligned to employers' needs through public-private alliances.

> Uganda, sponsored by the Japan International Cooperation Agency (JICA), has established the Nakawa Vocational Training College to provide vocational courses in electrical engineering and automobile engineering.
>
> Rwanda's TVET institution IPRC Tumba, financed by JICA and the Agence Française de Développement, in collaboration with the local government and the private sector, is a hub for training in advanced digital skills to be employed in the digital sector, in electrical and electronics engineering and in mechanical engineering (IPRC Tumba, 2024[61]).
>
> The Rwanda Coding Academy (RCA) is a unique educational institution that combines elements of general education and TVET. Launched in January 2019, RCA specialises in teaching advanced digital skills such as software development, embedded systems programming and cybersecurity (IFC, 2021[37]).

Strengthened collaboration between academia and industry can help universities produce graduates with market-ready digital skills. Skilled practitioners as adjunct lecturers allow industry-driven training and practice-oriented pedagogy. Industry advisory committees, comprised of professionals and experts from various industries,

provide guidance to tertiary education institutes on curriculum development and industry engagement programmes for faculty. East African universities, particularly those in Cluster 3 countries, still lag behind in this respect, but successful initiatives that link academia and industry exist in the region.

> Rwanda's Innovative Digital Platform[7] – financed by the Research and Innovation Systems for Africa (RISA) Fund – was launched in December 2023 and aims to reduce the skill gaps between academia and industry through improved research and consultancy, joint curriculum development, and job placement.
>
> The East Africa Skills for Transformation and Regional Integration Project (EASTRIP), funded by the World Bank, allowed for placing over 30 faculty staff of Tanzania's Dar es Salaam Institute of Technology in industries as part of mutual training and work programmes (World Bank, 2023[42]).
>
> Mauritius has planned a strategic review of training content to redress the mismatch between emerging graduates' skills and the labour market need for software engineers.

Intensifying the development of advanced digital skills and the skills of STEM graduates can enhance East Africa's role as a global digital hub. Investing in the development of advanced and specialised digital skills is critical for the region to supply high-end digitally skilled innovators and entrepreneurs. Cluster 1 countries particularly need to increase investments in R&D and knowledge production to generate momentum for innovation. Initiatives such as targeted support for bright STEM students can be effective, but to fill gender gaps, they need to focus on women, as only 30% of STEM graduates are female in East Africa. Educating more women would also expand the supply of experts in advanced digital skills and of STEM workers.

> In 2018, UN Women and the African Union Commission, in partnership with the International Telecommunication Union, UNESCO, the United Nations Economic Commission for Africa and UNICEF, launched the African Girls Can Code Initiative. This initiative equips African girls and women aged 17 to 25 with advanced digital skills.

Strengthening digital skills can foster the creation of digital startups and increase entrepreneurship. Strategic commitment to innovation can help advance digital upskilling and possibly lead to the development of startups (Choi, Dutz and Usman, 2020[21]) or improve digital entrepreneurship within existing businesses and organisations.

> The Mauritius Africa FinTech Hub skills programme, supported by PwC, aims to equip Mauritian startups with entrepreneurial skills to scale their business and access pan-African and wider international markets (Mauritius Africa FinTech Hub, 2024[38]).
>
> Since 2015, the Smart Duka programme, operated by TechnoServe, has provided business training and helped digitise informal micro-retailers in Kenya and Tanzania. It has also created a collaborative digital ecosystem in which shop owners operate collectively in business groups (e.g. through WhatsApp) and are connected to a supportive network of financial, technology and supply chain partners (TechnoServe, 2020[62]).

A single digital market and partnerships can drive the regional integration of digital skill supply and demand

A single regional digital market and a multi-currency digital payment facilitator could increase the development of digital skills. A unified digital market can promote seamless connectivity, harmonise regulations and facilitate cross-border payments. Creating such

a market could enhance the ongoing initiatives by the East African Community (EAC) and the Common Market for Eastern and Southern Africa to interconnect countries, promote digitalisation and encourage innovation (AUC/OECD, 2021[19]). The resulting larger integrated market could help expand opportunities for digital skills development, digital entrepreneurship and digital skills demand. These could boost the region's GDP by up to USD 2.6 billion (TradeMark Africa, 2022[63]), including an increase in intra-African trade, which currently represents 30% of East Africa's exports (Kuwonu, 2024[64]). The African Continental Free Trade Area's agenda, including its new international and multi-currency digital payment facilitator the Pan-African Payment and Settlement System, has the potential to deepen the supply and demand dynamics for digital skills (Choi, Dutz and Usman, 2020[21]).

> Through Strathmore University in Kenya, the African Union-European Union Digital for Development Hub launched the initiative Strengthening Data Protection across East Africa. The initiative allows data protection authorities and private sector representatives to exchange lessons learned, best practices, resources and guidelines (D4D Hub, 2023[65]).
>
> To support digital startups by youth and small and medium-sized enterprises, the African Union Commission and Google have partnered to offer Digital Skills Campaigns, five-day digital skills workshops. They have so far benefited 45 young business owners, managers, entrepreneurs and students from Ethiopia and Kenya (Mpemba, 2023[66]).

Regional partnerships between tertiary research and training institutions and regional centres of excellence can nurture advanced digital skills, including through strong private sector linkages. With support from development partners, regional partnerships and centres of excellence can establish training courses for specific advanced digital skills at the regional level. Regional data centres and supranational analytic hubs require workers who have advanced and specialised digital skills (Dupoux et al., 2022[11]).

> The Regional Flagship ICT Centre (RAFIC) for digital skills is one of 16 regional centres of excellence of EASTRIP. RAFIC has 1 400 graduates, 5 000 students, 180 teachers, and 60 managers and other staff. It has mentored 200 women in science and technology.
>
> Under the EAC's Digital Skills for an Innovative East African Industry initiative, the Inter-University Council of East Africa, the German Gesellschaft für Internationale Zusammenarbeit (GIZ) and an East African-German academic consortium have partnered to provide cutting-edge digital skills training. The initiative offers a two-year Master's programme in Embedded and Mobile Systems; it has taught digital and entrepreneurial skills to 96 students from Burundi, Kenya, Rwanda, South Sudan, Tanzania and Uganda, 34% of them women. Also, through the initiative's Digital Skills Accelerator courses, 150 unemployed graduates have been trained in Android Mobile Applications Development (BMZ et al., 2021[67]).

Attracting talent with advanced and specialised digital skills is essential to ensure the region's participation in future digital advancements. Programmes aimed at the diaspora skills pool and other highly skilled individuals can significantly enhance the development of local digital technologies. Digital nomad visas, skill mobility partnerships and reintegration programmes (see Chapter 2) are crucial for attracting talent and for circulating skills.

> Mauritius recently launched a digital nomad visa allowing non-citizens to live in Mauritius and work remotely for a company or client or own a business based outside the country for a year, with the option to renew the visa for a second year (Quantamnomad, 2023[68]).

> Seychelles launched its Workation Retreat Program digital nomad visa in April 2021. Valid for one year and renewable for six months, it offers tax exemptions on local and personal income as well as on business taxes (VisaGuide.World, 2024[69]).

Notes

1. Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Tanzania and Uganda are covered. Countries are ranked based on indicators in 6 pillars: (1) Digital skills institutions (including digital skills upon graduation), (2) Digital responsiveness (including responsiveness of the education system), (3) Government support (including importance of ICTs to government's vision), (4) Supply, demand and competitiveness (including size of the STEM gender gap), (5) Data ethics and integrity (including cybersecurity performance), (6) Research intensity (including academic articles per 1 000 graduates). Indicators are normalised into scores from 0 to 100.
2. Authors' calculation based on "ITU ICT SDG indicators – Proportion of youth and adults with ICT skills, by type of skills" (ITU, 2024[70]).
3. The complete overview of TVET programmes can be obtained upon request.
4. https://www.opportunitiesforafricans.com/government-of-kenya-presidential-digital-talent-programme-cohort-viii/
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Chapter 6

Skills for renewable energies in North Africa

This chapter examines the skills needed to support the development of the renewable energy sector in the six North African countries: Algeria, Egypt, Libya, Mauritania, Morocco and Tunisia. It provides an overview of current levels of education, employment and skills development in the region, followed by a case study on the skills required in the renewable energy sector. North Africa is well-equipped to take advantage of the many resources available to the region (solar, wind and hydroelectric power) to achieve a just energy transition. This chapter assesses the skill sets of workers in different segments of renewables value chains, and then analyses how the skill demand is evolving. Finally, it proposes a range of public policies to ensure the skill supply better aligns with the skill demand in the renewable energy and related sectors.

IN BRIEF

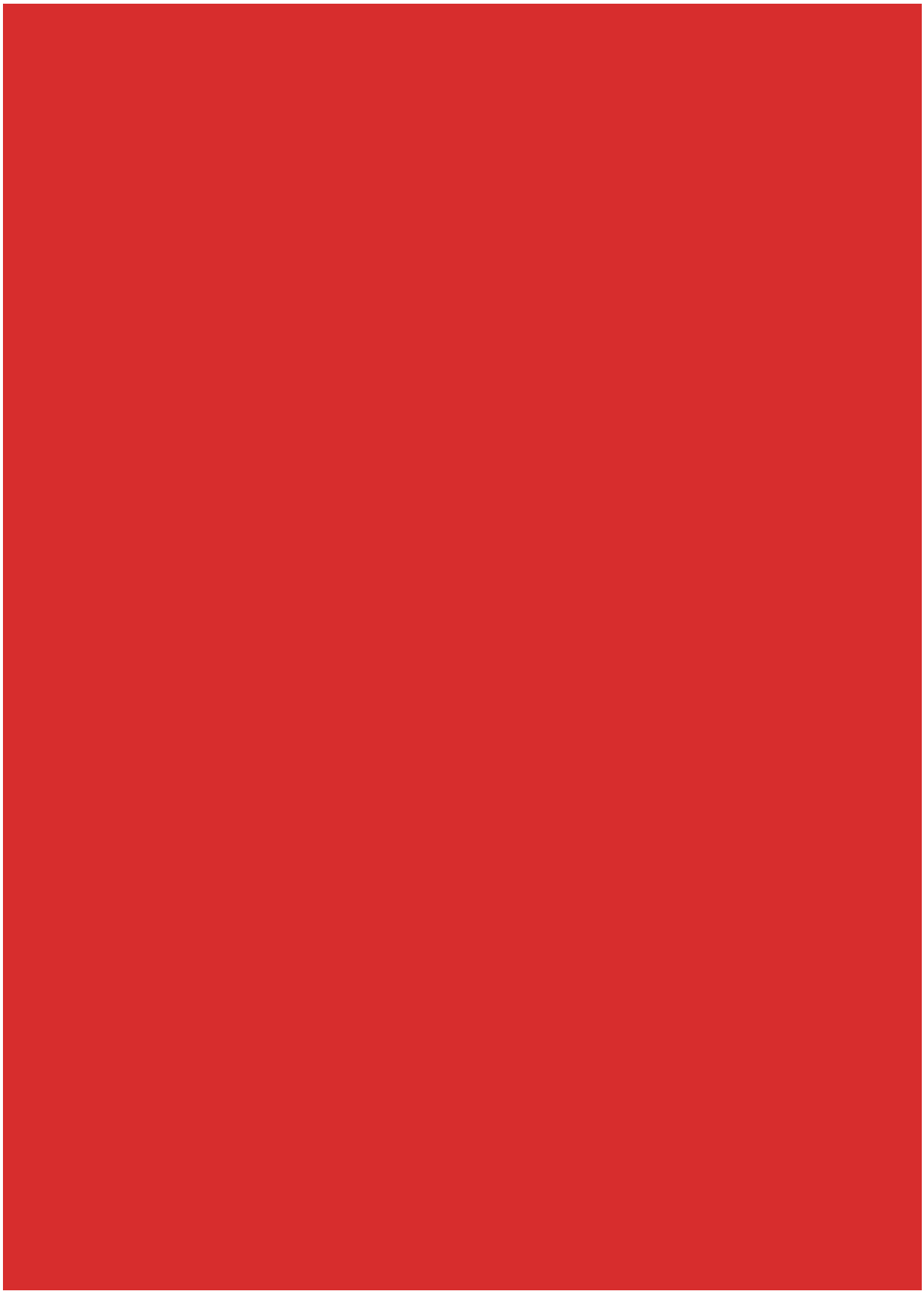
The quality of education in North Africa has improved significantly. Now the challenge is to maintain this progress for all: while the average years of schooling is 7.9 years – higher than the average for the continent (6.7 years) – once this figure is adjusted for learning quality, the average drops to 6.1 years. There are still a number of inequalities, not only between urban and rural areas, but also between genders. Although the region has the highest productivity on the continent (around USD 42 000 per worker), almost 73% of workers are in informal employment.

Renewable energy has the potential to create 2.7 million jobs in North Africa, given that the region boasts the continent's greatest potential for solar and wind power, and could become the leading exporter of green hydrogen by 2050, with a projected annual value of USD 110 billion.

However, the growing demand for skills is not being met. This mismatch between supply and demand is caused by a number of factors, including the narrow scope of national skills development strategies, the lack of funding for relevant training, and poor transparency in the dissemination of information, and the mismatch between the skills available and the needs of the labour market.

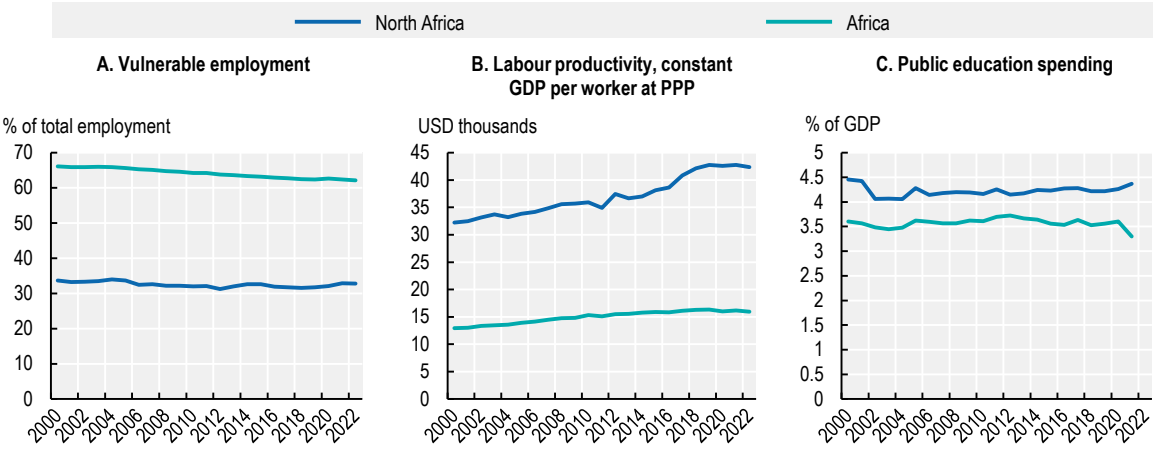
To develop skills in the renewable energies sector, policymakers could therefore consider three priority measures:

1. Developing and implementing participatory and inclusive national strategies that anticipate the growing demand for skills and that align training with the needs of the market, following a people-centred, gender-sensitive, and focused on sustainable local development approach.
2. Expanding the range of skills available by investing more effectively in research and development and centres of excellence, and by strengthening vocational and technical training, internships and work-study programmes.
3. Setting up an institutional framework supported by competent and well-resourced authorities for the good governance of public-private, regional and international partnerships.



North Africa regional profile

Figure 6.1. **Vulnerable employment, labour productivity and education spending in North Africa, 2000-2022**



Note: Vulnerable employment includes formal and informal self-employed workers and family workers, but excludes informal employees. As a proxy for informal employment, it is used here to show long-term trends, as time series on informal employment are not available for most African countries. Labour productivity is measured as gross domestic product (GDP) in constant 2017 international dollars at purchasing power parity (PPP) prices, divided by the population of employed people in thousands.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates (database)*, https://ilostat.ilo.org/; World Bank (2023[2]), *World Development Indicators (database)*, https://databank.worldbank.org/source/world-development-indicators; and IMF (2023[3]), World Economic Outlook (database), https://www.imf.org/en/Publications/WEO.

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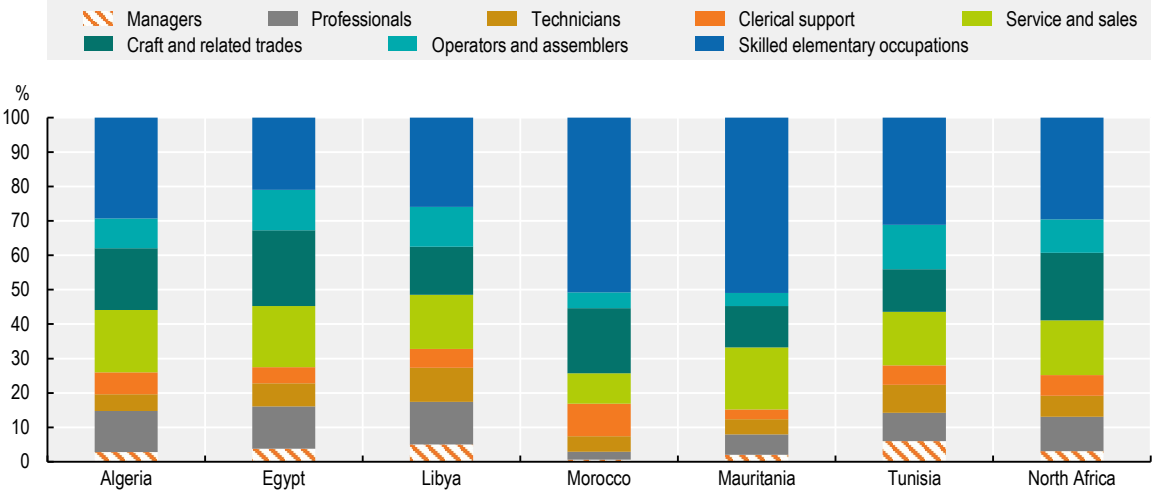
Figure 6.2. **Breakdown of working population by type of occupation in North Africa, 2021**



Note: "Technicians" include associate professionals; "Skilled elementary occupations" include skilled agricultural, forestry and fishery workers, and elementary occupations; and "Operators and assemblers" include plant and machine operators and assemblers.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates (database)*, https://ilostat.ilo.org/.

