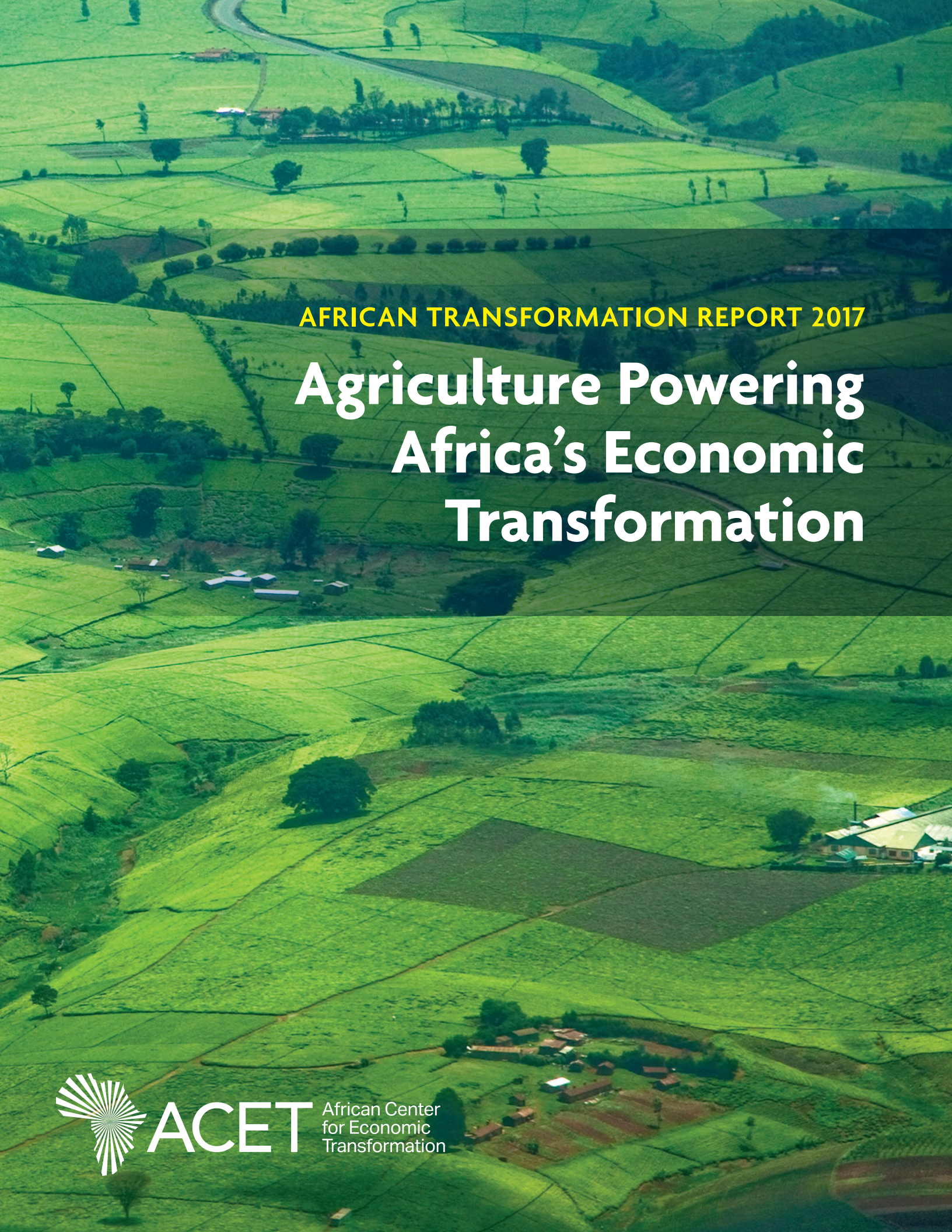

AFRICAN TRANSFORMATION REPORT 2017

Agriculture Powering Africa's Economic Transformation

ACET African Center for Economic Transformation

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The African Center for Economic Transformation is an economic policy institute supporting Africa's long-term growth through transformation. Our vision is that by 2025 all African countries will drive their own growth and transformation agendas, led by the private sector and supported by capable states with good policies and strong institutions. We work toward that vision through our analysis, advice, and advocacy. Please visit www.acetforafrica.org.

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Foreword

I am pleased to introduce our second African Transformation Report—*Agriculture Powering Africa's Economic Transformation.* As you might expect, it views agriculture and its challenges through a transformational lens. Rather than view agriculture as an isolated sector, it roots agriculture in the rural economy, and the national economy, so that it can power economic transformation. The target audience thus goes beyond ministries of agriculture and specialists in the agricultural sector to include heads of state and government, ministers of finance and planning, and the broader community of policymakers and experts interested in promoting faster economic transformations.

Given the importance of agriculture for most African countries, other African and international institutions have produced reports on rural transformation. What distinguishes our 2017 report? Four features.

It's practical. It's for African policymakers and practitioners who want a playbook for having agriculture power their economic transformation.

It's logical. It starts with improving land access and tenure, moves next to increasing productivity, next to commercializing farming, then to fueling agro-industry and agribusiness—and finishes with boosting employment, including for women, and balancing intensification with environmental sustainability and climate change.

It's comprehensive. It covers all the basic issues in agriculture, drawing on our research and policy advice, and some of the best work of other institutions. It assembles and synthesizes existing knowledge and adds to that knowledge with case studies and subsector reports to present examples and lessons on how to promote agriculture's transformation.

It's African. Grounded solidly in our understanding of what works and what doesn't work in Africa, our hope is that the report will contribute to advancing the vision for agricultural transformation that African heads of state and government expressed at their 2014 Summit in Malabo, Equatorial Guinea.

K.Y. Amoako
Founding President
ACET

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Preface

Agriculture can lead economic transformation in many countries in Africa—if farm productivity is raised and farming is linked to manufacturing and other sectors of the economy through agroprocessing, other agriculture-based manufacturing, and finance, logistics, and other upstream and downstream services. We refer to this process—of raising productivity on farms and strengthening linkages between farms and the rest of the economy—as agricultural transformation.

The 2014 African Transformation Report—*Growth with Depth*—highlighted the need to convert economic growth driven by commodities and macroeconomic reforms into growth that is structurally grounded and therefore job creating, welfare improving, and sustainable. That report called on African governments to work with the private sector to transform their economies by diversifying production and exports, becoming more competitive globally, boosting productivity across the economy, upgrading production technologies and national technological capabilities, and advancing human well-being through rapid job growth.

The pertinence of these recommendations has been reinforced by the collapse of commodity prices (particularly oil and minerals) since mid-2014 and the consequent slowdown in economic growth in many parts of Africa. As African policymakers respond to this collapse by intensifying efforts toward economic transformation, this second African Transformation Report—*Agriculture Powering Africa's Economic Transformation*—highlights the immense contributions that agriculture can make and offers practical examples, lessons, and recommendations.

Chapter 1 presents a data-rich assessment of the state of agriculture in Africa, its impact on macroeconomic outcomes, and its performance in the recent past. Chapter 2 discusses land tenure systems, focusing on feasible reforms that could enable the customary tenure systems that prevail in many parts of the continent to better support modern commercial agriculture. Chapter 3 examines how to raise farm productivity by improving farmers' access to knowledge, modern inputs (mainly improved seeds and fertilizer), irrigation, and mechanization. Chapter 4 looks at how to commercialize agriculture and covers risks, markets, and finance (including insurance). Chapter 5 pulls together the themes from chapters 2–4 to focus on the specific goal of growing enough of Africa's key food staples to feed households and support an expanding agroprocessing industry.