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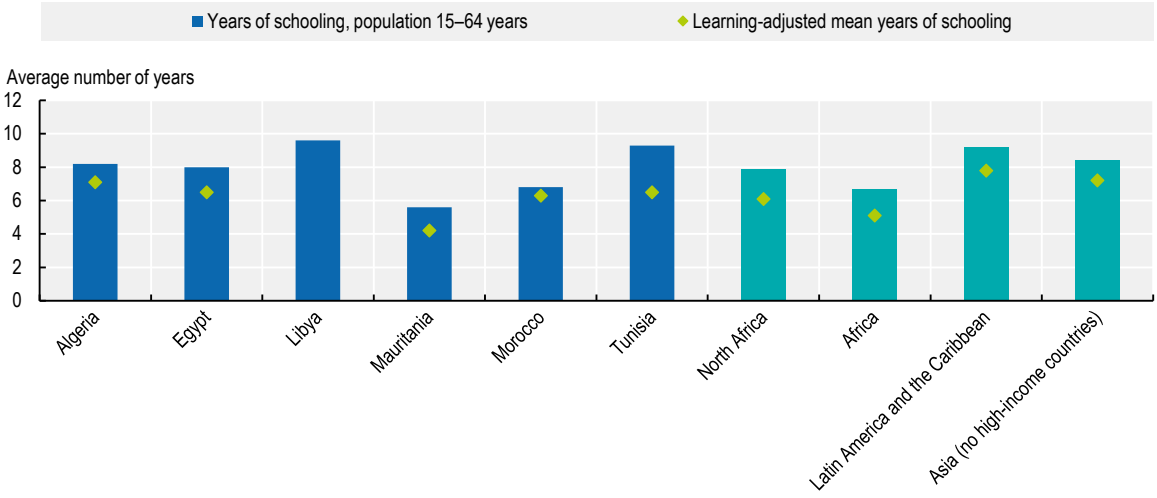
North Africa must continue its efforts to deliver high-quality skills for all

The level and quality of education in North Africa are higher than in other parts of the continent, but inequalities persist. The average years of schooling across the region is 7.9 years; this is higher than for the rest of the continent, where this figure stands at around 6.7 years. However, when average years of schooling is adjusted to account for the quality of learning, this average falls to 6.1 years in North Africa, compared with 5.1 years for the continent as a whole. This figure ranges from 7.1 years in Algeria to 4.2 years in Mauritania (Figure 6.3).

Differences between genders and between rural and urban areas widen gaps in basic skills. Girls are generally more proficient in reading than in mathematics, but they have higher results than boys in both skills. As regards the skill gap between urban and rural areas, children living in urban areas are generally more proficient in reading and mathematics than those living in rural areas (Figure 6.4). Despite these figures, women remain under-represented in the labour market. This is at the heart of a regional paradox: better access to education does not guarantee better integration into the workforce. Libya, Tunisia and Mauritania follow this trend, with female labour force participation rates (as a percentage of the female population aged 15 and over) reaching 35%, 27%, and 26% respectively in 2023. These rates sit below the global average (49%). In other North African countries, such as Morocco, Algeria and Egypt, labour force participation among women is even lower (20%, 16% and 15% respectively) (World Bank, 2023[4]). These figures underscore the role that structural barriers play in women's employment, including social norms (OECD, 2023[5]). Greater labour market participation by women would accelerate development (OECD, 2024[6]).

Figure 6.3. **Average years of schooling and learning-adjusted years of schooling, 2020**



Note: "Learning-adjusted average years of schooling" combines both the quantity and quality of education into a single measure, accounting for the fact that similar lengths of schooling may produce different learning outcomes. See Filmer et al. (2020[7]) for a detailed methodology.

Source: Authors' calculations based on World Bank (2023[8]), *Education Statistics* (database), https://databank.worldbank.org/source/education-statistics-%5E-all-indicators.

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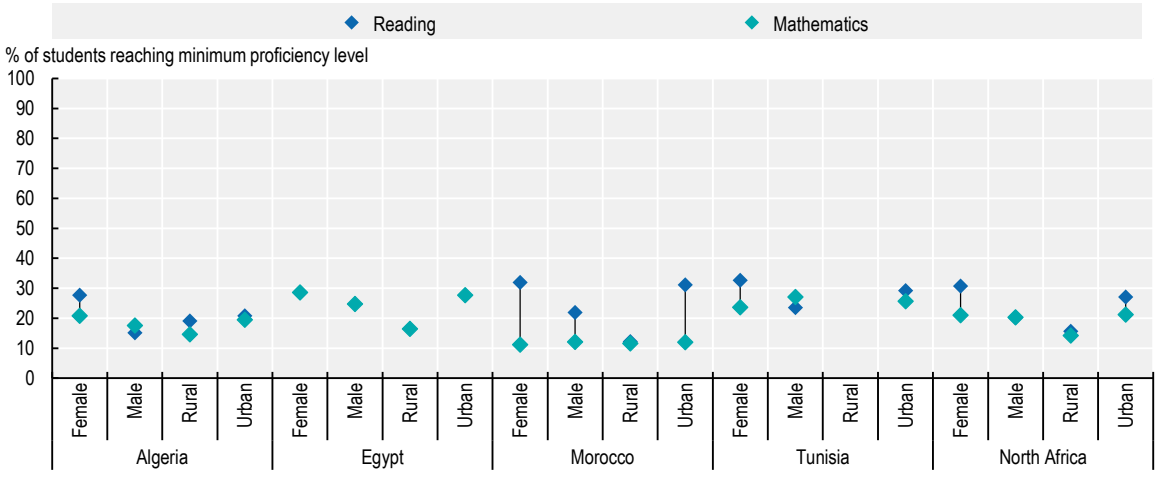
Figure 6.4. **Percentage of adolescents in lower secondary school achieving proficiency in reading and mathematics, most recent year observed (2013-22)**



Source: Authors' calculations based on UNESCO (2023[9]), *World Inequality Database on Education* (database), https://www.education-inequalities.org/.

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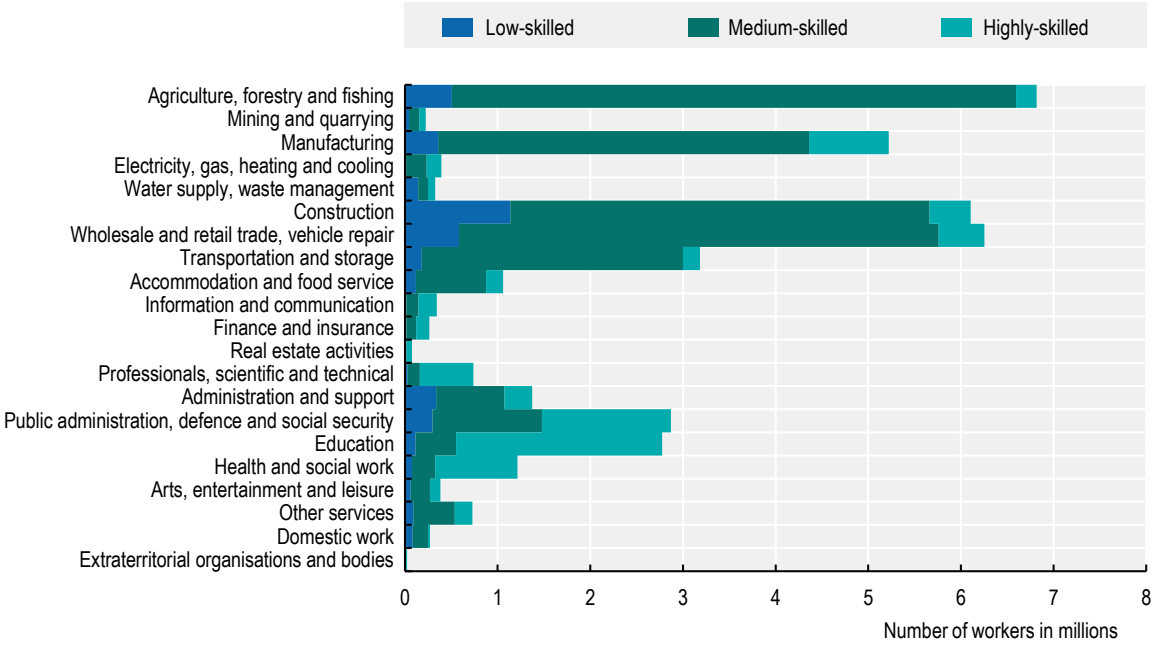
North Africa has a diversified economy and high levels of productivity, but informality remains widespread.

- Most of the working population is employed in agriculture, construction, retail and wholesale, often in the informal sector. Agriculture, forestry and fishing accounted for around a quarter of employment in 2021, with their share having shrunk since the early 2000s (31%).
- The construction and retail/wholesale sectors have been growing steadily since 2000, employing 14% and 17% of the active population respectively in 2021, compared with 8% and 13% in 2000.
- Compared with other African regions, North Africa has the highest share of the population working in the manufacturing sector. By 2021, 12% of the population worked in this sector, compared with a continental average of 7%.

Most employees working in these sectors are semi-skilled (Figure 6.5). In 2021, 31% of workers were in vulnerable employment (self-employed or unpaid family workers), the lowest share of any African region. Labour productivity remains high, reaching around USD 42 000 per worker in 2022 despite the predominance of informality in the region, with almost 73% of workers employed in the informal sector. This figure exceeds the average for the rest of the continent (USD 16 000 per worker).

Figure 6.5. **Number of workers by skill level and occupation, latest year available**



Note: Skill level is defined based on the complexity and range of tasks and functions that fall within the remit of an occupation. Skill level 1 (low) covers basic occupations. Skill level 2 (medium) covers plant and machine operators, fitters, craftspeople and related trades, skilled agricultural, forestry and fishery workers, service and sales workers and office workers. Skill levels 3 and 4 (high) cover technicians and associate professions, liberal professionals and managers. Figures for North Africa cover Algeria, Egypt, Libya, Mauritania, Morocco and Tunisia.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates (database)* https://ilostat.ilo.org/.

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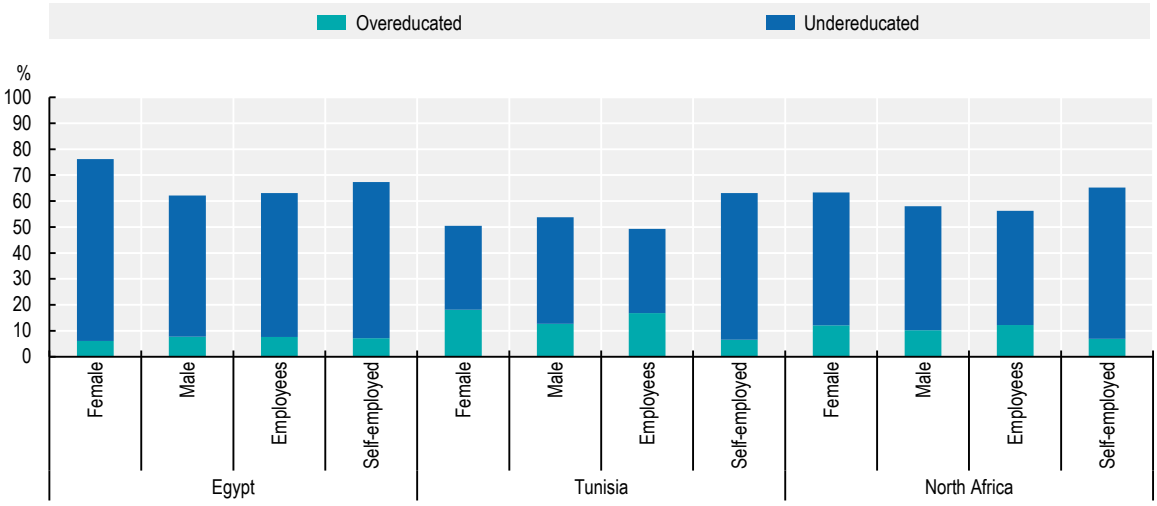
Despite the dominance of unskilled jobs, many workers do not have the required level of education for their occupation. In Tunisia and Egypt, 33% and 55% of the working population respectively are employed in jobs for which they are underqualified (Figure 6.6). This situation is more common among self-employed workers. Only a small proportion (around 12%) of salaried workers have a higher level of education than required for their occupation, consistent with findings from other surveys: in Egypt, for example, 37% of young people do not have the required level of education for their current occupation (Morsy and Mukasa, 2019[10]).

Figure 6.6. **Percentage of workers who have a higher or lower level of education than required for their occupation, 2022 or latest year available**



Note: Mismatches are assessed using the normative approach, by comparing the educational requirements for each occupational group set out in the International Standard Classification of Occupations (ISCO) with the educational level of each person with that occupation. Calculations are based on data available from national labour force statistics or other representative household surveys with an employment component.

Source: Authors' compilation based on ILOSTAT (2023[1]), *ILO Modelled Estimates*, (database), https://ilostat.ilo.org/.

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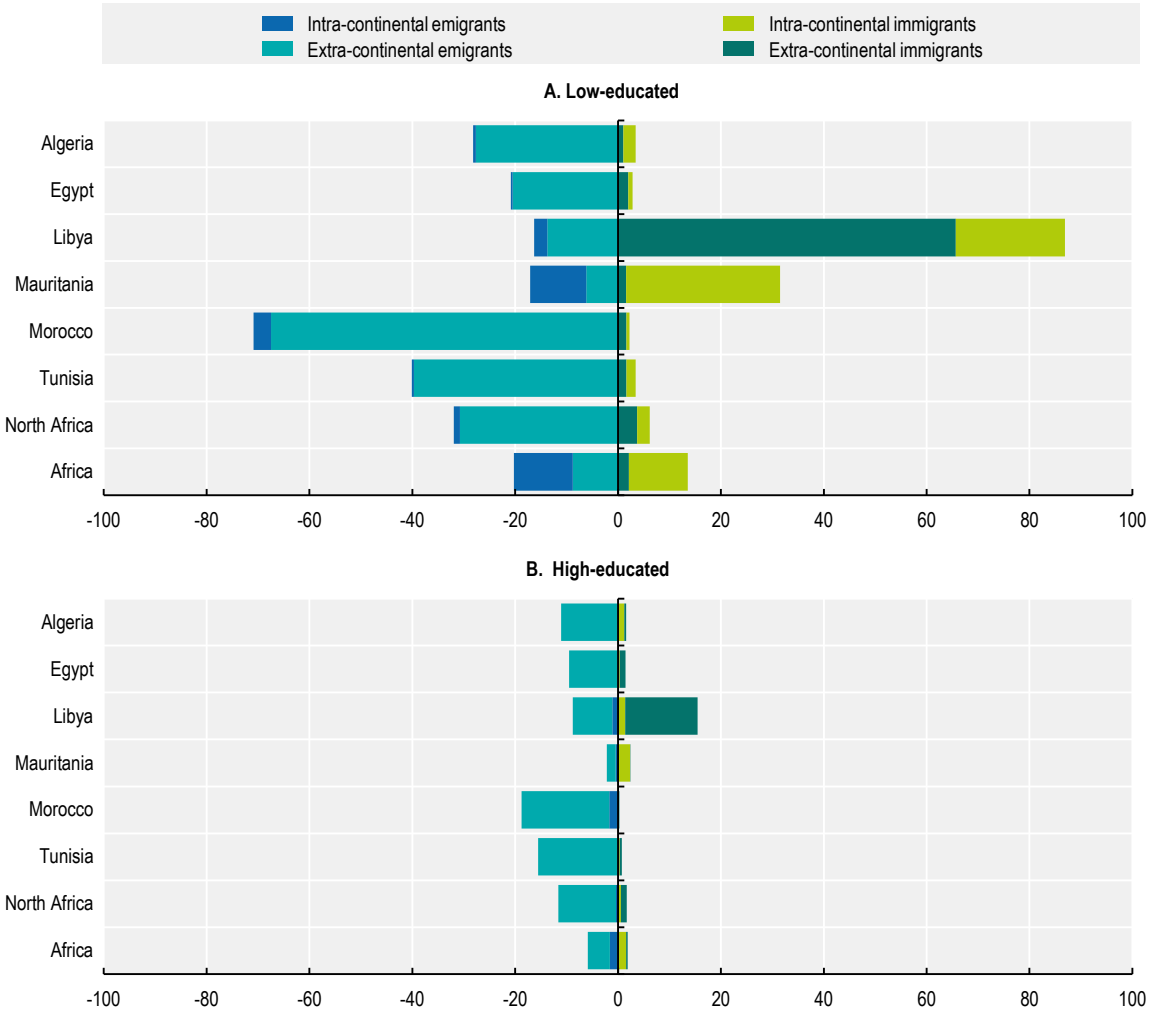
Green skills are uniquely valuable in efforts to adapt to climate change in North African countries. Climate change is having a major socio-economic impact on this region, reducing per-capita GDP growth by 5% to 15% each year (AUC/OECD, 2022[11]). The North Africa region is the most exposed on the continent to the risks associated with rising temperatures, such as droughts, water stress and fires. Despite the severity of its impacts, only 36% of people surveyed in Morocco, Mauritania and Tunisia had heard of climate change. Only 22% of people with no education and 28% of rural residents had heard of climate change, compared with 41% of urban residents (Afrobarometer, 2023[12]).

Migration in North Africa is characterised by flows of low- and semi-skilled workers into and out of the region, and to a lesser extent by the emigration of skilled workers to countries outside the continent. Low- or semi-skilled people – with secondary or lower education – mainly immigrate from the rest of the African continent. Libya is notable for its high levels of immigration from outside the continent. North Africa is also characterised by high levels of emigration to countries outside the continent. Skilled workers (with tertiary or higher levels of education) – particularly those from Morocco and Tunisia – mainly migrate to destinations outside the continent (Figure 6.7).

Figure 6.7. **Migrants by education level, origin and destination, 2020**



Note: Migrants per 1 000 inhabitants. Negative numbers represent emigration. "Low-educated" refers to individuals with secondary or lower education. "High-educated" refers to those with tertiary or higher education.

Source: World Bank (2023[2]), *Global Bilateral Migration* (database), https://databank.worldbank.org/source/global-bilateral-migration.

StatLink https://stat.link/abd3qx

The renewable energies sector presents a new opportunity to develop skills and productive employment in North Africa

Renewable-energy-related skills could be a source of new productive employment and support the response to climate change

North Africa has immense potential to develop renewable energies (particularly solar panels, wind power and hydroelectricity) while responding to increasingly pressing climate risks. The region has the greatest solar and wind energy potential on the continent. The average annual solar radiation is around 2 200 kWh/m² and the average wind speed is 7 metres per second (9.5 m/s in Algeria) (El-Katiri, 2023[13]). Using 1% of land for solar and wind power would increase energy capacity to 2 792 GW for solar and 223 GW for wind: 12 times Africa's current capacity. By 2050, North Africa is set to become the world's leading exporter of green hydrogen, with a projected export value of

USD 110 billion per year (Deloitte, 2023[14]). The ever-decreasing cost of renewable energy generation, particularly solar and wind power, is giving the sector a major boost (AUC/OECD, 2022[11]). Realising this potential is all the more urgent given the region's growing exposure to climate hazards.[1] Desertification is increasing and temperatures are rising, threatening fragile ecosystems and essential natural resources and leading to significant socio-economic impacts, including lower agricultural yields and growing water scarcity.

The energy transition could drive economic growth and productive job creation on a continental scale. North Africa's generation capacity has increased by 6% per year since 2011. Over the past decade, renewable electricity generation is estimated to have risen by over 40%, thanks to the rapid expansion of wind, photovoltaic solar and solar thermal power. However, the share of renewable energy in the electricity mix (9.5% of electricity generated) remains lower than in the rest of Africa (21%, of which 17% is hydropower). That the sector has significant room to grow is also demonstrated by the low share of renewable energies (only 4.6%) in the region's energy mix (IEA, 2020[15]). Algeria relies on fossil fuels to generate more than 95% of its electricity (ILO, 2018[16]) and Egypt 90% (IEA, 2024[17]; Ambassade de France en République arabe d'Égypte, 2022[18]). According to projections, sufficient investment in renewable energy to limit global warming to 1.5°C would increase GDP by an average of 5% and employment by an average of 2% compared with business-as-usual over 2021-2050 (Table 6.1).

Table 6.1. **Socio-economic effects of the energy transition (under the "1.5°C scenario" compared with the "business-as-usual scenario")**

	GDP (percentage difference)	Well-being (percentage difference in indices)					Employment (percentage difference, average 2021-2050)
		Environmental	Economic	Social	Distribution	Access to energy	
North Africa	5%	27%	2%	43%	8%	0%	2%
West Africa	15%	40%	1.5%	25%	10%	39%	1%
East Africa	10%	42%	6.5%	3.5%	10.5%	38%	4%
Central Africa	15.5%	46%	7.5%	73%	14%	41%	6.5%
Southern Africa	10%	35%	4%	47%	119%	18%	4%
Africa	6.5%	37.5%	4%	32%	22%	30%	3.5%

Note: The average differences are expressed as a percentage of GDP, well-being and employment and are calculated by comparing the 1.5°C global warming scenario against the business-as-usual scenario over the 2021-2050 projection period. They show that despite a positive effect overall at the continental level, there would be significant differences between regions.

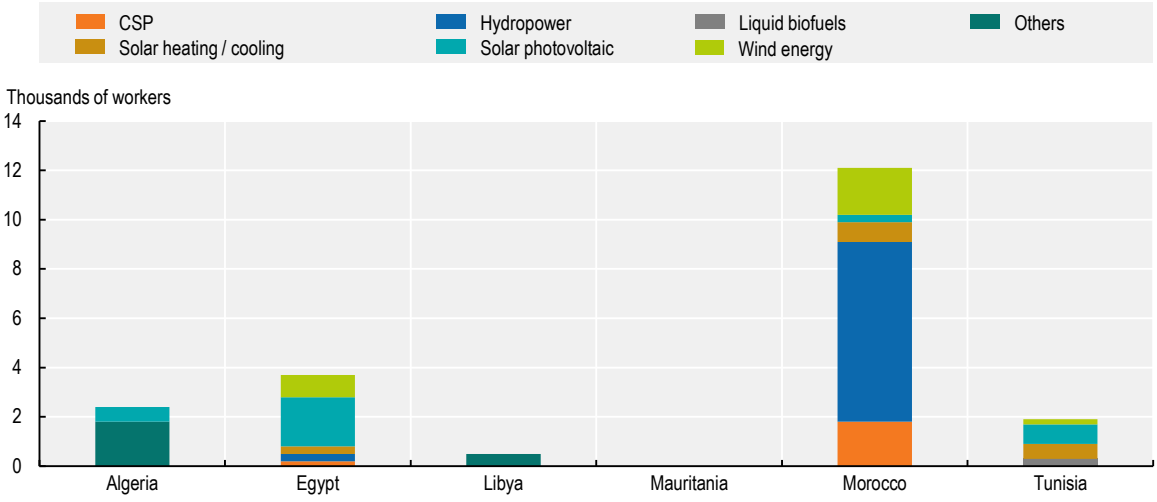
Source: IRENA/AfDB (2022[19]), *Renewable Energy Market Analysis*, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Jan/IRENA_Market_Africa_2022.pdf?rev=bb73e285a0974bc996a1f942635ca556.

International and national commitments to the energy transition are helping to grow the renewable energy sector. Global greenhouse gas emissions must be cut by 43% by 2030, compared with 2019 levels, to limit global warming to 1.5°C. At the 28th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 28), governments were called on to triple global renewable energy capacity and double their energy efficiency efforts by 2030. Most North African countries were active in the adoption of the aforementioned commitments, in particular Egypt and Morocco (which respectively hosted COP 27 in Sharm el-Sheikh in 2022 and COP 22 in Marrakech in 2016). At future COPs, governments will have to set new climate financing targets through the publication of new Nationally Determined Contributions (NDCs). Libya is the only country in the region that has signed but not ratified the Paris Agreement [2] and therefore does not publish an NDC.

Demand for renewable-energy-related skills is increasing, although it does vary depending on the value chain segment and type of company

The maturity of the renewable energy sector varies between countries in North Africa. By 2022, the sector employed at least 21 000 people in the region. Morocco accounts for the majority of jobs in the sector (59%), followed by Egypt (18%), Algeria (12%), Tunisia (9%) and Libya (2%) (Figure 6.8). Egypt, Morocco and Algeria have contributed to the expansion of solar energy in the region, ranking second, third and fourth for solar power generation on the continent. Egypt and Morocco are also leading in African wind power generation, ranking just behind South Africa (IRENA, 2023[20]). In oil and gas exporting countries such as Algeria and Libya, the renewable energy sector is still expected to grow alongside the dominant fossil fuels. These countries will therefore be able to draw on the transferability of certain skills from one sector to the other, in order to develop other lines of business in the renewable sector and compensate for any jobs lost in the fossil fuel sector (Table 6.2). This energy transition should also create jobs, particularly in the green infrastructure construction phase (AUC/OECD, 2022[11]).

Figure 6.8. **Total employment in renewables sector, latest available data**



Note: CSP = Concentrated solar power. The data are mainly for 2022, followed by 2021, with a few cases for which only earlier data are available. "Other" refers in particular to jobs not broken down by individual renewable energy technology.

Source: IRENA/ILO (2023[21]), *Renewable energy and jobs: Annual review 2023*, https://www.irena.org/Publications/2023/Sep/Renewable-energy-and-jobs-Annual-review-2023.

StatLink https://stat.link/u0dcix

Table 6.2. **Renewable energy skills development priorities by North African country profile**

Group	Countries	Priorities for renewable energy skills development
Net energy importers *Strong incentive to develop renewable energies*	Morocco, Egypt, Tunisia	Development of expertise to meet national or NDC objectives
Net energy exporters *Weak incentive to develop renewable energies*	Algeria, Libya, Mauritania[3]	Transferring and strengthening existing expertise in fossil fuels to renewable energies Development of mini-grid related skills (to complement national hydrocarbon-dependent grids)

Source: Authors' compilation. NDC = Nationally determined contributions.

Current projections are based on a growing demand for skilled workers in the renewable energy sector. Various climate scenarios forecast growth in employment

in the sector. Comparing the 1.5°C global temperature increase scenario with the business-as-usual scenario, North Africa could create at least 2.7 million additional jobs in the renewable energy sector (IRENA/AfDB, 2022[19]). However, the Stated Policies Scenario currently projects a significantly lower figure, estimated at 30 000 (IEA, unpublished).[4] Nevertheless, effective national strategies could increase renewable energy generation and create thousands of jobs (67 000 in Egypt and 25 000 in Morocco over the 2020-2050 period, and 70 000 in Tunisia by 2035) (World Bank/ESMAP, 2024[22]; AUC/OECD, 2023[23]; AUC/OECD, 2022[11]; World Bank, 2022[24]; World Bank, 2022[25]). International co-operation and co-operation with the private sector will therefore be crucial for sustaining the momentum of current policies and achieving more ambitious targets.

The potential for job creation in the renewable energy sector varies depending on the segment of the value chain in question. The value chain can be broken down into several segments: research and development (R&D), surveys and project design, component manufacturing and assembly, installation, construction and commissioning, operation and maintenance, and disassembly and recycling (AfDB, 2016[26]) (Box 6.1). Upstream, it is important to strengthen skills in R&D, component manufacturing, technology development, prototype testing and innovation. This requires design, engineering, production, quality control and logistics skills. Downstream, the skills needed to operate and maintain systems are essential. It is also vitally important to strengthen recycling-related skills to ensure components are properly managed at the end of their useful life. Finally, there is a growing need for technical skills in areas such as renewable energy engineering and storage technologies, as well as management skills including project management, data analysis, regulations, communication and financing (Table 6.3).

Table 6.3. **Skills breakdown by renewable energy value chain segment**

Value chain segment	Basic skills	Intermediate skills	Advanced skills
Project development	Basic skills, management, communication	Project development/facilitation	Designing engineering projects, architecture for small projects, atmospheric sciences, resource assessment, ecology, precedents for public funding, land valuation, land negotiation, lobbying, mediation, specialised procurement, specialised resource assessment
Manufacturing and distribution	Manufacturing, logistics, equipment transport	Computer software, industrial engineering, technical manufacturing, logistics, manufacturing-related quality assurance	Engineering research and development, manufacturing-related engineering, prototype modelling and testing, specialised procurement, specialised marketing, specialised sales
Construction and installation	General construction	Qualification in construction, transport, logistics, storage	Civil, mechanical and electrical engineering, construction project management, business development, commissioning-related engineering
Operation and maintenance	Basic skills, management, communication	Welding, pipework, plumbing, mechanisation, electricity, construction equipment operation, heating, ventilation and air conditioning	Plant management, measurement and control engineering
Cross-functional activities/facilitation activities	Associative management, leadership, administration, customer relations	Public policy, insurance, information technology, health and safety, sales and marketing	Education and training, specialised finance, scientific writing and publishing

Source: Authors' compilation based on World Bank/ESMAP (2024[27]), *Job Creation and Skills Development During the Energy Transition – Egypt*, https://documents1.worldbank.org/curated/en/099012324070535949/pdf/P17054613550c90311bcca14bbb87596a7a.pdf.

Box 6.1. **Specific skills required for the development of renewable energy value chains**

As part of its national strategy to meet its electricity needs while reducing its dependence on fossil fuels, Morocco plans to increase its renewable energy generation. The Tan Tan solar power plant project, set up to this end, will employ between 20 and 150 people per site, depending on the pace of installation and nature of the work.

- The component construction phase of the project (solar power plant, power lines, access roads), lasting 12 to 16 months, will require a range of technical skills, including civil engineering, electrical engineering, logistics and transport, and knowledge of how to operate site machinery.
- The operating phase will require only a limited number of operational staff (around 15 to 20 people per site), mainly for maintenance, servicing and security.

Source: Masen (2023[28]), Étude d'impact environnemental et social du projet solaire photovoltaïque de Noor Atlas : Plan de Gestion Environnementale et Sociale, https://www.masen.ma/sites/default/files/documents_rapport/Masen_Programme%20Noor%20Atlas_Projet%20Noor%20TanTan_PGES_V.f%C3%A9vrier%202023.pdf.

Large companies mainly look for people with technical skills, while small businesses and start-ups also need people with skills related to innovation, digital technology and sustainable financing. The survey[5] conducted in preparation for this chapter found that the specific skills required by multinationals pursuing renewable energies include energy auditing, project management, electrical engineering and electronics, energy storage, environmental assessment, standards and regulations, sustainable development communication and training. Small businesses and start-ups require soft skills related to innovation, project management, digital technologies and sustainable development, as well as skills related to green finance, seeking financing and conducting a financial analysis of clean energy. They also value skills related to strategic partnerships and networking to facilitate collaboration with local governments and financial institutions.

The range of training courses on renewable energies has expanded in recent years, but not enough to meet the growing demand for skills

The availability of training on renewable energies at universities and technical institutions varies between North African countries. A comparative analysis of degree-level courses found differences between countries in terms of course and specialisation supply. Bachelor's and master's degrees in renewable energies are available in most countries, but doctorates and technical and vocational education and training (TVET) are emerging more slowly, often with the support of international partners (Table 6.4).

Table 6.4. **Degree-level courses on renewable energies in North Africa**

Country	TVET	Bachelor	Master	Doctorate
Algeria		×	×	×
Egypt	×	×	×	
Libya			×	
Morocco	×	×	×	×
Mauritania		×	×	
Tunisia	×	×	×	×

Note: This table excludes short courses and projects aimed at improving skills in the renewable energy sector in the region.

Source: Authors' compilation.

Training provision suffers from a shortage of experienced trainers to the detriment of the quality of teaching and learning. Teachers and trainers teaching technical subjects in the region are often self-trained. This lack of teacher training negatively impacts the quality of the training and the knowledge passed on to graduates. Co-ordination between the various actors involved in training also needs to be improved.

Small and medium-sized enterprises (SMEs) have fewer resources to deliver in-house training programmes, which would help bring their employees' technical knowledge into line with their specific needs. Our survey found that SME owners do not have the necessary resources for in-house training. Formal education, especially at master's level (five years of higher education), is criticised for being too theoretical and failing to meet the practical needs of the labour market in terms of intermediate skills (Table 6.3). Conversely, learners on TVET, diploma (two years of higher education) or multi-stakeholder training programmes benefit from better practical knowledge (Box 6.2), while start-ups often try to attract foreign talent to fill skills gaps.

Box 6.2. **The Kaizen approach to skills development**

In North Africa, SMEs account for more than 90% of businesses and 70% of GDP (Lukonga, 2020[29]). The lack of knowledge and skills regarding how to improve quality and productivity is a key barrier preventing them from realising their full potential. The Kaizen approach, promoted by Japanese co-operation efforts, seeks to resolve these problems while increasing management skills within companies, by sharing specific experiences and tools. It is based on a culture of gradual improvement at all levels of the organisation and can be applied to the renewable energy sector. Originally designed to optimise organisational management in the workplace, the Kaizen approach has since been integrated into Japan's educational programmes to support the development of fundamental skills for employability (Suzuki and Sakamaki, 2020[30]).

The Japan International Cooperation Agency (JICA) and the African Union Development Agency – New Partnership for Africa's Development (AUDA-NEPAD) launched the Africa Kaizen Initiative (AKI) in 2017. This ten-year programme aims to accelerate the dissemination and impact of Kaizen activities across the continent (AUDA-NEPAD, 2021[31]). In Tunisia, the initiative's first partner, eight industrial sectors were targeted. In Libya, under the aegis of the Ministry of Industry, Mines and Energy, the country's "Kaizen Masters" ran two training sessions for companies and start-ups headed by young entrepreneurs and women, focused on the energy sector (WFP, 2023[32]). The annual JICA-AUDA-NEPAD Africa Kaizen Conference serves as a platform for sharing knowledge on lessons learned from Kaizen policies at the national level. From 2017 to 2022, Kaizen-related co-operation projects in 27 African countries reached 1 400 trainers, 18 000 companies and more than 280 000 managers and workers in these companies (JICA, 2023[33]).

Public policies to improve skills in the renewable energy sector in North Africa

To develop renewable-energy-related skills, North African countries should consider adopting three key public policy priorities: developing strategies to anticipate the demand for skills; increasing the quality of training on offer and improving access to information and training; and mobilising funding, alongside regional and international co-operation with public and private actors.

Implementing national strategies to anticipate the growing demand for skills

Innovative strategies to develop renewable-energy-related skills at the national level will be crucial. This can be achieved by closely co-ordinating public policies relating to the environment, renewable energies and skills, and by setting up mechanisms to anticipate, map, standardise and monitor skills. The bodies responsible for these activities should work with the Ministries for the Environment. In addition, the ratification and strict enforcement of environmental regulations could stimulate skills development in the sector (ERF/GIZ, 2023[34]). Some countries in the region are starting to pursue greater policy coherence by integrating skills and human resource development into their renewable energy policies. However, these initiatives are often confined to specific areas, such as the identification of skills needs and initial vocational training. Egypt, Morocco and Tunisia stand out for their successful integration of skills development into their national renewable energy strategies (Table 6.5). Furthermore, a review of intellectual property laws could facilitate knowledge transfer in the green economy, encourage the transition to renewable energy and promote environmentally sustainable technologies.

Table 6.5. **National renewable energy strategies incorporating skills development in the sector**

Country	National strategy for renewable-energy-related skills development	National renewable energy strategy	Renewable-energy-related training or skills integrated into the strategy	Notes	Term	Status	Lead body
Algeria	Yes	Programme de développement des énergies renouvelables [Renewable Energy Development Programme]	Yes	Algeria's strategy for developing renewable energy focuses on establishing the sector in combination with a training and upskilling programme. It aims to harness local Algerian skills, particularly in the fields of engineering and project management, to support the sector's growth. The renewable energy programme, designed to meet the electricity needs of the national market, is also expected to directly and indirectly create thousands of jobs.	2015-2030	Ongoing	Ministry of Energy and Mines
Egypt	Yes	Stratégie intégrée pour une énergie durable (Integrated Strategy for Sustainable Energy – ISES)	Yes	Under this strategy, Egypt has committed to developing skills for jobs in the renewable energy sector, notably through the creation of centres of excellence as part of an initiative to reform technical education.	2008-2035	Ongoing	Egyptian Supreme Council of Energy
Libya[1]	No	Plan stratégique pour les énergies renouvelables (Strategic Plan for Renewable Energies)[2]	No	-	2013-2025	Ongoing	Renewable Energy Authority of Libya (REAOL)[2]

Table 6.5. **National renewable energy strategies incorporating skills development in the sector *(continued)***

Country	National strategy for renewable-energy-related skills development	National renewable energy strategy	Renewable-energy-related training or skills integrated into the strategy	Notes	Term	Status	Lead body
Morocco	No	Stratégie nationale de l'efficacité énergétique (National Energy Efficiency Strategy)	Yes	Under its strategy, Morocco has committed to: • promote the Centre of Excellence for Energy Efficiency (Marrakech) • develop vocational and technical training • set up certification labels and targeted training programmes for professionals • develop e-learning courses • set up core teams with energy-related skills within communes or associations of communes • carry out a study to identify the skills and occupations required to meet emerging local demand	2020-2030	Ongoing	Ministry of Energy, Mines and the Environment
Mauritania	No	No	-	-	-	-	-
Tunisia	No	Stratégie Énergétique de la Tunisie à l'horizon 2035 (Tunisia's 2035 Energy Strategy)	Yes	Tunisia plans to maximise the socio-economic benefits of the strategy by taking a proactive approach to capacity building and skills development, technology transfer, research and development, and industrial policy to support the energy transition.	2023-2035	Ongoing	Ministry of Industry, Mines and Energy

Notes:

1. In 2023, the Libyan government launched the *National Strategy for Renewable Energies and Energy Efficiency* (NSREEE) outlining plans to achieve a combined solar and wind power capacity of 4 GW by 2035, with the specific target of reaching 20% renewable energy in the total energy mix by 2035. The strategy comprises four pillars aimed at diversifying energy sources, investing in renewable energy and increasing energy efficiency (Intec, 2024[35]; Renewables Now, 2023[36]). As the official document had not been published online before the publication of this report, it was not possible to analyse the inclusion of training or skills.

2. The Libyan government created the Renewable Energy Authority of Libya (REAOL) in 2007. Its main objective was to implement targeted policies to meet the government's objective of 10% renewable energy in the total energy mix by 2020, a target that has not yet been met. REAOL implements renewable energy projects, incentivises and supports related industries, proposes supportive legislation and regulations, and assesses Libya's renewable energy potential to identify priority areas (IEA, 2024[37]).