Chapter 6 considers how to leverage agriculture to develop manufacturing, particularly agroprocessing and the manufacturing of agricultural inputs. Chapter 7 reflects on the possible employment impacts of agricultural transformation, focusing on employment possibilities for educated youth in farming and in the off-farm segments of agricultural value chains. Chapter 8 considers how to ensure gender equity in agricultural transformation, and chapter 9 proposes ways to ensure that the transformation is environmentally friendly against a backdrop of climate change.

Throughout, the discussion draws attention to the importance of prudent macroeconomic policy to agricultural transformation through the impact of fiscal and monetary policies on interest rates and credit and of exchange rate and trade policies on the reliable availability of fertilizers and on farmers' ability to compete with imports and in export markets.

Yaw Ansu
Chief Economist
ACET

Acknowledgments

Yaw Ansu, ACET's Chief Economist, led the team that prepared this second African Transformation Report, *Agriculture Powering Africa's Economic Transformation*. The team comprised Francis Abebrese, Julius Gatune Karuiki, and Francis Mulangu (ACET staff), as well as Joseph Baah-Dwomoh, Mina Ballamoune, Frank Byamugisha, and Hailu Mekkonen (ACET Associates). Suggestions and support from ACET management and other staff are gratefully acknowledged.

The Concept Note for the report benefited from consultations in October 2014 with a number of agricultural organizations and experts based in Rome, including the Food and Agricultural Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), the Purchase for Progress Program of the World Food Organization (WFP), Bioversity International, and Ambassador David Lane (United States Ambassador to the United Nations Agencies for Food and Agriculture). Douglas Gollin (Oxford University) and Shashi Kolavalli (IFPRI, Accra) also reviewed and provided helpful comments on the Concept Note.

The report benefited from background studies by a team of experts. The following studies were conducted under the ACET-JICA collaborative research program, generously funded by JICA: Frank Byamugisha, ACET Associate (Securing Land Tenure and Easing Access to Land); Xinshen Diao, IFPRI, Washington, DC (Agricultural Mechanization and Agricultural Transformation); Fethi Lebdi, Agronomic Institute of Tunisia (Irrigation for Agricultural Transformation); Keijiro Otsuka, National Graduate Institute for Policy Studies—GRIPS—Tokyo (Transforming African Agriculture by Promoting Improved Technology and Management Practices); Mario J. Miranda, Ohio State University, and Francis Mulangu, ACET (Index Insurance for Agricultural Transformation in Africa); and Joseph Baah-Dwomoh, ACET Associate (Integrated Rural Development in Africa, Back to the Future?).

The rest of the background studies were: Patricia Kristjanson, World Agroforestry Institute, ICRAF (Transformation in Africa: The Role of Women); Alexis K. Aning, CEO, CCH Finance House Ltd. Ghana (The Role of Warehouse Receipt Systems in Agricultural Modernization in Africa); Eugenie Maiga, Universite de Koudougou, Burkina Faso, formerly of ACET, and Harounan Kazianga, Oklahoma State University (The Role of Agricultural Skills Development in Transforming African Agriculture); Ephraim Nkonya, IFPRI, Washington, DC (Agricultural Transformation, Environmental Sustainability, and Climate Change); and Marysue Shore, Global Business Strategies, Washington, DC (What Global Agribusiness Executives Say About Unleashing Africa's Potential).

The Bill & Melinda Gates Foundation generously funded these background studies and other aspects of the report's preparation. In addition, the report relied heavily on an earlier ACET study of 20 agricultural value chains in Burkina Faso, Ghana, Kenya, Tanzania, and Uganda, also funded by the Gates Foundation.

A stakeholders consultation meeting in Kigali in March 2016 helped refine the concept of the report. Participants included Felix Addo-Yobo (the National Development Planning Commission, Ghana), David Sarfo Ameyaw (Head, Strategy, Monitoring & Evaluation, AGRA), Martin Andersson (School of Economics, Lund University), Samuel Asiedu (Dalhousie University of Agriculture, Canada), Kwesi Atta-Krah (Executive Director, Hamidtropics, IITA Ibadan), Ammad Bahalim (GHVisions, Geneva), Grace Bediako (the National Development Planning Commission, Ghana), Aberra Debelo (Ethiopia Country Director, Sasakawa Africa Association), Rachid Doukkali (OCP Policy Center, Morocco), Ibrahima Hathie (Research Director, IPAR Senegal), Francis Juma (Editor, FoodWorld Media, Africa Agriculture and Value Addition magazine), Kiringai Kamau (Agricultural Expert and Transformation Advisor for the Minister of Agriculture in Kenya), Bridget Kezaabu (Food Scientist, Co-founder of Amaraproject), Harrison (Harry) Kiarie (a medium scale commercial farmer in Kenya), Alemayehu Koira Konde (Mastercard Foundation), Augustine Langyintuo (President, African Association of Agricultural Economists), Alexandre Macedo (Country Manager, Yara Rwanda), Victor Manyong (Director, Eastern Africa Hub, Social Science and Agribusiness, IITA), Gerald Masila (Executive Director, Eastern Africa Grain Council), Stephen Muchiri (CEO, Eastern Africa Farmers Federation), Gaudiose Mujawamariya (AfricaRice, Dar Es Salaam), Peter Ngugi (Yara's Commercial Manager in Rwanda), Jane Njuguna (Program Officer, Economist, Monitoring & Evaluation, AGRA), James Nyoro (the Bill & Melinda

Gates Foundation), Emmanuel Nzeyimana (Young Professionals for Agricultural Development Africa), Emily Ongus (Serendi Kenya Ltd.), Idrissa M. Ouedraogo (Directeur, Centre d'Etudes, de Documentation et de Recherche Economiques et Social, Université Ouaga 2, Burkina Faso), John Purchase (CEO, The Agriculture Business Chamber, South Africa), Kenneth Quartey (Managing Director, Sydal Farms, Ghana), Claire Schaffnit-Chatterjee (Researcher, Deutsche Bank), Ishmael Sunga (CEO, Southern African Confederation of Agricultural Unions), Abdou Tenkouano (Executive Director, CORAF/WECARD), Isabelle Tsakok (Adjunct Professor of International and Public Affairs, Columbia University), Hennie van der Merwe (CEO, Agri4africa), Marius van Huijstee (CEO, Dutch Agriculture Development and Trading Company), Nicholas Vink (Chair, Department of Agricultural Economics, Stellenbosch University, South Africa), and Anke Weisheit (Director, Research and Innovations, Excel Hort, Uganda).

A panel discussion on agricultural transformation at the launch meeting of ACET's Pan-African Coalition for Transformation (PACT), also held in Kigali in March 2016, provided helpful comments and suggestions. The panelists were: Dina Umali-Deininger (Agriculture Practice Manager for East Africa, the World Bank), Alemayehu Konde Koira (Program Manager, Economic Opportunities for Youth/Agriculture, the MasterCard Foundation), M.D. Ramesh (President and Regional Head, South and East Africa, OLAM Corporation), Dede Amanor-Wilks (Development Specialist/Consultant; now with ACET), and Kenneth Quartey (Managing Director, Sydal Farms, Ghana).

The draft report benefited from comments and suggestions by participants at a review meeting in Nairobi, Kenya in March, 2017. Participating were Benedict Kanu (African Development Bank—AfDB, Abidjan), Jane Njuguna, Emime Ndihokubwayo, Joseph Rusike, and Herbert Ainembabazi (all from the Alliance for Green Revolution in Africa—AGRA—in Nairobi), Rinn Self (the Bill & Melinda Gates Foundation, and a Visiting Fellow at AGRA), William Asiko and Anne Wangalachi (Grow Africa, Johannesburg and Nairobi), and Jane Kabubo-Mariara (University of Nairobi).