Source: ERF/GIZ (2023[34]), *Green Jobs and the Future of Work in Egypt: A Focus on the Agriculture and Renewable Energy Sectors*, https://erf.org.eg/publications/green-jobs-and-the-future-of-work-in-egypt-a-focus-on-the-agriculture-and-renewable-energy-sectors/; Republic of Tunisia (2023[38]), *Stratégie Energétique de la Tunisie à l'Horizon 2035 : Synthèse*, https://www.energiemines.gov.tn/fileadmin/docs-u1/synth%C3%A8se_strat%C3%A9gie_2035.pdf; Kingdom of Morocco (2020[39]), *Stratégie nationale de l'efficacité énergétique à l'horizon 2030*, https://www.mem.gov.ma/Lists/Lst_rapports/Attachments/33/Strat%C3%A9gue%20Nationale%20de%20l%27Efficacit%C3%A9%20%C3%A9nerg%C3%A9tique%20%C3%A0%20l%27horizon%202030.pdf; IRENA (2018[40]), *Renewable Energy Outlook: Egypt*, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Oct/IRENA_Outlook_Egypt_2018_En_summary.pdf?la=en&hash=58DBAA614BE0675F66D3B4A2AC68833FF78700A0; IEA (2016[41]), *Renewable Energy and Energy Efficiency Development Plan 2015-2030*, https://www.iea.org/policies/6103-renewable-energy-and-energy-efficiency-development-plan-2015-2030; Renewable Energy Authority of Lybia (2012[42]), *Libya Renewable Energy Strategic Plan 2013-2025*, https://climate-laws.org/documents/libya-renewable-energy-strategic-plan-2013-2025_100b?q=libya&id=libya-renewable-energy-strategic-plan-2013-2025_2e80; Ministère de l'Énergie et des Mines (2011[43]), *Programme des Énergies Renouvelables et de l'Efficacité Énergétique*, https://climate-laws.org/document/renewable-energy-and-energy-efficiency-development-plan_7cf0.

To ensure an effective transition to renewable energies, it will be important to set up a dedicated co-ordinating body responsible for aligning skills supply with needs in the renewable energy sector. This body would also be tasked with resolving current challenges, such as limited funding for co-ordination between educational institutions and companies, and developing renewable-energy-related skills in the education and

training system. In addition, effective co-ordination will improve resource use, helping to strengthen the sustainability of initiatives by harmonising and co-ordinating them with sectoral approaches (ILO, 2018[16]).

> In Morocco, the Moroccan Agency for Sustainable Energy (Masen) plays a central role in efforts to achieve the objectives of the National Renewable Energy Programme, which aims to generate 52% of electricity from renewables by 2030. Through tripartite partnerships and the establishment of training institutes for renewable energy occupations, Masen is training a skilled workforce that meets the needs of the sector (Masen, 2024[44]).

Policies and programmes aimed at delivering renewable-energy-related skills should take a multisectoral approach that is mindful of skill transferability. Such an approach would offer countries in the region the opportunity to achieve economies of scale and develop specialisations by capitalising on their comparative advantages in the sector. Extractive economies seeking to make the energy transition, such as Algeria and Libya, should target engineering and project management skills, to minimise the disruption to workers affected by the transition (Table 6.6). There are synergies between skills in the coal sector and the solar photovoltaic sector, and between skills in the offshore wind and offshore oil and gas industries (IRENA, 2018[45]). On the other hand, economies aiming to strengthen their position in renewable energy and energy efficiency value chains should strengthen their capacity through technology, engineering and innovation centres (AUC/OECD, 2022[11]).

Table 6.6. **Transferable skills by value chain segment in the renewable energy sector**

Segment	Transferable skills
Project development	Technical studies (geotechnical, water requirements, etc.)
	Social and environmental impact assessments
	Site preparation (clearing, grubbing, etc.)
	Grid connection and reinforcement studies
Manufacturing and distribution	Component assembly
Construction and installation	Component procurement
	Construction
	Civil engineering work
Operation and maintenance	Basic operations
	Site cleaning and security management
	Regular mechanical and electrical maintenance
	Power supply operation and maintenance

Source: World Bank/ESMAP (2024[27]), *Job Creation and Skills Development During the Energy Transition – Egypt*, https://documents1.worldbank.org/curated/en/099012324070535949/pdf/P17054613550c90311bcca14bbb87596a7a.pdf.

Governments can adopt participatory, inclusive and proactive national strategies to anticipate the demand for skills. This is particularly true in key sub-sectors such as green hydrogen, cooling technologies, water desalination and efficient energy storage. This approach would take citizens' interests into account when planning renewable energy projects, especially with regard to local development projects, employment and gender equality. Incentives can encourage private investors to hire local workers to implement renewable energy projects. Skills needs can also be anticipated through social dialogue, which positions workers and employers as sources of informed opinion and expertise (ERF/GIZ, 2023[34]). This dialogue should be gender-sensitive, both in terms of approach and budgeting, to facilitate women's participation in the labour market (Figure 6.4 and Figure 6.6). Similarly, a decentralised territorial approach can encourage women to

participate actively in the renewable energies sector, in both upstream and downstream segments of value chains (IRENA, 2019[46]).

> In Morocco, Action 48.5 of the National Energy Efficiency Strategy calls for the creation of rural energy co-operatives that bring together local skills in order to develop local energy service offerings tailored to the needs of farming communities. There is a particular focus on advice about, and maintenance of, solar pumps and high-tech equipment (Kingdom of Morocco, 2020[39]).

Expanding the supply of renewable-energy-related skills through high-quality training programmes, including in research and development, vocational training and apprenticeships

Investing in technology centres and research and development should guarantee the emergence of a skilled workforce and encourage innovation. There is particularly high demand for solar energy researchers, wind farm project and operations managers, geothermal engineers, energy modellers and engineers specialising in climate and solar thermal energy. In recent years, efforts have been made to create research and development bodies to improve research into renewable energies, promote energy efficiency and stimulate co-operation between companies.

> In Tunisia, the Borj-Cédria Technopole is a major hub for research and development in the areas of renewable energy and sustainable development. It brings together 450 permanent researchers and 600 PhD students and postdoctoral positions, and is responsible for 16% of national scientific output. In 2023, the Centre for Research and Energy Technologies (CRTEn) launched the Energy Training & Consulting laboratory to strengthen technology transfer in the renewable energy sector (World Bank/ESMAP, 2024[22]).
>
> In Algeria, the Renewable Energy Development Centre (CDER) designs and implements solar, wind, geothermal and biomass energy programmes. It has three research units and a commercial subsidiary, ER2, which now has nationwide reach as a centre of excellence in the field of renewable energy (CDER, 2024[47]).

The active engagement of national authorities is crucial for developing TVET institutions and making them viable. National authorities play a central role in creating an enabling environment for these institutions to grow. International partners also provide financial and technical support. Increased funding for national operators would incentivise TVET providers to increase the supply of skills in the sector.

> In Egypt, sectoral centres of excellence have been set up within the Ministry of Education and Technical Education (MoETE). They provide specialised TVET services in specific sectors, including renewable energy and related sectors that they aim to develop. These centres support technical high schools through an education system that integrates both the educational and commercial spheres. They are also tasked with establishing links with universities and research centres to provide schools with up-to-date knowledge at an advanced level (ERF/GIZ, 2023[34]).

Internships and work-study programmes give young people the opportunity to develop their professional skills in the sector. These programmes should pay particular attention to the development of technical skills, such as mechanics and electricity, as well as soft skills, such as project management. It is essential to incentivise paid internship programmes, especially for recent engineering graduates. A number of tax incentives are available to stimulate corporate participation, within a clearly defined framework. In addition, work-study programmes in sub-sectors of excellence should be promoted to encourage the development of the strategic skills needed in the renewable energy sector (AUC/OECD, 2022[11]).

> In Mauritania, the Ministry of Employment and Vocational Training, in partnership with the National Union of Mauritanian Employers and the United Nations Development Programme (UNDP), launched the STAGI digital platform in 2022, to facilitate the social and professional integration of young graduates via a mentoring system and by connecting them with companies for internships (UNDP, 2022[48]).

Mobilising regional and international financing and co-operation, from both the public and private sectors, to support the development of renewable-energy-related skills

Regional partnerships help disseminate knowledge and identify synergies. Such initiatives help strengthen research and training efforts, and promote innovation and the creation of networks of experts. Setting up regional platforms would facilitate the sharing of best practices and knowledge, while pooling human, financial and logistical resources. Closer regional co-operation would enable us to better identify each country's position within value chains, making it easier to identify which skills to develop. For example, some countries in the region have phosphate and cobalt reserves, which could allow them to develop specific industries in sectors related to the energy transition, such as battery and solar panel manufacturing.

> An example of **bilateral co-operation**, the MICEP (Morocco-Ivory Coast Energy Park) is a research partnership between Morocco's Research Institute for Solar Energy and New Energies (IRESEN) and Côte d'Ivoire's Félix Houphouët-Boigny National Polytechnic Institute (INPHB) to promote training, knowledge transfer and innovation in the field of energy efficiency and renewable energy (World Bank/ESMAP, 2024[49]).
>
> At the **regional level**, the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) offers capacity-building programmes on request to countries in the Middle East and North Africa (MENA) region that want to establish and strengthen their qualifications, skills and expertise in renewable energy and energy efficiency (AUC/OECD, 2022[11]).

Mutual recognition of skills, diplomas and certificates can improve labour mobility in the region. Mobility improves access to a specialised workforce, getting people into jobs where their skills will be most useful and stimulating investment in the sector. It also drives higher demand, by increasing the flow of human capital into countries, notably through efforts to harmonise education, social protection and employment policies in the region. Despite the divergent policies observed in the region, relevant initiatives have emerged, most notably in the form of international technical bodies.

> The Mediterranean Network of National Information Centres on the Recognition of Qualifications (MERIC-Net), which was funded by the European Commission from 2016 to 2019, aimed to encourage and improve the recognition of qualifications in the Mediterranean region, in order to facilitate mobility within the higher education institutions of the countries involved. This project has enabled new recognition procedures to be introduced based on the expertise acquired during the project (MERIC-Net, 2024[50]), (IEA, 2020[15]).

Implementing a dedicated regulatory framework can strengthen ties with public and private partners at the international level. Developing an enabling environment for partnerships with the private sector through reforms or the creation of dedicated institutions could help stimulate research and innovation and facilitate investment and access to finance in the sector (Box 6.3). Currently, more than 75% of the growth of the renewable energy sector in North Africa is the result of supportive policies and regulatory frameworks that facilitate private investment (IEA, 2020[15]).

In Morocco, the partnership between Huawei and the National Office of Electricity and Drinking Water (ONEE), established in 2023, serves as a lever for strengthening the sector's technical and technological skills. The agreement provides for access to ONEE's electricity science and technology centre and its technical laboratory equipment, as well as the design and implementation of joint projects (La vie éco, 2023[51]).

Since 2020, the World Bank has been providing technical assistance to Tunisia's General Authority of Public-Private Partnership (IGPPP) to improve the viability and efficiency of public and private partnerships. This initiative has a project development fund focused on three areas of intervention: i) building capacity to establish a robust pipeline of projects, including 1 700 megawatts of solar and wind power; ii) strengthening project preparation (profitability analysis, feasibility, calls for tender, etc.); and iii) improving project monitoring (Grimm, Bertolini and Tejada Ibañez, 2024[52]).

Box 6.3. **Casablanca Finance City's AFIC Initiative: a talent pool to catalyse competitiveness**

The Africa Finance Institute in Casablanca (AFIC), an initiative of the Casablanca Finance City Authority and the Casablanca-Settat Region, aims to promote the adoption of professional standards in the financial and professional services sector.

Scheduled to open in June 2025, the institute will offer training programmes and certifications, focusing on green and sustainable finance, to enable finance professionals to stay up to date with the latest industry trends and best practices. AFIC aims to promote the highest standards of ethics and integrity in the financial and professional services sector, and to strengthen and diversify the pool of highly qualified multilingual professionals who meet the needs of Casablanca Finance City, Morocco and the entire African continent.

The initiative is supported by an ecosystem of national and international strategic partners and professional bodies such as the Institute of International Finance (IIF), the Chartered Financial Analyst Institute (CFA Institute), the Chartered Insurance Institute (CII), the Chartered Banker Institute (CBI) and the Chartered Institute for Securities & Investment (CISI).

Annex 6.A. Qualitative survey of key actors in North Africa's renewable energy sector

Survey methodology

The survey is based on a qualitative approach using semi-structured interviews with key actors in the renewable energy sector. Interviews were scheduled for January 2024. To ensure that the research would comply with high ethical standards, participants were asked for their explicit consent for the interview audio to be recorded. The interviews, which lasted between 45 minutes and an hour, were transcribed.[6]

The target population

The survey is based on a non-representative sample of 18 participants covering most North African countries. It includes representatives from the public sector, industry associations, and private and public companies operating in the renewables sector or using renewable energy:

- Representatives from the public sector (from either the Ministry of Education or the Vocational Training Office) are involved in developing training programmes. These institutions offer training programmes covering initial, continuing and vocational training.
- The industry associations are directly and indirectly involved in training the staff of member companies. These associations act as intermediaries between their member companies and government ministries, and defend their members' interests.
- Organisations facilitating access to public and private financing provide support with preparing funding applications and finding investors.

Notes

1. The number of warmer days and nights (+2°C) has almost doubled since the 1970s. The rainfall trends observed are more varied and less pronounced, characterised by marked decreases in Morocco and Algeria, as well as parts of Libya, and a slight increase in Egypt (Plan Bleu, 2008[53]).
2. Eight Parties have yet to ratify the Paris Agreement: Iran (1.30% of global emissions), Türkiye (1.24%), Iraq (0.20%), Angola (0.17%), Yemen (0.07%), Eritrea (0.01%), South Sudan (data available) and Libya (data not available).
3. Although Mauritania is aiming to become one of the world's largest exporters of renewable hydrogen, at the time of publication of this report there was no clear strategy in place to achieve this objective.
4. The Stated Policies Scenario (STEPS) is based on current policy parameters, and takes account of ambitious targets and commitments only insofar as they are backed by detailed policies. Mauritania is not included in this calculation. Unpublished data.
5. The survey findings are based on interviews conducted across the region, covering both the public and private sectors, as well as academia. The annex presents the survey methodology and the target population.
6. The questionnaire is available on request.

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Chapter 7

Skills for agri-food in West Africa

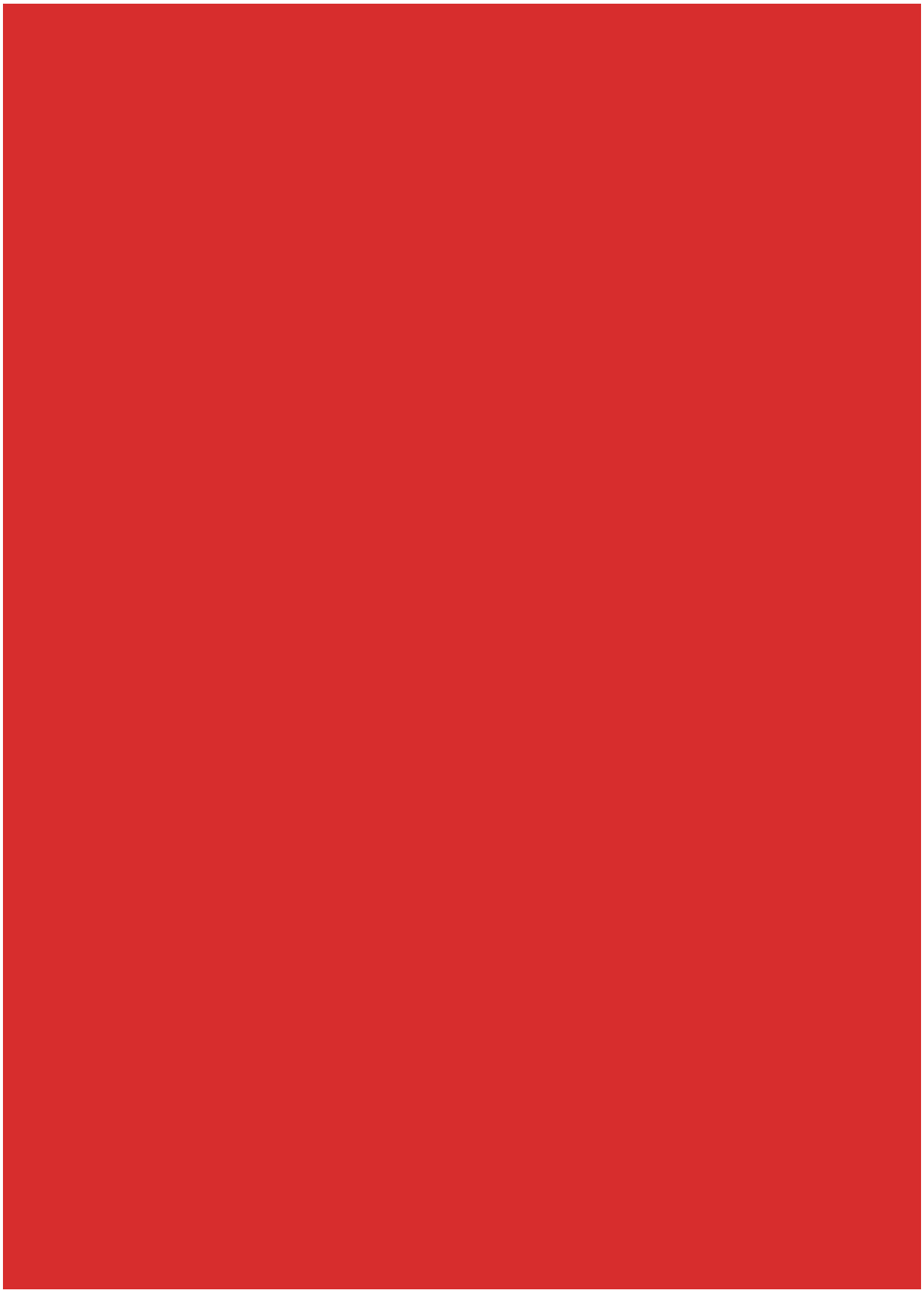
This chapter examines the skills that underpin the development of the agri-food sector in the 15 West African countries: Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. It provides an overview of levels of education, employment and skills development in the region, followed by a case study on the skills required in the agri-food sector. It analyses opportunities for the West African agri-food sector and constraints affecting it, and assesses the extent to which workers' skills align with those needed by sector. The chapter concludes with policy recommendations to align skill supply and demand, based on improvements in three areas: development of training strategies, co-operation between research organisations and companies, and funding programmes focused on targeted skills.

IN BRIEF

Improving education and training systems would offer West Africa enormous opportunities, but the region has major skills shortages. In 2020, the average length of schooling was 5.5 years, below the continental average of 6.7 years. Twenty-three per cent of young people in the region had completed secondary or tertiary education, but only 9% of secondary school students were undertaking technical or vocational education and training (TVET).

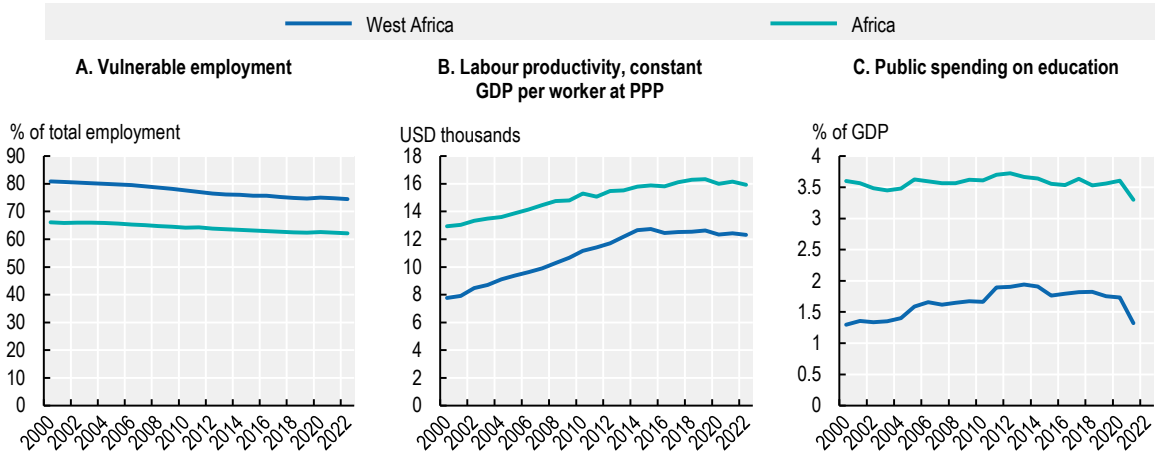
The agri-food sector is a major lever for productive transformation in West Africa. By the end of 2020, the agricultural sector alone accounted for around 25% of the region's gross domestic product (GDP) and 45% of employment. West Africa is facing climate-related and technological challenges that call for technical and soft skills, as well as investment in agri-food research. The lack of technical skills and awareness of good conservation practices among farmers, processors and traders results in post-harvest losses of 24% in the region, the highest figure on the continent.

Enhanced skills across the primary, secondary and tertiary segments of the agri-food sector would promote food self-sufficiency and the growth of the agri-food sector. Political decision-makers could prioritise three key lines of action: i) developing national sectoral professionalisation plans and programmes that promote local processing models and encourage public–private partnerships; ii) institutionalising co-operation agreements between regional research organisations and companies in the agri-food sector; and iii) increasing financing of skills development programmes to respond to global challenges, particularly climate change.



West Africa regional profile

Figure 7.1. **Vulnerable employment, labour productivity and education spending in West Africa, 2000-22**



Note: Vulnerable employment includes formal and informal self-employed (own-account) workers and contributing family members but excludes informal salaried employees. As an approximation of informal employment, it is used here to show long-term trends, as time series data on informal employment is missing for most African countries. Labour productivity is measured as the constant gross domestic product (GDP) in 2017 international USD at purchasing power parity (PPP) prices, divided by the population of employed people in thousands.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org; World Bank (2024[2]), *World Development Indicators* (database), https://databank.worldbank.org/source/world-development-indicators; and IMF (2023[3]), *World Economic Outlook* (database), https://www.imf.org/en/Publications/WEO.

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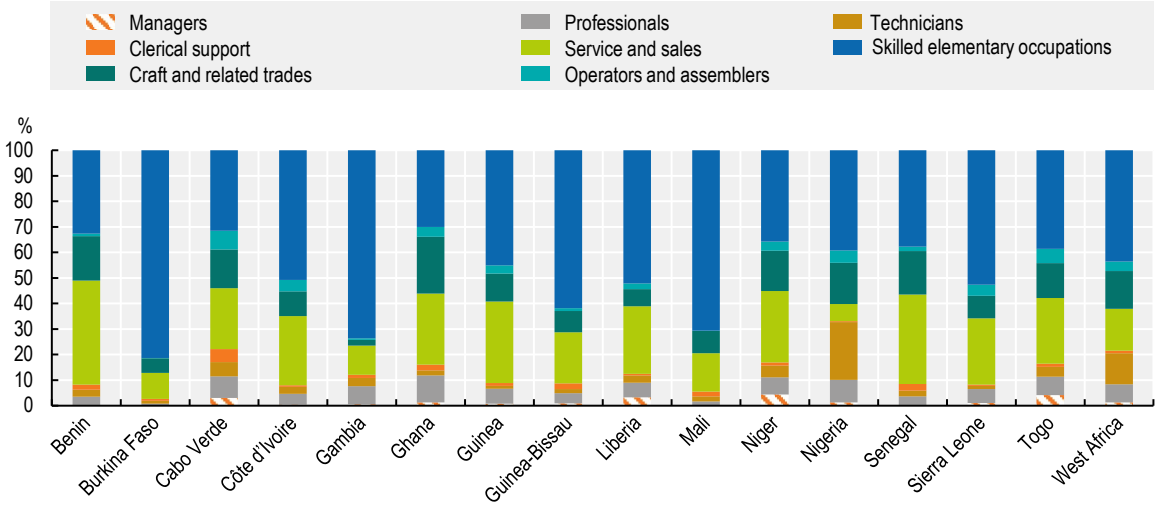
Figure 7.2. **Breakdown of working population by type of occupation by country in West Africa, 2021**



Note: : "Technicians" include associate professionals; "Skilled elementary occupations" include skilled agricultural, forestry and fishery workers, and elementary occupations; and "Operators and assemblers" include plant and machine operators and assemblers.

Source: Authors' calculations based on ILOSTAT (2023[1]), *ILO Modelled Estimates* (database), https://ilostat.ilo.org.

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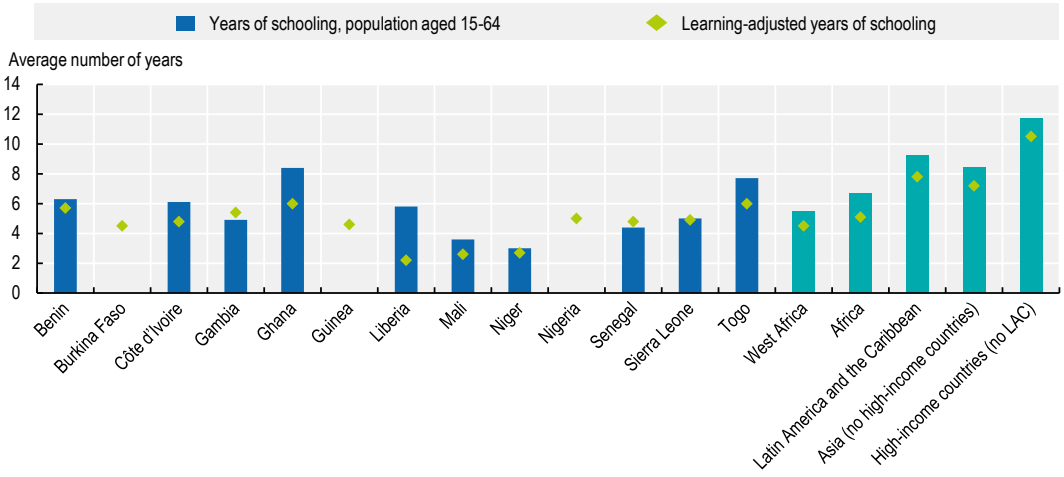
West African countries have a major shortage of skills

Despite the progress made in terms of access, the level and quality of education remain low overall in the region. In 2020, the average number of years of schooling was 5.5 years in West Africa, below the average for the continent (6.7 years), Latin America and the Caribbean (LAC) (9.2 years), and developing Asia (8.4 years). Nevertheless, there are considerable differences in the average years of schooling adjusted for learning quality. While the learning-adjusted years of schooling is six years in Ghana and Togo, it is less than three years in Liberia, Mali and Niger (Figure 7.3). As a result, less than a third of primary school leavers have basic reading skills. Similarly, less than 30% of teenagers starting secondary school achieve a satisfactory reading level and less than 15% have a satisfactory level in mathematics (Figure 7.4). Significant differences exist between urban and rural areas, though gender gaps are less pronounced.

Figure 7.3. **Average years of schooling and learning-adjusted years of schooling, 2020**



Note: LAC = Latin America and the Caribbean. Learning-adjusted years of schooling merge the quantity and quality of education into one metric, reflecting that similar durations of schooling can yield different learning outcomes. See Filmer et al. (2020[4]) for a detailed methodology.

Source: Authors' calculations based on World Bank (2023[5]), *Education Statistics* (database), https://databank.worldbank.org/source/education-statistics-%5E-all-indicators.

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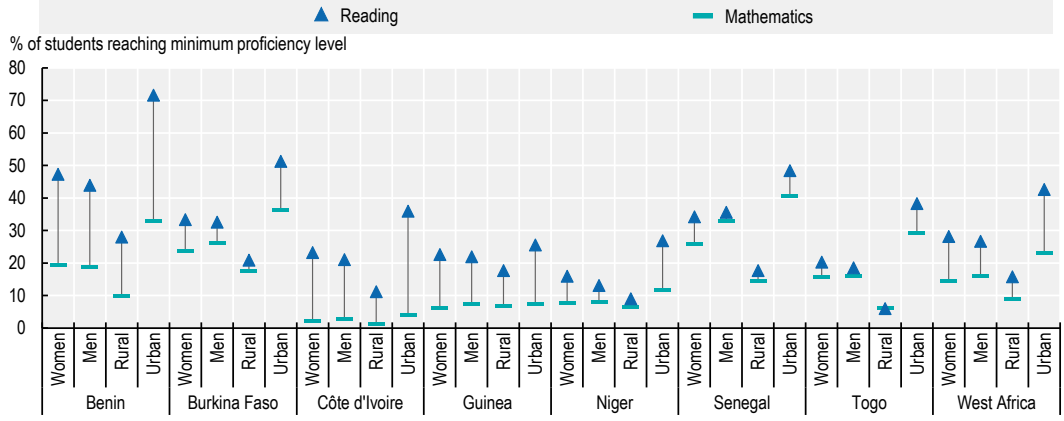
Figure 7.4. **Percentage of adolescents starting secondary school who are proficient in reading and mathematics, most recent year observed (2013-22)**



Source: Authors' calculations based on UNESCO (2023[6]), *World Inequality Database on Education* (database), https://www.education-inequalities.org/.

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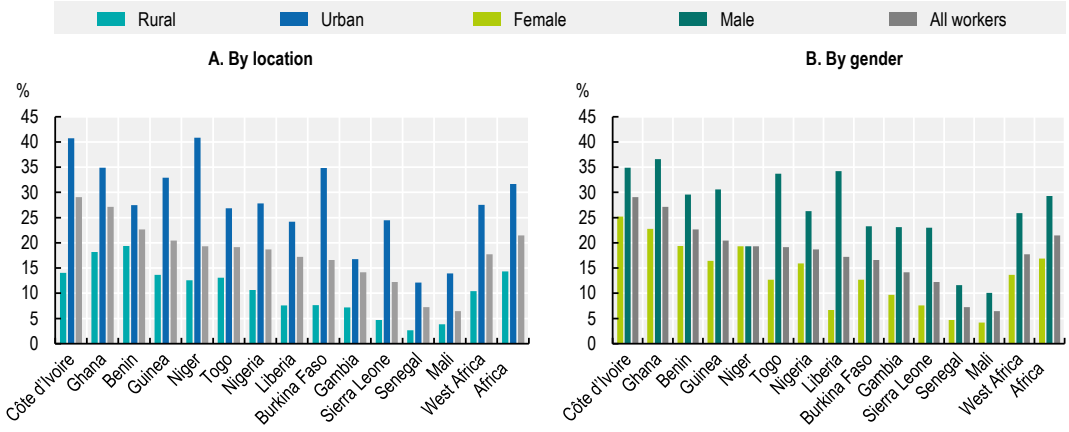
In West Africa, the performance of the education system is determined by socio-economic factors such as parental involvement, school support and literacy. Research by the CONFEMEN Programme for the Analysis of Educational Systems (PASEC), conducted by the Conference of Ministers of Education of French speaking countries (CONFEMEN) in several African countries, including seven in West Africa,[1] found that performance in reading and mathematics is better among students who receive help at home. High-performing children have access to books and live with literate parents or in the care of institutions that support school learning, which improves the quality of education (PASEC, 2020[7]).

Poor educational performance is compounded by limited uptake of vocational programmes. Although the number of young people in the region completing secondary or tertiary education rose from 13% in 2000 to 23% between 2000 and 2020, this has not translated into greater uptake of vocational training (AUC/OECD, 2021[8]). On average, only 9% of secondary school students are enrolled in vocational programmes, ranging from 47% in Gambia to less than 3% in Burkina Faso, Cabo Verde and Ghana (UNESCO, 2023[6]).

Most jobs remain low-skilled, with gaps between men and women. Around 18% of workers in West Africa are skilled, compared with around 22% for the continent as a whole (Figure 7.5). Côte d'Ivoire (29%) and Ghana (27%), which have more-developed manufacturing sectors, employ the highest share of skilled workers in the region. There are marked differences in access to employment between urban and rural workers, as well as between men and women. The share of workers in skilled jobs is relatively higher in urban areas, reflecting the presence of factories in cities; the unskilled workforce is concentrated in rural areas, and is mainly employed in agriculture. In West Africa, 26% of men work in skilled jobs, compared with 14% of women. This can be explained by inequalities in access to education, particularly higher education, and by social norms that disadvantage women, namely discrimination within families, physical violence, restricted access to productive and financial resources, and attacks on civil liberties (OECD Development Centre, 2022[9]; BAfD/ECA, 2020[10]).

Figure 7.5. **Percentage of workers in skilled jobs, by gender and place of residence, 2010-2019**



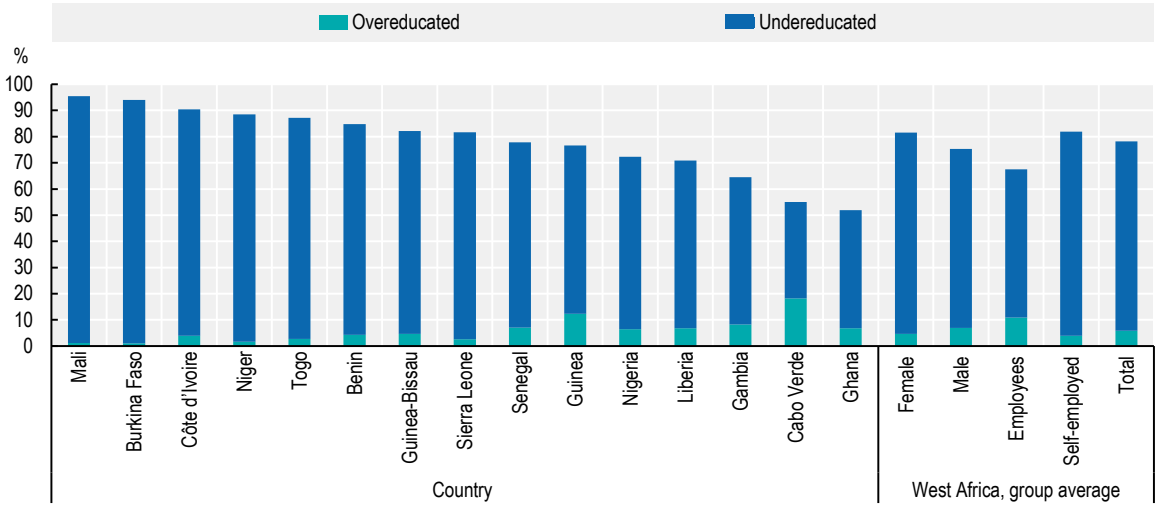
Note: Data are drawn from nationally representative demographic and health surveys (DHS) collected between 2010 and 2019. Occupational categories were divided into skilled and unskilled occupations as follows: skilled occupations include professional, technical, managerial, clerical and skilled manual work; unskilled occupations include sales, agriculture, household and domestic work, services and unskilled manual labour.

Source: Authors' calculations based on USAID/DHS (2023[11]), *Demographic and Health Surveys (DHS)* (database), https://dhsprogram.com/.

StatLink https://stat.link/p8m6gi

The majority of workers do not have the level of education required for their occupation. On average, 78% of workers in West Africa are employed in jobs for which they are not adequately qualified (Figure 7.6). This situation is more common among women and self-employed workers. The majority of workers (72%) do not have the level of education required for their occupation. The rate varies across the region: it stands at 37% in Cabo Verde and 45% in Ghana, but exceeds 90% in Burkina Faso and Mali. Only a small proportion of workers (between 4% and 11%) have a higher level of education than required for their occupation.

Figure 7.6. **Percentage of workers who have a higher or lower level of education than required for their occupation, 2022 or latest year available**



Note: Mismatches are assessed using the normative approach, by comparing the educational requirements for each occupational group set out in the International Standard Classification of Occupations (ISCO) with the educational level of each person with that occupation. Calculations are based on data available from national labour force statistics or other representative household surveys with an employment component.

Source: Compiled by the authors based on ILOSTAT (2023[12]), ILO Education and Mismatch Indicators, https://ilostat.ilo.org/resources/concepts-and-definitions/description-education-and-mismatch-indicators/.

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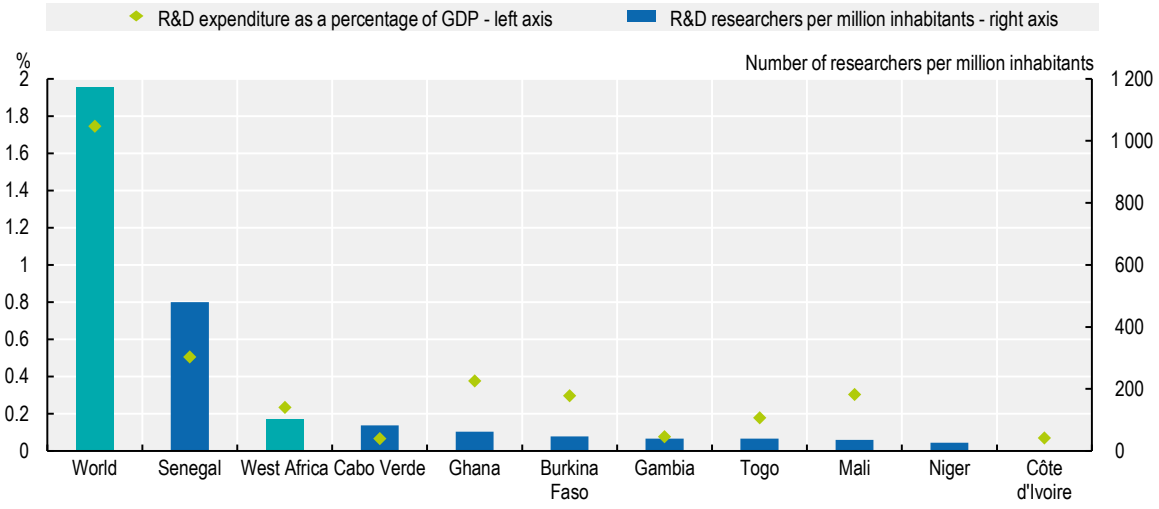
The shortage of technical skills can be partly explained by the low capacity of the education system. In West Africa, the education system is under-resourced both in terms of human resources and teaching materials making it unable to produce the skilled workforce required to grow the industrial sector. For example, in West Africa, research and development (R&D) expenditure as a percentage of GDP was 0.23% between 2010 and 2022, compared with around 2.2% worldwide. As a result, West Africa has just 102 researchers per million inhabitants, compared with a global rate of 1 392 (Figure 7.7). The lack of skilled workers means that most workers are employed in jobs for which they do not have the required skills, reducing sectorial productivity.

Figure 7.7. **R&D expenditure (as a percentage of GDP) and number of R&D researchers per million inhabitants, average 2010–22**



Source: UNESCO Institute for Statistics (2023[13]), *UIS.Stat* (database), http://data.uis.unesco.org/Index.aspx.