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A team at Communications Development Incorporated in Washington, DC, designed, edited, and laid out the report—led by Bruce Ross-Larson and including Jonathan Aspin, Joseph Brinley, Joe Caponio, Meta de Coquereaumont, Mike Crumplar, Debra Naylor (design), Chris Trott, John Wagley, and Elaine Wilson (layout).

Pursuing two tracks to industrialization

African countries have the opportunity to pursue two tracks to industrialization—one that leverages their relative labor-abundance for labor-intensive and export-oriented light manufacturing, and another track that leverages their advantages in agriculture for globally competitive manufacturing based on agriculture.

OVERVIEW

Powering Africa's Economic Transformation

ACET's vision

To create within a generation a modern, competitive, and environmentally sustainable agricultural sector that ensures food security, supports a middle-class lifestyle for a growing number of farmers, and powers Africa's economic transformation

For the most part, agriculture in Africa remains backward and tied to a commodity-exporting economic model that countries are trying to move away from. Yet for many countries, agriculture presents the easiest path to industrialization and economic transformation. Increasing productivity and output in a modern agricultural sector would, beyond improving food security and the balance of payments (through reduced food imports and increased exports), sustain agroprocessing, the manufacturing of agricultural inputs, and a host of services upstream and downstream from farms, creating employment and boosting incomes across the economy.

Many of today's successful economies followed that path to economic transformation. It is even more relevant for Africa today, given its factor endowments and emerging global trends in manufacturing technology, demand patterns, and location decisions of lead firms in global value chains. These global trends are making an industrialization strategy based on exports of labor-intensive manufactures, used so successfully by East Asia, more difficult. But fortunately, African countries can combine that strategy with one based on modernizing agriculture and developing agro-based manufacturing and services. African countries have the opportunity to pursue a dual-track to industrialization—one track that leverages their relative labor-abundance for labor-intensive and export-oriented light manufacturing, and another track that leverages their advantages in agriculture for globally competitive agriculturally based manufacturing. These two tracks are complementary and reinforce each other.

Agricultural transformation can power economic transformation

Many African governments are beginning to look at agriculture through a transformational lens, prioritizing the sector in economic planning. That new perspective is reflected at the continental level in the African Union's 2003 Maputo Declaration on Food Security and Agriculture in Africa and the 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation and the associated Comprehensive African Agriculture Development Program (CAADP), and at the country level by some countries' explicit pursuit of agro-based industrialization strategies, particularly Ethiopia.

Agricultural transformation incorporates two main processes: transforming or modernizing farming by boosting productivity and running farms as modern businesses, and strengthening the links between farms and other economic sectors in a mutually beneficial process, whereby farm output supports manufacturing (through agroprocessing), and other sectors support farming by providing modern manufactured inputs and services.

For many countries, agriculture presents the easiest path to industrialization and economic transformation

Modernized farming has the following characteristics:

- Higher land, labor, and total factor productivity, achieved through greater use of modern agricultural inputs and scientific approaches to farming.
- More farmers running their operations as a modern commercial enterprise.
- Diversification of products from the farming system as a whole, but with specialization on individual farms.
- Greater resilience against weather variability and climate change.
- More trade with other sectors of the economy.
- Achieving them will require action on four fronts:
- Assisting the nearly 8 in 10 African farmers who are traditional smallholders, and often uneducated, to acquire the knowledge and inputs to modernize their operations, boost their productivity, become more commercially oriented, raise their incomes, and become more resilient.
- Attracting and assisting some educated youth to take up farming and operate small and medium-size commercial farms.
- Encouraging the small number of large commercial farms to develop mutually beneficial links with small and medium-size farms.
- Removing barriers to women in farming so that the energies and enterprise of all farmers—not half of

Contributing to economic transformation

them—will be unleashed to accelerate the pace of farm modernization.

A modernized farm sector with strong linkages to other economic sectors will contribute to overall economic transformation by:[1]

- Boosting the production of food staples to improve food security and keep living costs low, making it easier to keep wages competitive and support labor-intensive manufacturing (the second track of the dual-track industrialization strategy).
- Supporting agroprocessing with raw agricultural outputs at the scale, quality, and reliability required.
- Supporting other agribusinesses by purchasing their products and services, including businesses manufacturing agricultural machinery, implements, and intermediate inputs and those providing transportation, logistic, and financial services.
- Raising farmers' incomes and expanding markets and jobs throughout the nonfarm segments of agricultural value chains.
- Expanding markets for nonagricultural sectors, such as those producing nonfood or durable consumption items.
- Improving the balance of payments by expanding and diversifying exports and substituting domestic production for food and other agriculture-based imports that can be produced competitively at home.
- Increasing government revenues and personal savings through higher agricultural incomes, which can be converted to national investments for growth.

Opportunities and challenges

Africa is blessed with many natural advantages and rising market opportunities that could be leveraged for agricultural transformation. These include abundant uncultivated arable land, estimated at over half the world's total; a young and growing labor force, projected to be the world's largest by 2050; tropical and subtropical climates, permitting long and multiple growing seasons; and urbanization and a growing middle class, expanding national and intraregional markets for agricultural products.

But Africa faces difficult challenges in leveraging these advantages and opportunities. Although arable land is abundant, it is not readily accessible to those who want to farm, particularly on a commercial basis. Land tenure systems in many parts of the continent do not provide security of tenure or support efficient land rental markets. Large tracts of land are inaccessible because of ongoing conflicts or poor transportation infrastructure (or both, as for example in Democratic Republic of Congo, the country with the largest expanse of uncultivated arable land).[2]

The average age of farmers in Africa is estimated by some sources to be as high as 60, and few in the large and growing African youth population are poised to step in to revitalize the ranks of farmers. Youth are not interested in agriculture as it is now practiced in Africa, where the farming technology is still primitive and requires back-breaking manual work. An increasing number of youth are educated, and education systems do not prepare them for farming (and even orient them away from it). And most farming does not provide an income that can support the lifestyle to which educated youth aspire. This lack of interest in farming among African youth is contributing to the aging farming population and farm-labor shortages in some localities, particularly during planting and harvesting seasons.

Africa is blessed with many natural advantages and rising market opportunities that could be leveraged for agricultural transformation

Nor can African farmers take full advantage of the long growing season because only about 5.4% of agriculture is irrigated. As a consequence, much farming stops in the dry season or crops are devastated by a lack of precipitation. Productivity of land (yields) and of labor (output per worker) is low, because of lack of access to knowledge of modern farming techniques, high-yielding seeds, fertilizers and other inputs, irrigation, and mechanization.

It is also hard to exploit the growing urban and intraregional markets. Roads and other transport infrastructure are inadequate, significant barriers to intraregional trade remain, and many consumers, especially city dwellers, believe that domestically produced foods are inferior to competing imports. Africa's urban areas are increasingly dependent on food imports, now at around US$68 billion a year for the continent, US$37 billion for Sub-Saharan Africa. And agroprocessing and other agriculturally related manufacturing are held back by the usual policy, regulatory, and infrastructure constraints that weigh on manufacturing, stifling the opportunity to use agriculture to kick-start industrialization.

By reviewing challenges and proposing solutions, this report aims to convince African policymakers and their development partners of the benefits and feasibility of prioritizing agricultural transformation as the driver of overall economic transformation. The report should also be of value to the private sector, farmers, and educated youth who might consider farming or opportunities in agricultural value chains as profitable and appealing occupations.

Two consistent themes run through the report.