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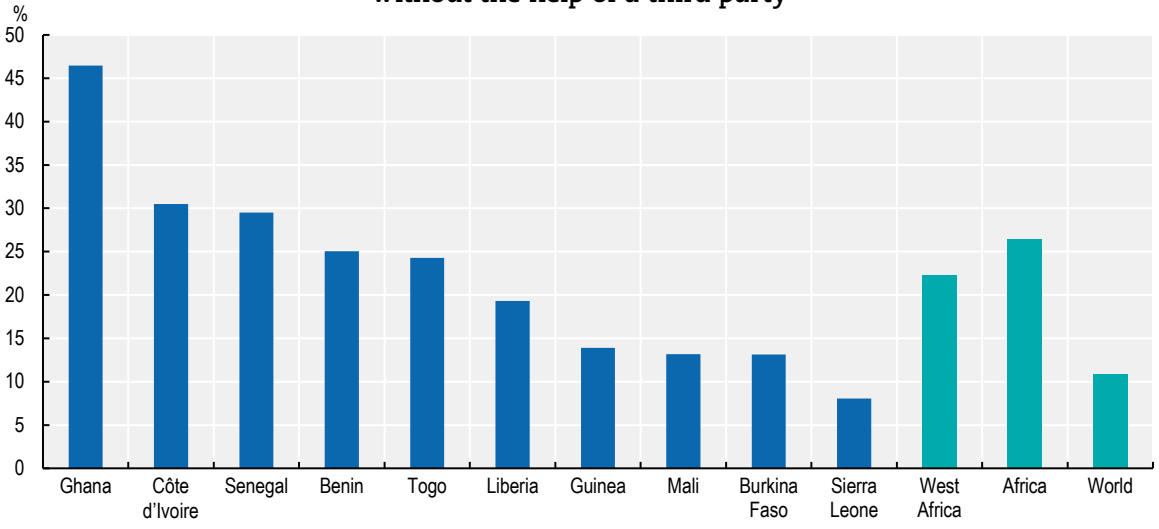
Digital skills can help transform economies, but they are developing unevenly across the region. The percentage of respondents able to use a mobile money account without the help of a third party ranges from over 45% in Ghana to less than 15% in Burkina Faso, Guinea, Mali and Sierra Leone (Figure 7.8). The low penetration of digital skills reflects the limited capacity of West African countries to adopt technologies that could strengthen the skills needed to develop the agri-food sector.

Figure 7.8. **Percentage of respondents able to use a mobile money account without the help of a third party**



Source: Demirgüç-Kunt et al. (2022[14]), The Global Findex Database 2021 (database), https://doi.org/10.1596/978-1-4648-1897-4.

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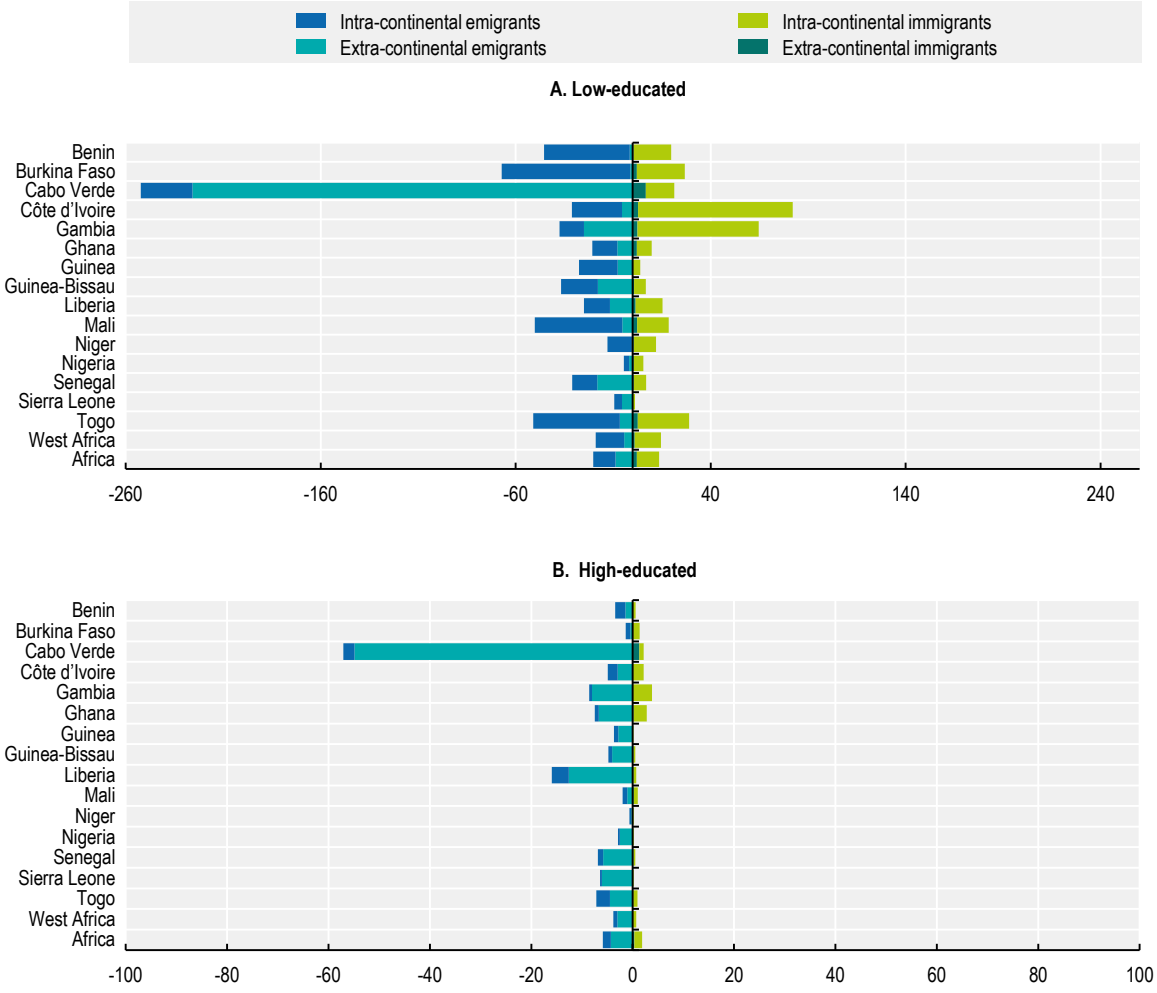
The region has high levels of internal migration, but skilled workers are migrating outside the continent. Low- or semi-skilled people – with secondary or lower education – mainly migrate within the region. Conversely, the majority of skilled workers – with tertiary or higher levels of education, and particularly those from Cabo Verde – mainly migrate to destinations outside the continent (Figure 7.9).

Figure 7.9. **Migrants by level of education, origin and destination, 2020**



Note: Migrants per 1 000 inhabitants. Negative numbers represent emigration. "Low-educated" refers to individuals with secondary or lower education. "High-educated" refers to those with tertiary or higher education.

Source: World Bank (2023[15]), *Global Bilateral Migration* (database), https://databank.worldbank.org/source/global-bilateral-migration.

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The agri-food sector: A major lever for productive transformation in West Africa

In West Africa, the agri-food sector is of strategic importance for the economic development of countries. More than 50% of the West African population lives in rural areas, and 65% of the active population works in the agricultural sector (AUC/OECD, 2022[16]). At the end of 2020, the sector accounted for around 25% of the region's GDP and 45% of employment. It is expected to contribute USD 430 billion and provide 131 million jobs by 2030. Jobs in the food economy are mainly concentrated in agriculture (78%) and are mainly found in rural areas (81%), including 15% in food processing, trade and out-of-home consumption, with this figure reaching 60% in urban areas (Allen, Heinrigs and Heo, 2018[17]). Developing the skills needed to grow the agri-food sector could help the region to better integrate value chains, and take greater advantage of the establishment of the African Continental Free Trade Area (AfCFTA) and the Economic Community of West African States (ECOWAS).

West Africa is a world leader in the production of several agricultural and food products, but it depends on imports for staple foods. In 2019, the region's share of global production of fonio, shea nuts, yams and cocoa beans was between 66% and 100% (AUC/OECD, 2022[16]), while between five and nine West African countries regularly rank among the world's top 20 producers of a dozen agricultural products (AUC/OECD, 2019[18]) (Table 7.1). Local stakeholders also have a strong foundation in the processing of vegetable oils, cassava by-products, sugar cane and tropical fruits. However, despite the wide range of agricultural products grown, West Africa faces major shortages of commodities such as rice (it is the continent's leading importer at 20 million tonnes/year), maize (in 2022 exports reached USD 9.87 million, while imports totaled USD 208.26 million) and vegetable oils (including soybean and sunflower, despite significant palm oil production).

Table 7.1. **West Africa's highest agri-food product exports, by country 2018-2022**

Country	Product	Exports in USD million, 2018-2022
West Africa	Cocoa beans	30 070
Côte d'Ivoire	Cocoa beans	19 129
Ghana	Cocoa beans	7 301
Nigeria	Cocoa beans	2 981
Senegal	Fish	1 461
Benin	Edible nuts	1 279
Guinea-Bissau	Edible nuts	812
Burkina Faso	Oilseeds	781
Togo	Soybeans	678
Niger	Oilseeds	678
Mali	Live cattle	279
Guinea	Edible nuts	276
Cabo Verde	Prepared or preserved fish	261
Liberia	Palm oil	225

Note: Products correspond to the four-digit code under the Harmonized System nomenclature.
Source: Authors' calculations based on Gaulier and Zignago (2023[19]), *BACI* (database), www.cepii.fr/cepii/fr/bdd_modele/presentation.asp?id=37.

The region is facing major challenges that are holding back the expansion and modernisation of agriculture, such as climatic conditions and small-scale production models. High temperatures and humidity can make fruit, vegetables and meat deteriorate faster. However, farmers and agri-food processors often have limited access to modern preservation technologies (e.g. refrigeration, freezing, drying, irradiation processing), which reduces agricultural productivity. The lack of skills and awareness of good preservation practices among farmers, processors and traders results in post-harvest losses of 23.6%, the highest rate on the continent (FAOSTAT, 2023[20]). In addition, farmers (the majority of whom run small family operations) play a crucial role in the region's food security but have insufficient access to adequate infrastructure, agricultural extension services, financing, agricultural inputs and foreign markets (Box 7.1). Less than 10% of potentially irrigable land is effectively irrigated – due in part to the under-utilisation of underground water resources – limiting the region's agricultural potential (Gadelle, 2005[21]).

Box 7.1. **Developing strategic value chains to boost local industry**

Foreign competition remains a major challenge for the local agri-food industry, constraining its ability to develop the skills it needs to grow. Domestic industries, which have not yet reached the efficiency level of foreign industries, have no access to foreign markets due to their weak product development and inability to comply with various regulatory, sanitary and plant health standards. Between 2016 and 2020, West African countries had to import nearly USD 60 billion worth of food products, of which around 67% were semi-processed or processed products (Badiane, Collins and Glatzel, 2022[22]). Partnerships with multinationals will facilitate the emergence of local agri-food industries and provide access to the technical expertise needed to compete with foreign industries, allowing them to upgrade and develop skills.

An increasing number of training initiatives meets the demands of specific value chains. A meeting on agri-food value chains in October 2023 highlighted the key challenges affecting the processing of infant formula – of which imports into Africa are expected to exceed USD 1.1 billion by 2026 (ITC/AU/EU, 2022[23]) – namely safety, management and measuring potential contaminants. For its part, Danone highlighted positive results in the dairy sector, where 10 000 West African farmers have already been trained on irrigation techniques to help them manage water stress. The goal is to reach 100 000 farmers soon (OECD/AUC/AUDA-NEPAD/EC, 2023[24]).

Closing the agri-food skill-gap could boost the sector's productivity and resilience

A range of skills will be needed across the primary, secondary and tertiary segments to develop the agri-food sector in West Africa. The agri-food sector encompasses a wide range of activities requiring specific skills (Table 7.2). Skilled workers are needed in food safety management and control, process and product quality management and assurance, efficient resource use and organisation. Strategic planning, insight and thinking skills are the most sought-after (Ramalho Ribeiro et al., 2023[25]).

Table 7.2. **Skills needed for the development of the agri-food sector**

Area of responsibility	Skills required	Example professions	Type of skills
Agricultural production	• Land preparation, proper use of inputs (seeds, fertilisers) and machinery	Farmer, agricultural technician	Technical
Food safety	• Proficiency in food safety standards and health regulations • Implementation of food-chain safety protocols	Food safety manager, health inspector	Technical; managerial and soft
Food processing	• Food processing and preservation • Use of food processing equipment	Food processor, food engineering technician	Technical
Quality control	• Quality control of raw materials and finished products • Proficiency in quality control tools and methods	Food quality manager, food laboratory technician	Technical
Supply management	• Supply chain management to ensure constant availability of raw materials • Efficient logistics for product transport and storage	Food logistics specialist	Technical
Regulatory compliance	• Compliance with government standards and regulations governing the production and sale of food	Health inspector, food safety specialist	Technical
Food quality and safety management	• Implementation of food quality and safety management systems • Staff training on food quality and safety standards	Food safety manager, food quality manager	Technical; managerial and soft
Financial management	• Financial management for budgeting, planning and monitoring costs. Analysis of production costs and profit margins	Agri-food management controller	Technical; managerial and soft

Table 7.2. **Skills needed for the development of the agri-food sector *(continued)***

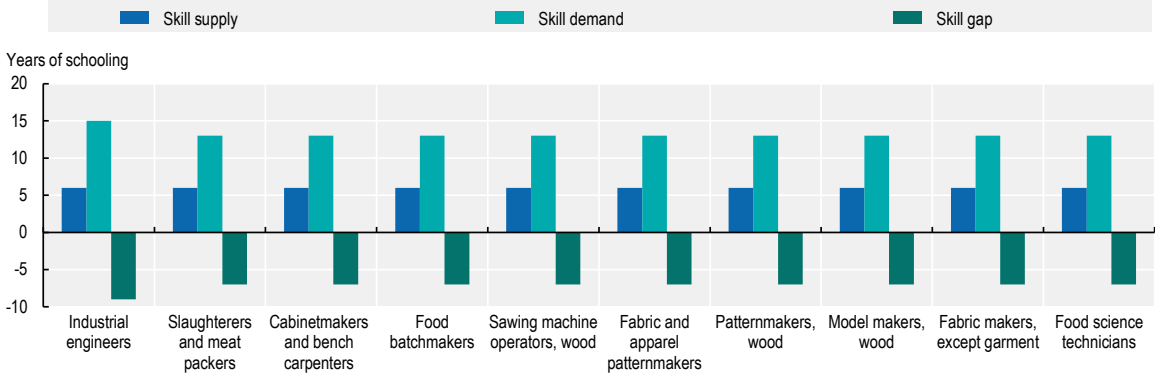
Area of responsibility	Skills required	Example professions	Type of skills
Managerial positions	• Efficient management of production and distribution teams. Strategic planning for company growth • Effective communication with stakeholders, customers and suppliers • Management of public relations and crisis communication; food marketing. Knowledge of food market trends and consumer preferences	Food production manager, shelf placement manager	Managerial and soft
Marketing and sales	• Effective communication with stakeholders, customers and suppliers • Management of public relations and crisis communication; food marketing. Knowledge of food market trends and consumer preferences	Food salesperson, food product manager	Managerial and soft

Source: Produced by the authors.

There is a shortage of agricultural product processing skills, usually acquired through informal learning. The rudimentary technologies used by stakeholders in this sector severely limit their efficiency and capacity to innovate. Conversely, multinationals operating in the food processing sector are equipped with modern skills that allow them to take advantage of new, modern and more efficient technologies (Aryeetey, Twumasi Baffour and Ebo Turkson, 2021[26]).

Technical, resource management and soft skills are crucial to the growth of the agri-food sector. In Ghana, the supply of basic skills meets the demand from companies in the sector, but there are major shortages of technical and system management skills[2] (Aryeetey, Twumasi Baffour and Ebo Turkson, 2021[26]). In Senegal, skills level required by several occupations far exceeds the current supply, with a gap ranging from seven to nine years of schooling – a significant skills shortage (Figure 7.10). Food technicians need the widest possible range of skills, including basic, system management and problem-solving skills (Aly Mbaye et al., 2021[27]). Other occupations, such as accountants and electrical engineers, have similar requirements, particularly with regard to problem-solving in the context of food processing.

Figure 7.10. **Professional skills deficits in selected agri-food occupations**



Source: Produced by the authors based on Aly Mbaye et al. (2021[27]), *Employment Creation Potential, Labor Skills Requirements, and Skill Gaps for Young People: A Senegal Case Study*, https://www.brookings.edu/wp-content/uploads/2021/04/21.04.02-Senegal-IWOSS_FINAL.pdf.

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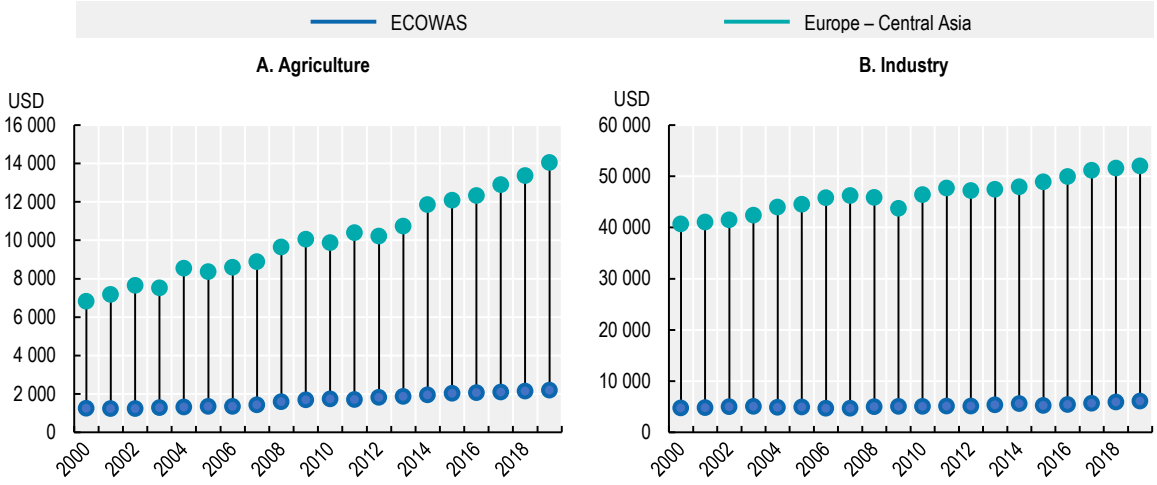
The growth of the agri-food industry requires investment in research and development to strengthen technical skills

Poor assimilation of technical skills, limited investment in R&D, and gaps in basic knowledge have worsened the productivity gap in West Africa's agricultural sector.

Despite improvements, agricultural sector productivity remains relatively low. The widening productivity gap is a symptom of an under-skilled workforce. The productivity gap between West Africa and European and Central Asian countries is widening in both the primary and secondary segments, highlighting the scale of the efforts required to develop a competitive agri-food sector (Figure 7.11).

Figure 7.11. **Productivity gap between ECOWAS countries and European and Central Asian countries in agriculture and industry (difference in value added per worker)**



Source: World Bank (2024[2]), *World Development Indicators* (database), https://databank.worldbank.org/source/world-development-indicators.

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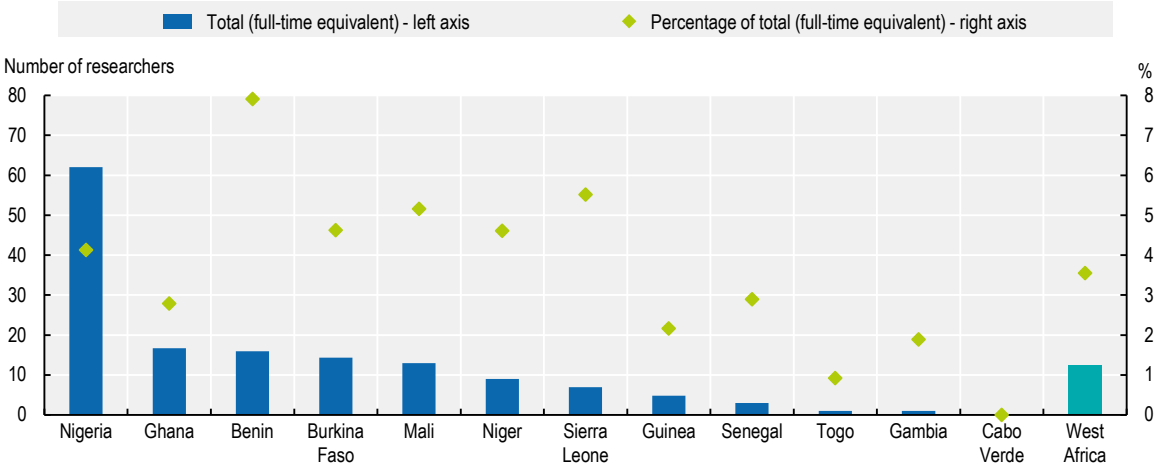
There is a marked shortage of technical skills in West Africa in the field of agri-food research. The number of food science and nutrition researchers is low in several countries, particularly Cabo Verde, Gambia, Ghana, Guinea, Senegal and Togo (Figure 7.12). The percentage of total full-time equivalent researchers in food science and nutrition in these countries is below the regional average (3.6%). Nigeria and Ghana are notable exceptions, with a relatively more developed agri-food sector.

Figure 7.12. **Researchers in food science and nutrition, latest year available (2014-16)**



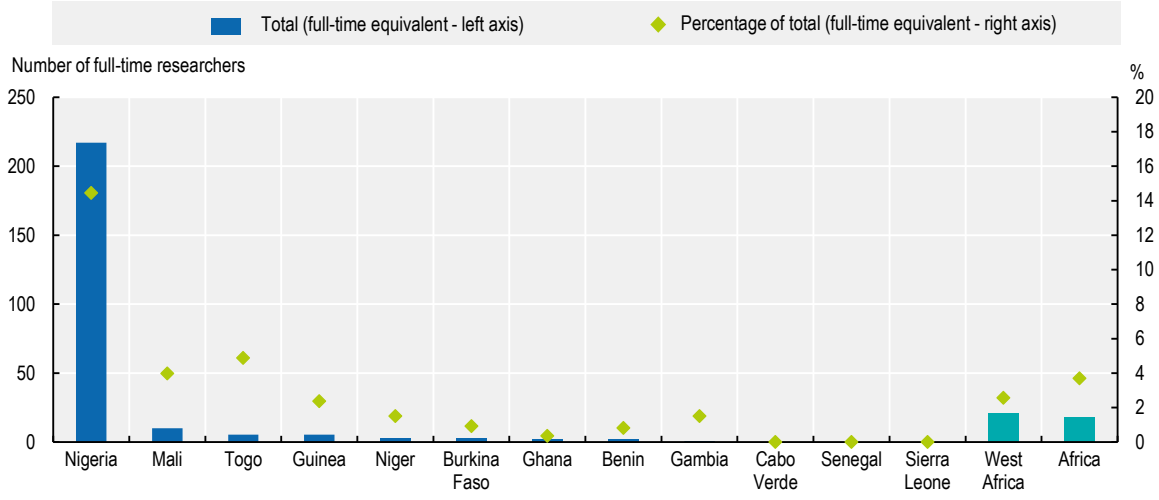
Note: "Total" indicates the total number of researchers specialising in food science and nutrition. "Percentage of total" indicates the proportion of researchers specialising in food science and nutrition among agricultural researchers.

Source: IFPRI (2024[28]), *Agricultural Science and Technology Indicators (ASTI)* (database), https://www.asti.cgiar.org/.

StatLink https://stat.link/rx9u6i

Regional differences in the number of veterinary medicine researchers highlight the need for investment in skills and regional collaboration. In West Africa, veterinary medicine researchers account for around 2.6% of agricultural researchers, below the average for Africa as a whole (3.7%), with significant differences across West African countries (Figure 7.13). Initiatives to increase the number of researchers and promote regional collaboration in this specific field are essential to improve animal health, productivity, and food security.

Figure 7.13. **Researchers in veterinary medicine, latest year available (2014–16)**



Note: The "Africa" category covers 30 African countries. "Total" indicates the total number of researchers specialising in veterinary medicine. "Percentage of total" indicates the proportion of researchers specialising in veterinary medicine among agricultural researchers.

Source: IFPRI (2024[28]), *Agricultural Science and Technology Indicators (ASTI)* (database), https://www.asti.cgiar.org/.

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Developing adaptability skills is essential to meet the challenges facing the agricultural sector, such as technological transformations, international standards and climate change

Demand for agri-food processing and logistics skills is growing in West Africa. The presence of supermarkets in agri-food value chains is increasing. This is standardising production, imposing strict quality standards (AUC/OECD, 2022[16]) and creating new challenges in terms of skills. Education policies need to adapt to these changes if the West African agri-food sector is to remain competitive and continue to comply with regulations. It will be crucial to maintain the focus on secondary education and technical training to meet the growing demand for skills. Governments can better equip the workforce to adapt to changing markets by investing in education and training.

Compliance with international rules and standards requires specific skill sets. Oversight of mandatory standards (monitoring, traceability and quality assurance systems) is essential to developing and scaling up agri-food production. Measuring quality through sampling, microbiological and biochemical analysis, environmental testing, and caloric and nutritional content requires investment in equipment and skilled personnel. To succeed, the sector will need to standardise policies, introduce new regulations, regional procedures and bodies, and strengthen the technical skills needed to comply with these standards. Within the framework of the West African Economic and Monetary Union (WAEMU), ECOWAS and the AfCFTA, standards mainly concern food, human and plant health.

Continuous learning and green skills are needed to adapt farming practices to climate change. In West Africa, agricultural productivity is heavily affected by climate change. Droughts, excessive rainfall and floods are already impacting agricultural productivity and, consequently, the food security of rural households. Although around 51% of people surveyed in 13 West African countries have heard of climate change, this figure drops to 42% for people with no education, and to 47% for rural inhabitants, compared with 55% for urban inhabitants (Afrobarometer, 2023[29]). Climate change requires continuous learning and skills to implement different adaptation strategies, such as changing crop varieties, sowing dates, crop density and irrigation, fertiliser management (Sultan and Gaetani, 2016[30]) and organic farming techniques (Box 7.2). Climate-resilient farming techniques entail two additional challenges in that they require strong management skills and have high startup costs to equip specialised plantations (Abegunde, Sibanda and Obi, 2019[31]).

Box 7.2. Organic farming in West Africa

West Africa has great potential to develop organic farming. Despite the fact that only 0.23% of farmland was used for organic farming in 2021, this represented a 543% increase compared with 2012. Given the high international demand for organic products, developing organic farming would enable West Africa to increase its exports to higher-income regions (FiBL, 2023[32]). However, export-oriented programmes should be designed such that they do not undermine the region's food security (Aïhounton and Henningsen, 2024[33]).

Organic farming helps farmers adapt to environmental challenges. Organic farming methods allow soil and water resources to be used more sustainably. The most-exported organic agricultural products, in particular soybeans, have adapted to global warming (FiBL, 2023[32]; De Bon et al., 2018[34]).

The development of organic farming must be accompanied by a change in skill sets. This type of farming relies on more labour-intensive and relatively less capital-intensive farming methods. It is, therefore, relatively well suited to the West African context. Nonetheless, advanced agronomy skills are needed to achieve sufficient yields without resorting to chemical fertilisers (Agricultural Recruitment Specialists, 2024[35]). While many organisations with the know-how to successfully implement organic agriculture are active in the region (De Bon et al., 2018[34]), farmers will require technical training to ensure their efforts yield profits.

West African decision-makers can draw on public policy tools to improve agri-food skills

The West African economy is transitioning, as demonstrated by the initiatives and projects being implemented in the agri-business sector. However, when it comes to harnessing agri-business as a lever for economic development in the region, progress remains slow and little has been done to adapt to economic changes. To take full advantage of the potential offered by agri-business, policy recommendations should focus on three kinds of interventions: developing professionalisation plans and programmes; institutionalising co-operation agreements between research organisations and companies in the agri-food sector; and funding skills programmes to better respond to global challenges.

National and regional plans and programmes to professionalise the sector could do more to support local processing businesses and encourage public-private partnerships

Strengthening foundational knowledge must serve as the basis for developing national skills plans and programmes tailored to target sectors. Depending on their natural and comparative advantages in the agri-food sector, countries should identify the skills required to achieve their structural transformation objectives and determine how to develop these skills. These skills plans will enable countries to better target areas that will support their development. Comparative advantages are central when identifying priority value chains: coastal countries could, for example, focus on agri-food businesses linked to fish, vegetables, fruit, juices and their by-products, while Sahelian countries could focus on meat, milk, dried fruits and their by-products. The skills receiving support in a given country should align with its priority industries.

ECOWAS has drawn up a regional strategy to boost the employability of young people in the agro-sylvo-pastoral sector. Adopted in 2019, this strategy aims to address the specific challenges that young people in the region face in relation to employment in the agricultural sector (ECOWAS ARAA, 2024[36]). It encourages the youth to engage in agricultural entrepreneurship by providing financial, technical and institutional support to start and grow their businesses. This includes training and capacity-building programmes to develop their technical, entrepreneurial and leadership skills. The strategy aims to improve young population's access to productive resources such as land, water and agricultural inputs, as well as consulting and trade-related services. It promotes innovative farming practices and use digital skills to increase efficiency and productivity in the agricultural sector. The strategy calls for collaboration between governments, regional and international organisations, the private sector, civil society and other stakeholders to implement effective programmes to improve the youth's employability in the agro-sylvo-pastoral sector.

There are other initiatives to promote local products and on-site processing. To add value locally, a number of countries are setting up agricultural growth poles ("agropoles" in French), as centres of excellence in agro-industrial production, or special economic zones. Given that the food systems of many West African countries have been affected by the COVID-19 pandemic and the disruption of grain exports from Ukraine and Russia, these countries have stepped up investment and collaboration between the public and private sectors. Examples of initiatives include:

- In Benin and Togo, the Glo-Djigbé and Adétikopé industrial zones, respectively, are being developed through a partnership between the two countries and the Arise Integrated Industrial Platforms (ARISE IIP) group, which specialises in logistics and industrial platforms. The aim is to maximise the value of natural resources such as cotton, cashew nuts, soybeans, cereals and fruit (mangoes, oranges and pineapples) by processing them locally for export.
- In Senegal, agropoles are designed to boost sales in the local market, where small and medium-sized agribusinesses are key players in the transformation of dairy products, processed cereals, vegetable oils, and fruit juices. Three integrated agropoles are already up and running (in the Centre and South regions of the country), while agropoles in the North and West regions are under construction.
- The Bagré agropole in Burkina Faso stands out for its wide range of skill sets and its commitment to agricultural development. It is a strategic hub that brings together professionals and researchers specialising in various agricultural sub-sectors. This agropole mainly focuses on such skills as agronomic research, good agricultural practices and innovative technologies to increase the sector's productivity and sustainability (Kaboré and Sédogo, 2014[37]).

The prevalence of the informal sector in West African countries is a barrier that must be overcome by setting up mechanisms to transform family-centred production units into co-operatives. Although informal businesses currently offer a wide range of processed or semi-processed products in African countries, they are not well equipped to withstand the challenges of an industrialising agri-food sector. Improving the quality of agri-food products and adapting supply to demand is a major challenge for family farms, which account for 95% of the West African population working in agriculture (ROPPA, 2018[38]). The agri-food sector is influenced by quality, traceability, hygiene and packaging standards, which small informal production units find it more difficult to comply with. Moreover, the costs involved in setting up a modern, competitive agri-food business are beyond the reach of small, informal operations with no access to bank financing. As a result, grouping informal production and processing units operating in the same sub-sector into co-operatives often allows them to achieve better economies of scale, increase the size of their production facilities, compete more effectively and develop the skills needed to establish cutting-edge agri-food businesses in West Africa.

Private initiatives that combine vocational training, the development of innovative processes and local production are essential to enhance skills in the agri-food sector. Business incubators in the agri-food sector need to be set up as part of research projects that have training and professionalisation components. These research projects will enable production activities to be monitored more rigorously and skills to be updated and upgraded to optimise production and satisfy market demand. The Songhaï project in Benin follows this approach and is an example that could be replicated across the region (Box 7.3).

Box 7.3. **The Songhaï Centre: An agri-food skills incubator in West Africa**

The Songhaï Centre's mission seeks to draw on the environmental wealth of the African continent, by combining new technological developments with more sustainable production systems. Its production model strengthens dynamic links and synergies between primary production units (crop, animal, fish farming), and industry and services (agri-business).

Founded in 1984 by Brother Godfrey Nzamujo on 1 hectare of land, the Songhaï Centre approach has since expanded to cover more than 22 hectares, with its innovative model reaching other regions of Benin, as well as Liberia, Nigeria and Sierra Leone. It is particularly recognised for its focus on training young agricultural entrepreneurs since 1989.

In addition to its role as a laboratory trialling environmentally conscious farming methods, the Songhaï Centre plays a key role in skill training for the sustainable development of the agri-food sector. The Songhaï Leadership Academy training programme is supported by a number of development partners, including the Agence française de développement (AFD) (Ambassade de France au Bénin, 2021[39]). The course lasts six months, with a new intake of 80 to 120 full-board students every two months. This training programme intends to catalyse the creation of an experience-sharing network.

The Songhaï model goes beyond farming to operate as a skills incubator namely in fruit juice, pastry, rice, palm oil and soap production. It is shaping a new generation of agricultural entrepreneurs, or "agripreneurs", yearning to thrive in an environmentally conscious and economically viable system.

Operationalising co-operation agreements between regional research organisations and agri-food companies could improve access to the labour market

Strengthening collaboration with regional and international training centres is of strategic importance. West Africa is home to a number of technical research centres and institutions specialising in agriculture within universities (Annex Table 7.A.1). These centres play a crucial role in research and innovation, and management training in the agricultural sector. They offer training courses for different skill levels (agricultural technicians, researchers, food industry professionals). Training courses cover areas such as crop improvement, water management and food security. These centres would benefit from intra-African and intercontinental research exchange and mobility programmes (see Chapter 2).

Skills development initiatives must better prepare the workforce for an ever-changing working environment by tailoring the training offer. To maximise the effectiveness of these programmes, it is crucial to establish close links between the agricultural and agro-industrial sectors, on one hand, and between vocational training centres and agri-food businesses, on the other hand. This could be achieved by developing TVET programmes, that incorporate in-company placements and partnerships with companies in the agri-food sector. Placement contracts should serve as a bridge between training centres and production units. Regarding tax benefits (accessible to only a minority of formal companies), government-backed financial support mechanisms could be set up to encourage the development of innovative production processes within the framework of co-operation agreements between companies and research centres. In this vein, in 2009 the Nigerian government launched a programme to develop and modernise the country's agricultural sector and promote food self-sufficiency (Box 7.4).

Despite the current need for TVET in West Africa's agricultural sector, supply remains insufficient. The agricultural sector alone employs almost half of the region's workforce, but most countries continue to import a large share of their food products, mainly due to a lack of skills (Gustafson, 2023[40]). This can be explained in part by the limited availability of training in the agricultural sector. In Nigeria, of the 171 technical colleges surveyed, only 37 (21.6%) offer courses in agriculture and related disciplines (Akinde and Vitung, 2020[41]). Conversely, Benin is working to increase the supply of vocational training, and the number of technical agricultural colleges in the country is due to increase three-fold to around 30 by 2025, according to the country's National Strategy for Technical and Vocational Education and Training (SN-EFTP 2020–2030) (Marie, 2022[42]).

Box 7.4. Agricultural training initiatives in Nigeria

Nigeria has made major changes to its national agricultural policy in recent years. Nigeria's Vision 2020 programme, launched in 2009, sought to develop and modernise the country's agricultural sector and promote food self-sufficiency. The Agricultural Transformation Agenda (ATA), established in 2011, is part of a series of long-term efforts to transform the sector. Training future generations is a crucial element of this strategy.

The policies implemented integrate a gender-sensitive approach. In 2009, women accounted for 70% of the agricultural workforce in Nigeria, despite being seriously affected by a lack of access to resources (FAO, 2018[43]). In 2012, Nigeria's Federal Ministry of Agriculture and Rural Development (FMARD) merged two of its divisions to create the Gender and Youth Division, in an effort to improve youth participation in the agricultural labour market. In 2013, this division launched the Youth and Women

Box 7.4. **Agricultural training initiatives in Nigeria *(continued)***

in Agri-business Investment Programme (YWAIP), which trained 5 000 young people for two to six weeks, introduced them to mentors and provided them with financial support to launch their businesses. More than half of the trainees were women. In 2015, 5 500 programme participants including more than 3 000 women, were still employed in agricultural businesses (Adesugba and Mavrotas, 2016[44]).

Training policies in the agricultural sector have focused on young people and agri-businesses. From 2015 to 2020, FMARD's Gender and Youth Division led a major initiative aimed at training young people in leadership, entrepreneurship and management skills to promote self-employment and improve young people's perception of the agricultural sector. The initiative was supported by the International Labour Organization (ILO) and the Food and Agriculture Organization of the United Nations (FAO). More than 80% of participants were able to set up businesses after their training. However, barely 6 600 trainees took part in 2014 (Mavrotas, 2015[45]).

It is vital to institutionalise co-operation agreements between regional and international research organisations and companies in the agri-food sector. The latter often operate in silos, independently from research and training centres in West Africa. This makes it difficult to transfer skills and keep employees updated about new processes. The mismatch between training and jobs is a recurrent criticism addressed at the education sector. Moreover, new processes developed by research centres are not always applied in the private sector, due to the disconnect between the two spheres. Co-operation agreements would make it possible to train managers on the skills needed to develop production models. They would provide practical support for research trials and operationalising new methods. This would enable companies to support scientific research, which they could then use to improve their productivity. Research-based training contracts, designed to lead to applied master's and even doctorate-level diplomas, could also be trialled in West Africa. They are already in use in France in the form of *Conventions Industrielles de Formation par la Recherche* (CIFRE).