The first is that the institutional environment of African agriculture is changing from one involving

mainly farmers and governments, supported by donors, to a more diverse and dynamic mix involving farmers, governments, donors, the private sector, foundations, and nongovernmental organizations. The many actors provide opportunities, but also some challenges. The biggest opportunity is that Africa's fiscally and capacity-constrained governments do not have to do it all—initiate, finance, and implement. They can leverage the finance, knowledge, and capacity of other actors for many tasks while focusing on key public goods or strategic services with high social returns, ignored by others because of low private returns. Governments can also extend the reach of their resources through public–private partnerships. The challenges facing governments in this changed environment include setting standards, disseminating information, and enforcing smart regulations that promote competition and agricultural growth in an environmentally sustainable manner.

Microelectronics now enable more precise irrigation systems

The second theme encompasses emerging opportunities for technological leapfrogging, particularly those arising from advances in information and communication technology. This option is vital, considering that many countries' agricultural extension systems have been severely weakened and are unlikely to be revived soon, if at all. Mobile phones, used increasingly by multiple actors in Africa, especially the private sector and nongovernmental organizations, can provide a cheap and practical way to reach farmers. Similarly, satellites, geographic information systems, and advances in data analytics are making detailed soil maps affordable and allow farmers to receive location-specific recommendations for agronomic practices, including customizing fertilizer application to local soil conditions. And microelectronics now enable more precise irrigation systems, smaller and more appropriate machinery, and the use of drones for farm operations at costs that are becoming affordable to African countries. These are just a few of the opportunities for technological leapfrogging, and the list is likely to grow.

Agenda for Africa's agricultural transformation

This section presents the main recommendations for addressing the issues discussed in the report. Together, they constitute a powerful agenda for leveraging the transformation of agriculture for overall economic transformation in Africa.

Securing land tenure and access to land

Agriculture requires access to land. And transforming agriculture requires investments and working capital to raise productivity and run a commercial farm. To make those investments worthwhile to farmers, they need secure titles to their main farm asset, land. Secure titles also enable them to use their land as security for loans to finance investments and commercial operations. Formalization of land rights to achieve secure titles could also incentivize part-time and low-productivity farmers and elderly land owners to rent out their land and look for more rewarding opportunities off the farm. This process will facilitate land consolidation, make it easier for educated youth interested in farming to acquire land, enable more efficient use of labor, and ultimately increase agricultural productivity.

Most African countries are fortunate in that the model of land ownership that developed on the continent is not one in which land is concentrated in the hands of a small number of large owners and worked by a mass of landless peasants as was previously the case in some other parts of the world. Land in Africa has historically been communally owned, with almost every adult in a village having traditional access rights to some farm land. This system has often been a very effective safety net that has helped avoid destitution in the countryside. The other side of the coin, however, is that under this tenure system individual farmers cannot use land as a personal business asset in which to invest or with which to secure loans. Also, this tenure system makes it difficult to consolidate farming plots into farms that are large enough to make modern commercial farming viable. For example, 60% of farm plots in Ghana are under 1.2 hectares and 85% are under 2 hectares. In Uganda, 58% of farms are smaller than 1 hectare, and in Zambia half the farms are smaller than 2 hectares.

This land tenure system is one of the biggest challenges to modernizing agriculture in Africa. The quandary is how to come up with land tenure systems that facilitate modern commercial agriculture and that also respect the ownership rights of communities and traditional smallholders. Related to this challenge are two issues of equity that require attention as the tenure system changes: ensuring that women have fair and equal access to land, and ensuring that large tracts of communal land are not sold to outside interests in opaque transactions that do not fairly compensate members of the community ("land grabs").

Raising productivity on African farms and modernizing African agriculture will require reform of customary land tenure systems. Easier said than done, but measures can still be taken to improve access to land.

First, secure land rights:

- Improve tenure security over communal lands by organizing and formalizing communal land-owning

groups, demarcating the boundaries of their land, and registering the land (as Mexico has done successfully).
- Improve tenure security over land that is now individually owned through systematic land titling, using simple low-cost mapping technologies, as Rwanda and Ethiopia have done.
- Strengthen formal and traditional institutions responsible for resolving land disputes.
- Enhance and protect the land rights of women through legal and administrative reforms to support gender equality in constitutions, land-related laws, and laws that govern marriage, divorce, and succession, as Rwanda and Ethiopia have done.

Second, ease access to land:

- Develop local land governance institutions to improve the allocation and leasing of communal lands, as Botswana has done.
- Ease restrictions on land rental markets as Ethiopia is doing, following in the footsteps of countries like China and Viet Nam.
- Improve land information systems through reengineering and computerization as Rwanda, Mauritius, and Uganda have done.
- Bring idle land into use through policy actions including imposing a tax on unused agricultural land to encourage land owners to use, sell, or rent it out; developing transport infrastructure to open up inaccessible agricultural lands; and improving mechanisms for allocating unused state land for productive use.

Third, protect the land rights of local communities from dispossession by large investors and promote principles of responsible agricultural investment:

- To avoid displacing local people, strengthen rural land use planning to identify surplus agricultural land for investors, an approach taken by Mozambique.
- Encourage direct deals between investors and landowners (as Mexico has done) while discouraging expropriation, which often provides too little compensation.
- Promote business models that provide opportunities for smallholders to invest in their land as alternatives to encouraging large farm investments, which require land acquisition and risk dispossessing small landholders.

Boosting productivity on farms

A key to achieving agricultural transformation on the continent is raising productivity levels on African farms. Africa lags behind the rest of the world in both labor and land productivity in agriculture. Productivity levels in North Africa are comparable to those in Asia and South America, but those in Sub-Saharan Africa are much lower. With higher productivity, farmers can grow enough food not only to feed their households but also to sell surpluses and acquire cash to diversify their diets and satisfy their nonfood needs. As productivity rises and farm households accumulate assets, they become confident enough to release household labor to both value-added agricultural activities and nonagricultural productive activities, further diversifying their economic activities and increasing household income. Higher productivity will also generate surpluses to be used as cheap raw material to support a competitive industrial sector through agroprocessing. And food surpluses can lower food prices and the cost of living, thereby increasing the disposable income of nonfood producers and moderating wage increases, which will enhance the global competitiveness of African countries in labor-intensive manufacturing.

Irrigation, improved seeds, fertilizer, power tilling, and extension services boosted average dry paddy rice yields to 5.5 tons per hectare

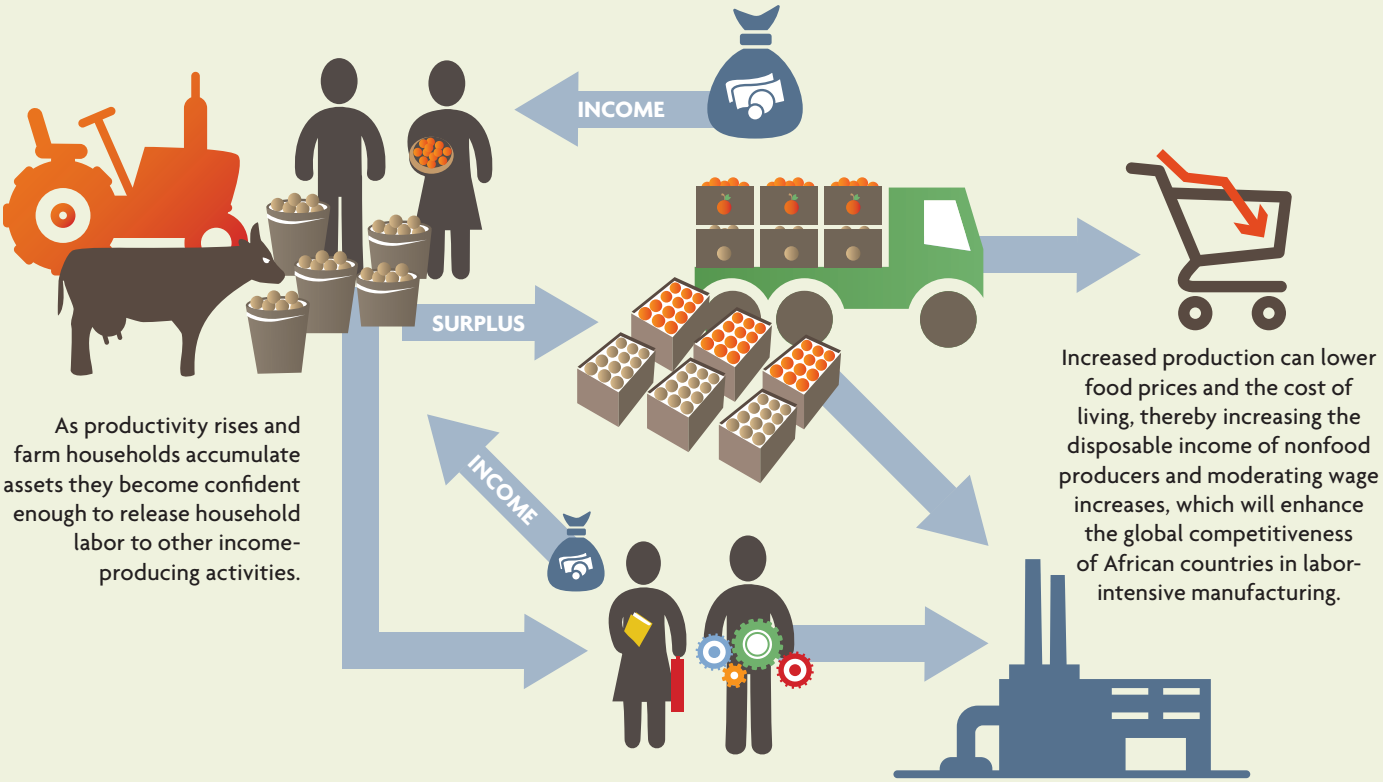
Asia and South America managed to raise yields (land productivity), particularly in wheat, rice, and maize, quite dramatically in the 1960s and 1970s applying "green revolution" technologies. Driving the revolution was a yield-increasing package that included improved seeds, fertilizers, irrigation where needed, some mechanization, and improved farm management techniques based on research and transferred to farmers through agricultural extension. Conditions vary widely across the continent, but where the green revolution package has been adequately available to farmers and tailored to local conditions, it has worked in a number of places in Africa. For example, in the Kpong irrigation area in Ghana's Volta River region, a combination of irrigation, improved seeds, fertilizer, power tilling, and extension services boosted average dry paddy rice yields to 5.5 tons per hectare, comparable to irrigated rice yields in Asia and much higher than in the rest of Ghana.[3] Yields are similar in the Nakhlet Small-Scale Irrigation Scheme on the northern bank of the Senegal River in Mauritania.[4] And in Senegal and Tanzania, irrigation and improved seeds and better farming practices have pushed yields to 3.7–4.5 tons per hectare, comparable to the average of 4.0 tons in tropical Asia.

Even under rainfed conditions, yields have been significantly improved in some areas in Ghana and in Uganda with improved rice seed varieties and farm practices. Yields in maize have also been high in the highlands of Kenya with the adoption of hybrid varieties, and the application of inorganic fertilizer and manure in a mixed crop-cattle farming system. Maize yields are very high in South Africa, and yields in general are higher in North

Boosting productivity on farms

A key to achieving agricultural transformation on the continent is raising productivity levels on African farms.

With higher productivity, farmers can increase production and incomes and thereby reduce poverty among close to half of the African population that depend on farming.



As productivity rises and farm households accumulate assets they become confident enough to release household labor to other income-producing activities.

Increased production can lower food prices and the cost of living, thereby increasing the disposable income of nonfood producers and moderating wage increases, which will enhance the global competitiveness of African countries in labor-intensive manufacturing.

The increased production could also increase the availability of food to improve food security, and to support viable agroprocessing industries.

A key part of the challenge of boosting productivity on African farms lies in making the green revolution package adequately accessible to African farmers and tailored to local conditions.

Africa than in Sub-Saharan Africa, so there is scope for intra-regional learning among African countries in pursuing the green revolution agenda.[5]

So, boosting productivity on African farms lies in making the green revolution package adequately accessible to African farmers and tailored to local conditions—the package of improved seeds, fertilizer, farmer education, irrigation (where needed), and appropriate mechanization.

Improved seed varieties. Numerous varieties of modern seeds have been released in Africa over the past 10 years, but adoption has been slow. One reason is that improved varieties are hybrids, so seeds must be purchased each season. Improved varieties also demand more fertilizer, adding to production costs for financially and credit-constrained smallholder farmers and reducing their incentive to use them. Steps to increase the use of improved seeds include:

- Make improved seed varieties more accessible to smallholder farmers by involving and organizing actors along the value chain—from production to processing and marketing—to support farmers. For example, processors and buyers of produce could provide seeds (and fertilizers) as part of their contract arrangements with farmers.
- Support input dealers or "agrovets" in rural areas. In a number of African countries, input distribution has been transformed from a largely public system to a more liberalized system with private, independent, agro-dealers. One model is AGRA's Agro-dealer Development Programme (ADDP), which provides training, capital, and credit to build and develop networks of certified agro-dealers to enhance the quality, quantity, and range of seeds offered to hard-to-reach farmers. Programs need to consider the heterogeneity of smallholder farmers that the agro-dealers must serve and the diversity of agro-ecological and business environments in which they must operate.[6] Support for more enterprising agro-dealers to expand their operations into full-time occupations should be also considered.
- Provide clear policy guidance for importing and handling hybrid seeds.
- Maintain stable, but realistic, exchange rates so that seed and fertilizer importers can manage their imports; and the new international lenders and NGOs that source money in dollars and lend to farmers in local currency can be protected against losses due to large exchange rate fluctuations.
- Support the formation of large, strong, and well-organized farmer-based organizations that can coordinate efficient procurement of inputs and sale of outputs for members and police sales contracts to prevent violations by members in cases where an off-taker in a contract farming arrangement supplies the improved seeds.
- Keep public policies predictable, so that everyone along the value chain can plan with confidence and reduce their risks.

Increased access to fertilizers. Cost is a major deterrent to optimal use of fertilizer in Africa. Poorly developed agricultural markets, high transport costs, and low and variable output prices persist even as the prices of agricultural inputs rise. Because most crops grown by smallholder farmers are staples and nonexportable, while fertilizer is imported, currency depreciation often raises the price of fertilizer several times above output prices. Consequently, the value-to-cost ratio for fertilizer use declines, creating a disincentive to fertilizer use. Some actions to improve and expand fertilizer use:

Boosting productivity on African farms lies in making the green revolution package adequately accessible to African farmers and tailored to local conditions

- Until more sustainable responses to the high cost of fertilizers are put in place, provide short-term subsidies so that poor smallholders can afford to buy fertilizers. The subsidies must be well-targeted to the poor farmers who need them. In the past, many fertilizer subsidy programs were not well targeted, and public sector programs suffered from late arrival and distribution of fertilizers and sudden changes that made it difficult for farmers to plan and get the maximum benefits from fertilizer use.
- Introduce "smart" fertilizer subsidy programs, which are designed to ensure that the benefits in terms of gains in agricultural productivity and food security exceed the gains from investing the public resources in other areas. To avoid crowding out commercial sellers or undermining investment in fertilizer distribution by suppliers and agro-dealers, the programs should provide subsidies to farmers to enable them to purchase fertilizer from private dealers at market prices, rather than have the government distribute fertilizer to farmers at below market prices.[7] Nigeria introduced a targeted fertilizer subsidy voucher pilot program in 2009–11 and upgraded it in 2012. In Nigeria's Kano State, vouchers are key for increasing farmer participation in the private fertilizer market.[8] Governments should study such smart fertilizer subsidy programs and refine them to reduce the fiscal burden, improve targeting, and strengthen private sector participation. Even with smart fertilizer subsidy programs, close attention must continue to be paid to targeting, fiscal sustainability, and the

need to finance other important public services in agriculture.