Regional and continental training networks are essential for strengthening agricultural and agri-food skills in West Africa. The Agricultural and Rural Training International Network (FAR)[3] for instance, has set up a skills development platform dedicated to promoting agriculture (Box 7.5). It offers academic training in agricultural and rural engineering for trainers, school directors, and training co-ordinators. The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) is a network of 129 African universities, including 27 in West Africa. It trains university students and supports collaboration and co-ordination in agricultural research.

Box 7.5. **A commitment to agricultural and rural training**

The Agricultural and Rural Training International Network (FAR) is a platform for exchanging and strengthening skills, centred around sustainable agriculture and rural environments. Founded in 2005 in Ouagadougou in the framework of a major conference,[4] the FAR network brings together 18 countries from Africa and beyond that are committed to promoting professional and social integration through training. With over 3 000 active members, the network strives to develop the necessary skills to face the challenges of modern agriculture.

In addition to providing tailored support to member countries working to modernise their training systems, the network offers high-level training courses, such as the MIFAR international master's degree. Through capacity-building workshops and innovative projects, FAR catalyses the development of cutting-edge skills, essential for transforming rural environments.

By generating knowledge, communicating, and advocating for agricultural and rural training, FAR has positioned itself as a major international changemaker in the agricultural sector. The network is working to create a more dynamic, inclusive, and sustainable agricultural sector by sharing best practices and facilitating dialogue between stakeholders.

International organisations working to promote the agricultural sector and food self-sufficiency can play a decisive role in improving skills in the West African agri-food sector. For example, the International Fertilizer Development Center (IFDC) works mainly in developing countries to promote food security and improve the livelihoods of agricultural populations. Its efforts focus on developing and disseminating effective, sustainable technologies for soil fertility management, and creating markets for agricultural inputs and products, to foster rural development and increase agricultural productivity. IFDC co-ordinates the implementation of its activities in several African countries and in Asia. In Benin, IFDC has created 461 farmer field schools, training 6 915 farmers and 294 seed producers on good agricultural practices. Over 4 050 more farmers have adopted the practices they learned at the field schools in 2021.

To better respond to today's global challenges, in particular climate change, it will be necessary to scale up financing of skills development programmes

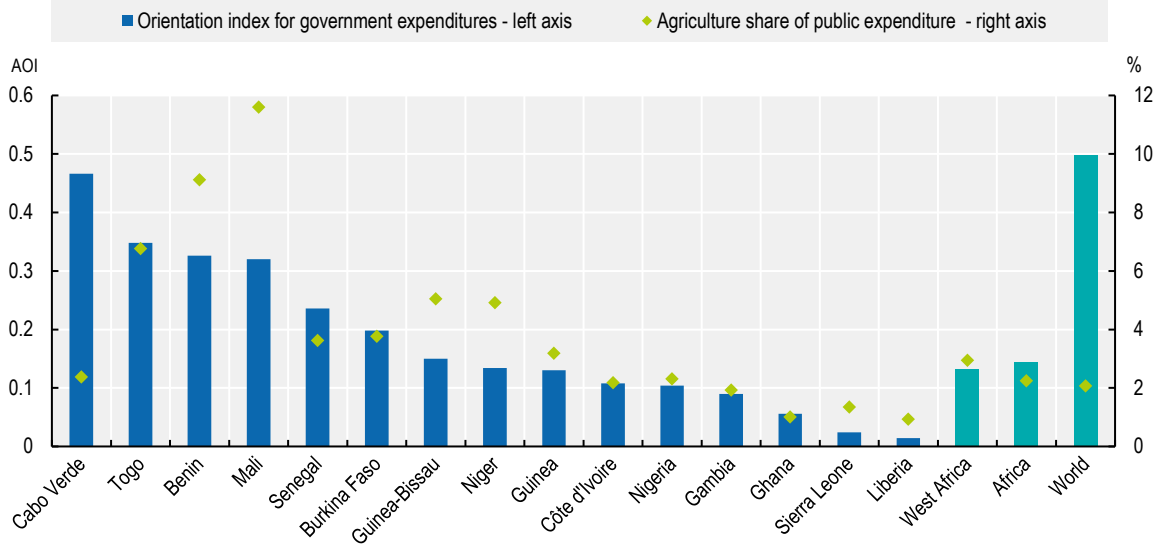
A forward-looking vision that takes into account the pressing needs of climate change would help develop the skills required. To respond to climate change, skills development programmes could include training modules on the responsible management of natural resources, promoting organic and ecologically sustainable agriculture, and climate change adaptation strategies. Stakeholders in the agri-food sector need to be trained on sustainable agricultural practices that protect biodiversity, reduce greenhouse gas emissions and bolster the resilience of food systems in the face of environmental and climate-related challenges. ECOWAS, for example, has been implementing the Agroecology Programme (PAE by its French acronym) in West Africa since 2018 to improve agricultural training and capacity building in order to sustainably intensify agriculture and promote agroecology.

Financing the development of the agri-food sector is a major challenge; countries can nevertheless rise to it by implementing effective policies and innovative funding models. Since 2010, formal investment in the region's agri-food sector has stagnated. Local bank loans are the main formal source of financing for the agriculture, forestry and fisheries

sector, accounting for USD 6.7 billion in 2020, while development finance stood at just USD 1.7 billion and public spending at just USD 1.1 billion in the same year. Foreign direct investment (FDI) fluctuates greatly and tends to be concentrated in the largest West African economies, leading to a general shortage of funding for agricultural productivity and downstream activities (e.g. processing, marketing and distribution) (AUC/OECD, 2023[46]). The "Babban Gona" ("*Great Farm*" in Hausa) franchise model, which brings together investors, development finance institutions and foundations, is proving effective. Babban Gona aims to double the net income of participants – mainly youth in rural northern Nigeria – compared with the national average, through loans, inputs, harvesting and storage services and training via the *BG Farm University* platform (courses in agronomy, financial literacy, business skills and leadership). Since 2010, the organisation has created 300 000 agricultural jobs. An additional 850 000 people have benefited indirectly (Babban Gona, 2024[47]).

More public investment will help grow the sector and improve food self-sufficiency. In view of the persistent risk of food insecurity, following the Maputo Declaration on Agriculture and Food Security in 2003, governments pledged to earmark at least 10% of their national budgets for implementing the Comprehensive Africa Agriculture Development Programme (CAADP). This initiative aims to increase annual growth in the sector to 6%. With the exception of Benin, Guinea-Bissau, Mali and Togo, ECOWAS countries have allocated less than 5% of their expenditure to the agricultural sector. Moreover, the agriculture orientation index for government expenditure[5] is relatively low in West Africa (0.13) compared with the global average (0.5) (Figure 7.14).

Figure 7.14. **Agriculture orientation index for government expenditure and share of total public expenditure spent on agriculture in West Africa, average 2017-21**



Note: An agricultural orientation index (AOI) greater than 1 indicates greater government orientation towards the agricultural sector, i.e. the sector receives a higher share of public spending relative to its contribution to economic value added. If it is less than 1, the orientation towards agriculture is weaker; if equal to 1, government orientation towards the agricultural sector is neutral.

Source: World Bank (2024[48]) *SDG Metadata translation project*, https://worldbank.github.io/sdg-metadata/metadata/fr/2-a-1; FAOSTAT (2023[20]), *Food and agriculture data* (database), https://www.fao.org/faostat/en/#home.

StatLink https://stat.link/b91eqx

While informal private financing plays an important role for smallholders in West Africa, compared with other regions, it is not generally aimed at improving skills. Most informal private investment in the region (USD 23.1 billion in 2020) is focused on

agricultural production and is often risky, possibly entailing excessively high interest rates or low financial accountability (AUC/OECD, 2023[46]). Nevertheless, initiatives in the formal sector aim to address the shortages of credit and green skills in West Africa. For example, the ECOWAS-led West African Initiative for Climate-Smart Agriculture is a blended finance fund that encourages smallholders to adopt climate-smart farming practices, thereby broadening their environmental skills. The fund, which plans to mitigate up to 2 million tonnes of CO_2 emissions per year (equivalent to more than 6 billion kilometres, of driving), pools public and concessional capital and provides subsidised interest rate loans of up to USD 1 million to farmers' organisations and agri-businesses (The Lab, 2024[49]).

Annex 7.A. Technical research centres specialising in agri-food research

Annex Table 7.A.1. **Examples of technical research centres in West Africa specialising in agri-food research**

Country	Technical research centres	Mission and/or research targets
Benin	Institut national de la recherche agronomique du Bénin (National Institute of Agricultural Research of Benin – INRAB)	Improving the productivity, climate resilience and sustainability of food systems
	Centre de contrôle biologique de l'IITA (International Institute of Tropical Agriculture's Biological Control Centre – Cotonou)	Specialising in crop productivity and sustainability, crop resilience to climate change, pest and disease control, and farmer capacity building
Burkina Faso	Centre de coopération internationale en recherche agronomique pour le développement (Centre for International Co-operation in Agronomic Research for Development – CIRAD)	Specialised in improving the productivity, sustainability and resilience of agricultural systems
	Institut de l'environnement et de recherches agricoles (Institute for the Environment and Agricultural Research – INERA)	Specialised in agroecology, crop improvement and sustainable agricultural development
Côte d'Ivoire	Institut national polytechnique Félix Houphouët-Boigny (Félix Houphouët-Boigny National Polytechnic Institute – INP-HB), formerly INRA – Côte d'Ivoire	Agricultural productivity, development of sustainable farming practices
	Centre national de recherche agronomique (National Agricultural Research Centre – CNRA)	Agriculture and agri-food issues
Mali	Institut d'économie rurale (Institute of the Rural Economy – IER)	Specialised in soil management, animal husbandry and plant and animal disease control. Seeking sustainable agricultural approaches that promote food security
	Institut polytechnique rural de formation et de recherche appliquée (Rural Polytechnic Institute for Training and Applied Research – IPR/IFRA)	Agricultural and animal husbandry training and research
Niger	Institut national de la recherche agronomique du Niger (Niger National Institute for Agricultural Research – INRAN)	Specialised in food security and agricultural and rural development in Niger
	Centre national de spécialisation en agro-météorologie et en environnement (National Centre for Specialisation in Agrometeorology and the Environment – CNSAME)	Specialised in agrometeorology, farm management and food safety
	Centre régional AGRHYMET (Agriculture, Hydrology, Meteorology Regional Centre)	Research and training on food security, natural resource management and climate monitoring
Nigeria	Institut national de recherche sur les plantes-racines (National Root Crop Research Institute – NRCRI)	Root and tuber crops
	Institut de recherche sur le riz du Nigeria (National Institute for Rice Research – NIRRI)	Rice and rice growing
	Institut international de recherche sur les cultures des tropiques semi-arides (International Crops Research Institute for the Semi-Arid Tropics – ICRISAT)	Vital crops for communities in arid zones, ranging from chickpeas, pigeonpeas, peanuts and sorghum, to pearl millet, eleusine (finger millet), little millet and oilseeds
	International Institute of Tropical Agriculture (IITA)	Tropical agriculture: crop improvement, soil management and food security
	Lake Chad Research Institute (LCRI)	Cereals
	Nigerian Institute for Oil Palm Research (NIFOR)	Palm oil
	National Agricultural Extension Research and Liaison Services (NAERLS)	Agricultural extension services
Senegal	Centre d'étude régional pour l'amélioration de l'adaptation à la sécheresse (Regional Study Centre for Drought Adaptation Improvement – CERAAS)	Improving drought-resilient crops, water management and food security
	Institut sénégalais de recherches agricoles (Senegalese Institute for Agricultural Research – ISRA)	Improving the productivity, sustainability and resilience of agricultural systems

Note: This table lists the most representative research centres in the region.
Source: Compiled by the authors.

Notes

1. Benin, Burkina Faso, Côte d'Ivoire, Guinea, Niger, Senegal and Togo
2. System skills are a sub-category of soft skills (see Box 1.1 in Chapter 1). They include: i) reasoned decision-making; ii) optimising and anticipating impacts; and iii) evaluating and adjusting performance to meet objectives.
3. Priority countries concerned (members of the FAR network): Algeria, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Côte d'Ivoire, Democratic Republic of the Congo, Guinea, Haiti, Madagascar, Mali, Mauritania, Morocco, Niger, Senegal, Togo and Tunisia.
4. The workshop "Mass training in rural areas: Food for thought in defining a national policy" was held in Ouagadougou (Burkina Faso) in June 2005. It was organised by the French international co-operation cluster (Pôle National de Coopération Internationale – Marseille) at the request of the French Ministries of Foreign Affairs and Agriculture.
5. The agriculture orientation index for public expenditures describes the share of public expenditure allocated to agriculture divided by agriculture's share of GDP – with agriculture defined here in the strict sense to cover forestry, fisheries and livestock. It measures progress towards Target 2.a of the Sustainable Development Goals (SDGs).

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Annex A. Statistical annex

Data used in this edition of *Africa's Development Dynamics* have been compiled and presented in tables available for free download on the Development Centre's website (https://oe.cd/AFDD-2024) along with some additional social and economic indicators that add context to the report's analysis.

All indicators that were chosen for the annex provide national data figures for all or nearly all African countries, as well as most countries in the rest of the world. These choices were made in order to allow for both comparisons between African countries and comparisons with groups of similar countries outside of Africa that could serve as benchmarks. These data give context to the analyses presented in the report and allow readers to investigate the underlying data in more depth.

Data were obtained from various sources, including harmonised data sets of annual national data from reputable international institutions, as well as some indicators that were calculated by researchers working on the publication. Figures will get updated as new data come available so that readers can always track the latest versions of key indicators. Therefore, some differences between figures in the statistical annex and figures reported in the publication may reflect changes to the data tables made after the publication of the written report.

Access the online *Africa's Development Dynamics* statistical annex here: https://oe.cd/AFDD-2024.

Data tables available for free download on line

	Click on title to download table
Table 1	Indicators of growth, employment and inequality
Table 2	Annual real GDP growth rate, 1990-2029
Table 3	Annual population growth rate, 1990-2029
Table 4	Annual real GDP growth per capita, 1990-2029
Table 5	Demographic estimates
Table 6	Basic education indicators
Table 7	Labour force characteristics
Table 8	Sectoral breakdown of the economy
Table 9	Indicators of inequality and poverty
Table 10	Gender indicators
Table 11	Communications infrastructure
Table 12	Digitalisation
Table 13	Basic health indicators
Table 14	Subjective well-being
Table 15	Growth decomposition by expenditure
Table 16	Public finances
Table 17	Trade by manufacturing intensity
Table 18	Export diversification
Table 19	Global and regional trade
Table 20	External financial inflows
Table 21	Investment and capital stock
Table 22	Returns on direct investments
Table 23	Ecological sustainability
Table 24	Sustainable public investments and adjusted net savings
Table 25	GHG emissions by sector
Table 26	Electricity and sustainable energy
Table 27	Origin and destination of added value
Table 28	International trade costs
Table 29	National wealth
Table 30	Environmental causes of premature deaths
Table 31	Informal economies and informal employment
Table 32	Employment by occupation
Table 33	Education mismatch
Table 34	Mean years of education

Data tables available for free download on line *(continued)*

	Click on title to download table
Table 35	Employment by sector
Table 36	Employment by business activity and skill level
Table 37	Migration by education level
Table 38	Projected education profiles
Table 39	Projected youth education profiles
Download all annex tables in a single Excel file here: https://github.com/AfDDAnnex/AfDDDDAf2024/raw/main/AfDD_2024_Statistical_Annex_all_tables.xlsx	
Download a table of data sources here	
Download a table of country groupings here	
Download the data dictionary for the variables in these tables here	

More extensive data, including time series for all variables back to 2000, are also available on line

The figures presented in these statistical tables, with the exception of Tables 2-4, represent the most recent years for which data are available. However, a complete dataset containing all these indicators for the years 2000-present in one compressed flat csv file can be downloaded from this link: https://github.com/AfDDAnnex/AfDDDDAf2024/raw/main/AfDD_2024_Stats_by_year.zip. Otherwise, the same indicators can be found online through the OECD's online statistical portal at https://data-explorer.oecd.org/ and clicking on "Development", followed by "Africa's Development Dynamics" on the menu.

The data in the statistical annex are also available for key country groupings

The statistical annex reports statistics for nearly all world countries, and also aggregations of indicators over country groups developed for benchmarking and analysis. The table indicating the countries that belong to each group is among the files available in the statistical annex. The country groups featured in the analysis are the following:

- **The five regions of the African Union** (Central Africa, East Africa, North Africa, Southern Africa, and West Africa, as defined by the Abuja Treaty)
- **Africa and benchmark country groupings** (Africa, Asian countries excluding high-income countries, Latin America and Caribbean countries, and the World)
- **Resource-rich countries**
  Countries that obtain a significant fraction of their GDP from underground natural-resource extraction are referred to as "resource-rich". These resource endowments can have major implications for economic, political, and social development. In this report, countries are identified as resource-rich based on whether, over the previous decade, the estimated contribution of the extraction of hydrocarbons, coal and minerals to economic output exceeds 10% of GDP in at least five years.
- **Income level**
  The World Bank divides the countries of the world into four categories based on GNI per capita, using their Atlas Method:[1] low-income countries, lower middle-income countries, upper middle-income countries, and high-income countries.
- **Geographic access**
  The report provides a breakdown between countries that are landlocked, countries that have a portion of coastline, and island nations. Gaining access to world trade can be complicated by a country's access to the ocean or lack thereof, while island nations have been shown to have different development patterns than other coastal nations. In addition to this three-way breakdown of countries, this report provides data on countries deemed "Landlocked Developing Countries (LLDC)" and "Small

Island Developing States (SIDS)" by the UN Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS).[2]

- **Least developed countries**[3]
  The UN-OHRLLS classifies some countries as "Least Developed Countries (LDC)". This categorisation of countries was officially established in 1971, by the UN General Assembly, and represents countries that face low levels of socio-economic development. Countries are designated as LDC countries based on income criteria, the health and education of their populations, and their economic vulnerability.
- **Fragile states**[4]
  The OECD studies fragility as a multi-dimensional concept of risks that could pose a critical challenge to the ability of countries to achieve their development aspirations, in particular the goals outlined by the UN's 2030 Agenda for Sustainable Development. Based on the results of this research, presented in the OECD *States of Fragility* report, countries are categorised as being "fragile" or "extremely fragile".
- **Regional Economic Communities and other intergovernmental organisations**
  Partnerships of countries formed for the purposes of regional integration or co-operation that have economic or political significance and that are particularly relevant to an analysis of African economic performance are included here. This includes the 8 Regional Economic Communities (REC) recognised by the African Union, as well as other regional and international organisations, such as the Association of Southeast Asian Nations (ASEAN), Mercado Común del Sur (MERCOSUR), the European Union (EU) and the OECD that serve as benchmarks. Aggregate figures for PALOP (*Países Africanos de Língua Oficial Portuguesa*, the Portuguese-speaking African countries) were included in response to a request from members of this country grouping.

Notes

1. Please see http://datahelpdesk.worldbank.org/knowledgebase/articles/378832-what-is-theworld-bank-atlas-method.
2. Please see www.un.org/ohrlls/.
3. Please see www.un.org/ohrlls/content/least-developed-countries.
4. Please see www.oecd.org/dac/conflict-fragility-resilience/listofstateoffragilityreports.htm.