- Accompany programs to promote fertilizer use with soil mapping services, and encourage private fertilizer dealers to supply fertilizer blends that are tailored to local soil conditions. To be fully effective, inorganic fertilizer needs to be applied at the right time, in the right amount, in the right nutrient ratios, and with complementary micronutrients (such as sodium and barium).
- Encourage a broad program of soil fertility management,[9] including integrated soil fertility management and conservation agriculture, as an important complement to increased use of inorganic fertilizers, to improve soil health and fertility and reduce adverse environmental impacts.

Returns to irrigation in dryland are high, increasing yields by an estimated 91% and total factor productivity by about 3%

Improved farmer education and farm management. Farmers' use of optimal agronomic practices strongly affects the productivity increases that can be realized by using improved seeds and fertilizers. Farmers need to know what improved varieties are available and how to cultivate them, including the proper use of fertilizers and other complementary farming practices, which vary by soil type and other agroecological features. Rural advisory services in many African countries are not reaching most farmers, but they are failing particularly to provide information and services to female farmers. Traditional government extension services are no longer adequate as governments cannot afford to provide such services at the quality and scale required to be effective. Other options to supplement government extension services include private sector extension and training programs delivered through contract farming, new forms of public sector extension and training using modern information and communication tools, and peer-to-peer learning schemes, such as farmer field schools. Governments should encourage the following measures, which are already in place in several places in Africa, to supplement the public sector efforts:

- Support the operations of private actors, such as input companies, that combine extension services with input sales as part of their product marketing.
- Increase the use of e-Extension, using mobile phones and other modern communication technologies to reduce the cost of delivering extension services in hard-to-reach places. Collaborate with mobile phone companies and private sector partners to develop and periodically update an e-Extension curriculum tailored to local conditions.
- Create innovative communication and learning approaches to reach farmers. An example is the "Shamba Shape-Up" program in East Africa, which uses television programming to reach farmers. To increase the range of such "edutainment" to farmers without access to television, the concept can be adapted to radio drama.
- Use farmer-to-farmer learning approaches to increase access to extension services. This approach, which has trained women to provide extension services, has increased the number of women reached in Kenya, Rwanda, Tanzania, and Uganda.[10] Another inexpensive but effective option is farmer field schools, which use field experiments and farmer-to-farmer learning to instill new skills.

More use of irrigation. Irrigation has spatial and temporal productivity benefits. It allows agricultural production on drylands, which make up three-quarters of the agricultural land area in Sub-Saharan Africa.[11] Practicing rainfed agriculture in drylands is infeasible or extremely risky. Irrigation makes it possible to reduce production risks.[12] Irrigation also allows dry season production, expanding the temporal availability of vegetables and other crops. Returns to irrigation in dryland are high, increasing yields by an estimated 91% and total factor productivity by about 3%.[13] Despite these benefits, irrigation's contribution to agricultural output in Africa remains small.[14] In 2006, African countries irrigated just 5.4% of their cultivated land, compared with a global average of around 20% and an Asian average of almost 40%.[15] Geographic coverage is also skewed. A large proportion of irrigated land is concentrated in North Africa, Sudan, Madagascar, and South Africa. In other African countries, the potential for expanding irrigation is enormous, but in Sub-Saharan Africa, outside South Africa, less than 10% of the irrigation potential has been tapped (in North Africa, more than 80%). Steps to increase irrigation include:

- Determine the size and type of irrigation scheme based on an area's agro-ecological conditions and government budget constraints, using the internal rate of return as a guide. Large, multipurpose water supply schemes can serve multiple strategic goals beyond irrigation (providing water for domestic and industrial use, generating hydropower, and providing ecosystem services), but they are expensive to build and difficult to manage. Small-scale irrigation schemes are less expensive and can yield results more quickly. While the internal rate of return is high for most irrigation projects, it varies from 12–18% for

large-scale systems and 13–33% for small-scale projects in all subregions of the continent.

- Apply comprehensive approaches to irrigation development and water management. In North Africa, where irrigation systems are well developed, countries have relied on decennial plans for agricultural water management, with water infrastructure development as the main pillar (big and small dams, shallow and deep wells, and geographical water transfer networks).
- To enhance the quality and responsiveness of irrigation operations and maintenance, which have in many cases been poor, transfer responsibility for operating and managing irrigation works from the public sector to water user associations, which act as intermediaries between farmers and the state owners of irrigation infrastructure. Provide capacity-building support to the associations.

Mechanization to expand cultivated areas and raise yields. Mechanization levels are very low in Sub-Saharan Africa. There are 43 tractors per 100 hectares in South Africa, 35.6 in Zimbabwe, 26.9 In Kenya, 20.7 in Zambia, and around 10 in the rest of Sub-Saharan Africa, compared with 128 in India and 116 in Brazil. The rate is considerably higher in North Africa, reaching as high as 141 per 100 hectares in Tunisia. Expanding mechanization can support agricultural transformation by bringing more land, including land with highly compacted soils, under cultivation and by easing labor constraints that are emerging in some farming systems and that will intensify as the yield-raising package is implemented.

But expansion of agricultural mechanization faces major challenges. In the past, several African governments tried to address the mechanization challenge by importing agricultural machinery to use on state farms or to rent to farmers. These approaches failed because of inefficiencies and poor governance in the state-run agencies and because of the failure to adequately address other fundamental challenges that affect the profitability of farming and consequently farmers' willingness and ability to pay for mechanization services. Recently, some governments have adopted more private sector–friendly approaches, including subsidizing machinery-hiring services and credit guarantee programs for agricultural machinery. Private sector involvement may improve operational efficiency, but all subsidy programs raise concerns about fiscal sustainability and effective targeting that need continuing attention. Beyond subsidies, the following approaches can help address the mechanization challenge:

- *Farmer-to-farmer tractor hiring services.* Programs that help farmers purchase farm machinery to rent out to other farmers, in addition to using it on their own farm, deal with the reality that most farms are too small to support purchasing a tractor for individual farm use. Such programs help the owner fully utilize the machine—and thus to quickly recover its cost—and expand mechanization access to nearby farmers who lack the capital or credit to purchase their own machines. This approach is being tried in Ghana and Nigeria and deserves broader support.
- *Mechanization services provided by farmer organizations.* Agricultural cooperatives and other farmer groups can jointly own tractors and other mechanized equipment for use by members. Collective ownership can help small farmers overcome the cost and scale constraints of owning a tractor. However, joint ownership of productive assets can give rise to collective action problems such as free riding that can reduce the effectiveness of cooperative tractor ownership. Farmer organizations may need support in setting up mechanisms to minimize these problems.
- *Using smaller tractors and two-wheeled power tillers.* Access to mechanization could also be improved and costs reduced by using smaller but equally suitable machines that are cheaper and require less land to be fully utilized. Two-wheeled power tillers have spread rapidly in much of Asia, as have small four-wheeled 20–40 horsepower tractors in India. But in African countries, the average horsepower is 40–102, even though there is little savings in cost per horsepower for large tractors compared with smaller ones. Where tractors are imported through government and donor-funded programs, trade policy should provide incentives for importing smaller tractors. Preference should be given to bringing in a large number of small tractors rather a small number of large tractors.
- *Local fabrication of small machines and spare parts.* Governments should support local fabrication of simple agricultural machinery, which is beginning to take place in some African countries, including Ethiopia, Ghana, Kenya, Senegal, Zambia, and Zimbabwe. Engineering departments in universities and polytechnics should be encouraged and supported to design or adapt simple machinery for use under local conditions. Local entrepreneurs, including small and medium-scale enterprises, should receive incentives to produce this machinery. Countries may need to revise tariffs, which now tend to be lower on imports on assembled tractors and higher on imports of the inputs and parts required for local fabrication or

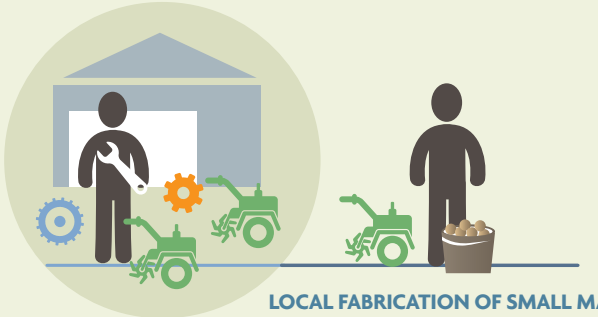
Collective ownership can help small farmers overcome the cost and scale constraints of owning a tractor

Expanding the use of machines

FARMER-TO-FARMER TRACTOR HIRE

FARM ORGANIZATION TO FARMER MEMBER EQUIPMENT LOANS

USING SMALLER TRACTORS AND TWO-WHEELED POWER TILLERS



LOCAL FABRICATION OF SMALL MACHINES AND SPARE PARTS

assembly. Technical institutes should also be supported to provide cheap outreach courses to mechanics in rural areas to improve their skills in repairs in order to minimize downtime for tractors and other farm machinery.

Commercializing African agriculture

Commercializing agriculture means encouraging and assisting African farmers to transition from farming as a way of life—a primarily subsistence activity, occasionally supplemented by produce sales when there are surpluses—to farming as a business, depending more on markets for acquiring inputs (including finance) and selling outputs. Policies, regulations, and programs must create a conducive environment to enable the business of farming (and agribusiness in general) to be profitable. In particular, macroeconomic, exchange rate, and trade policies, in addition to purely agricultural policies, should aim to reduce the considerable natural and policy risks facing farmers.

Increasing access to land and raising productivity are key prerequisites for transforming African agriculture. Another important prerequisite is a commercial orientation. Running farms as a business requires policies, institutions, and regulations that support the efficient development and functioning of agricultural input and output markets and that reduce and help manage agricultural risks.

Improve macroeconomic and regulatory environments. In most African countries, commercialized agriculture would constitute the largest private sector activity in the value of output and the number of businessmen and businesswomen. If African farms are to be run as businesses, macroeconomic and regulatory environments have to support business activities:

- Government policies—macroeconomic policies (fiscal and monetary policies that affect the availability and cost of finance), exchange rate and trade policies—and regulations should take into account the need for profitability in agriculture.
- Governments should include and prioritize agriculture in their private sector development strategies.

Strengthen input markets. Beyond the policies, institutions, and programs to increase farmers' access to the "green revolution" package that have already been discussed, a key consideration in improving input markets in Africa is to eliminate fake inputs, which are ubiquitous. Strengthening input markets will require:

- Better resourcing and strengthening of regulatory agencies.
- Incentivizing the emerging franchising and inputs-as-a-service business models that lower costs and improve quality. These include franchising business models (as in Kenya) that self-police through branding and quality control systems and that lower cost through economies of scale. Incentives could include tax breaks for franchise owners tied to service growth targets and access to subsidized credit to fund franchise growth.

Strengthen output markets. Recommended measures to strengthen output markets include:

- Improve transport infrastructure in the medium to long run. In the short run, increase the availability of cheap "first mile" transport solutions (such as motorized tricycles) by removing import duties and incentivizing local assembly and manufacture through tax breaks.
- Strengthen contract farming to improve the stability of prices, for example, by strengthening contracting laws, developing alternative disputes resolution mechanisms (such as arbitration) for farmers and contract buyers, and routing some government support (such as subsides on fertilizers) to entities contracting with farmers and providing inputs.
- Improve market intermediation to incentivize stronger, well-capitalized traders able to invest in storage, price stabilization instruments (such as warehouse receipt systems) by:
  - Using public–private partnerships to manage national buffer stocks so that more promising traders can take over running the storage infrastructure that governments built up in some countries.
  - Making special funds at low interest rates available so that traders can borrow to invest in upgrading storage infrastructure.
- Intensify efforts to deepen regional integration, emphasizing the logic of natural markets (along borders of neighboring countries, for example) and establishing special market zones (natural markets) that may be regulated differently until the slower process of regional integration catches up.

Commercializing agriculture means encouraging and assisting African farmers to transition from farming as a way of life to farming as a business

Reduce and manage agricultural risks. Once policies and regulations are in place that support the needs of agriculture as a business and minimize uncertainty for farmers and others in agricultural value chains, farmers will still need to deal with the natural risks of agricultural production. For the vast majority of farmers, whose crops depend on rain, the greatest natural production risk is unreliable availability of water. Expanding irrigation

will reduce some of the risk, but other policies are also needed to help farmers better manage risk:

- Include education about risk in government extension programs to improve farmers' understanding of risk and knowledge of available risk management tools.
- Provide incentives for insurers and others to develop and market risk mitigation products. Part of the subsidies received by farmers could be used to purchase insurance (for example, a fertilizer voucher could include a subsidy for insurance).
- Mandate that loans extended to agricultural sector actors include insurance on the loan.

Support programs that assist smallholders in adopting a commercial orientation. In addition to actions to improve the business environment for agriculture, improve agricultural markets, and reduce or better manage risks, specific policies could help smallholders shift to a more commercial orientation:

Becoming more competitive in producing food staples requires a focus on the entire value chain

- Provide training to smallholders on growing for the market—"Grow crops with potential customers in mind" instead of the traditional "look for customers after growing crops." A good example of such training is the Japan International Cooperation Agency–supported Smallholder Horticulture Empowerment Project in Kenya. Provide training and support for quality certification for export markets.
- Support the development of a symbiotic farming ecosystem that includes a mix of large-scale, medium-scale, and smallholder farmers who support each other though knowledge diffusion and service provision (mechanization, contract farming).
- Route some support for smallholders though medium and large-scale farmers who have contractual relationships with smallholders.

Feeding Africa

The most important goal of transforming agriculture is to enable Africa to feed itself and not depend on imports for products for which natural conditions are conducive to producing domestically. All the policies and reforms for land tenure, farm productivity, and commercialization of agriculture have to find concrete expression in the increased availability of key food items from domestic sources for direct consumption and for supporting an agroprocessing industry. This requires increasing the production of key food staples.

Africa now imports significant portions of its major food staples—at a cost of US$68 billion annually, US$37 billion in Sub-Saharan Africa—despite having the potential to produce many of them competitively. By importing food that countries could produce, African countries are forgoing higher incomes and employment, misusing foreign exchange that could finance imports of machinery and technology to advance their economic transformation, and suffering from higher food prices and food insecurity. Increased domestic supplies of food and lower prices would also moderate wage increases and enable Africa to leverage its relative labor-abundance into global competitiveness in labor-intensive manufacturing and advance its industrialization agenda.

Why are African countries relying more on imports for key food staples? For four main reasons. More people are moving to cities, which means that more people are buying rather than producing their food. Low productivity in the production of food staples combines with the high cost of transporting domestic production from farms to urban areas to put domestically grown food at a competitive cost disadvantage relative to imports. And as people move to cities and their incomes rise, their food preferences shift to include more processed and convenience foods and more dairy and meat products, which the underdeveloped agricultural value chains and processing industries are unable to meet. As a result, the gap between domestic supply and demand is widening, putting upward pressure on prices, threatening to aggravate food insecurity, and increasing food imports.

Becoming more competitive in producing food staples requires a focus on the entire value chain of the key food staples, with the choice of staples depending on country circumstances. That is because it is not enough to increase the production of food staples; challenges in storage, transportation to urban areas, and packaging and branding all have to be addressed.

In addition to the production-side measures presented above, the following measures can improve postharvest handling:

- Incentivize adoption of simple solutions for reducing postharvest losses, such as use of hermetic bags for storage.
- Train extension workers on methods of constructing simple mud silos and create village teams to work with the guidance of extension workers to build these simple but effective storages. This could also be a business opportunity for rural youth. Some of the funds used under youth programs could be directed to this activity.
- Upgrade quality and branding of local products. In many cases, the poor quality and weak branding of local products make them seem inferior to imports,

particularly among middle-class urban consumers. (Rice in West Africa is a case in point.) Measures could include:

- Incorporate quality assurance training and support as part of the extension package for farmers.
- Provide quality control support, which could be presented as a business opportunity for youths. For example, youths could be assisted to set up threshing and drying services under youth employment programs.
- Provide incentives to processors (such as rice millers) to install better equipment to improve the quality of their products. One way is to lower import duties on machinery and equipment that improve the quality of final products (for example, "destoners" for milled rice).
- Public education and advertisement programs should promote domestic products that are nutritionally equivalent to imports.

And trade policy can encourage local processing:

- Use differential tariffs to incentivize importers to develop local processing capacity—for example, having higher duties on processed products than on raw products.
- Use mandates to incentivize importers to develop local supply chains—for example, insisting that wheat flour, mainly imported, contain at least a certain percentage of cassava flour (as in Nigeria) or local sorghum flour, which does not lower quality or taste.

Adding value and spurring agro-based industrialization

Beyond increasing agricultural productivity and output and making agriculture profitable, transforming Africa's agriculture requires linking it to a modern agro-industrial sector. Upstream from farms, the demands of a modernized agriculture could support the manufacture of inputs such as fertilizers and other farm chemicals, farm implements, and packaging. Downstream, increased and reliable agricultural outputs can support a vibrant and competitive agroprocessing sector. Expanding agro-industry will contribute to Africa's industrialization, increase employment and incomes, and reciprocally stimulate agricultural growth by creating new output markets and increasing farmers' incomes and enabling them to invest in land and new inputs to further improve productivity.

In most African countries, however, value-added in agro-industry is well below potential. In particular, value added in agroprocessing is less than 40% of agricultural value added in most countries, compared with 80% in Brazil. South Africa is an exception, with value added in agroprocessing reaching 180% of agricultural value added. And most fertilizers and other manufactured agricultural inputs are imported. The challenge of developing agroprocessing and agro-related manufacturing, assuming that farm supply problems are solved, turns on industrial policy and a conducive environment for business. Industrial policy and private sector development policies should prioritize attracting agribusiness investors (agroprocessors, manufacturers of agricultural inputs, and other service providers in agricultural value chains). Agricultural development policy and industrial development policy must be linked, and ministers of finance, ministers of trade and industry, and heads of investment promotion and export promotion agencies should talk and coordinate more with ministers of agriculture.

Many African countries have good opportunities in agroprocessing, as illustrated by the potential in cotton, cassava, oil palm, and leather products (chapter 6). Opportunities in these and other agricultural products go beyond food production to the manufacture of industrial products to serve domestic and export markets. Today, Africa depends largely on imports for these products. There are four main approaches to spurring agro-based industrialization in Africa:

Transforming Africa's agriculture requires linking it to a modern agro-industrial sector

- Target support to specific product value-chains of high promise, within the overall context of supporting agricultural modernization, to ensure that supplies of produce are available at the scale, quality, and reliability needed by industrial processors.
- Work to attract agribusiness investors into export processing zones and industrial parks, through private sector development and industrial policy that prioritizes the targeted agricultural value chains. This will require close coordination between the ministries of finance and planning, the ministry of trade and industry, the investment and export promoting agencies, and the ministry of agriculture.
- To promote the growth and expansion of local small and medium-size enterprises: support rural artisanal food processors and link them to urban industrial processors as suppliers, building on some of the evolving models, and support local fabricators of simple agricultural machinery and tools.
- Intensify efforts through regional integration to open up wider markets to African processors and input manufacturers on the continent, which can provide some relief from the restrictive standards that discourage African food products from entering developed country markets.

Leveraging agriculture for employment

Agricultural transformation can also be an important part of the solution to growing unemployment, particularly youth unemployment, in Africa. While rising productivity on farms means that fewer people will be needed to produce a given quantity of output or to farm a given area of land, the development of agricultural value chains, including agroprocessing, input manufacturing, and agricultural services, will open a host of productive employment opportunities in nonfarm sectors. Many of these jobs are likely to be attractive to Africa's expanding population of educated youth, most of whom shun farming. And some of the educated youth who currently avoid farming might be attracted to it if there were well-designed programs to help them enter and succeed in a modernized and commercially oriented farming system that would give them access to a middle-class lifestyle (approaching the standard of living of their peers in white-collar jobs).

Agroprocessing, input manufacturing, and agricultural services will open a host of productive employment opportunities

So, a transformed agriculture—a modernized farming system with strong linkages to other sectors of the economy—can respond to both the general unemployment problem and the specific problem of educated youth unemployment. In the long term, bringing more young people into farming is essential for replacing the aging traditional smallholders who are now the backbone of African agriculture.

Expand jobs in off-farm agricultural value chains. The first part of the agenda for expanding off-farm agro-related jobs is essentially to strengthen selected agricultural value chains and promote agro-industry. The second part—employment—will have to be complemented by two additional actions:

- Support education and training institutions in collaboration with industry to transfer the types of skills needed in the economic activities being targeted.
- Market training and jobs in agro-related economic activities as attractive career options through information and media campaigns featuring national leaders.

Encourage some educated youth to take up farming. The agenda to attract educated young people to take up farming has to focus on the challenges that discourage them from farming. These challenges are the same as the challenges of farming modernization articulated in this report—access to land, to the "green revolution package" of inputs, to finance, and to markets. But the barriers are even higher for youth, who lack the necessary resources and social connections. In addition, youth find current farming practices and rural life unattractive. But the effort to engage youth in agriculture is worthwhile, to take advantage of their generally higher education levels, more commercial orientation, and strong drive, which make them more trainable as modern farmers. Many young Africans already mix livelihoods to earn income. Providing them with financial literacy, business development, and soft skills can help them manage a portfolio of self-employment and temporary and seasonal work for others in household agricultural production.[16]

Initiatives could include "agricultural industrial parks" designed to attract youth to commercial farming. Similar projects were introduced in Africa in the 1960s and 1970s (called integrated agricultural or area development projects), but heavy-handed state control led to their collapse. The agricultural industrial park model proposed here is different. It is a market-oriented business enterprise that receives initial support from the state in collaboration with donors and the private sector in sound public–private partnership arrangements. Democratic Republic of Congo, Mozambique, Tanzania, and other African countries are already developing large agricultural industrial parks or development corridors (chapter 7). These projects aim to attract large agricultural investors, but there is no focus on using them to develop a new class of educated small and medium-scale national commercial farmers. Japan and Brazil are supporting Mozambique in adapting Brazil's very successful *cerrado* agricultural settlement and development experiment, but it needs a greater emphasis on using the project to support educated national small and medium-scale commercial farmers. The proposed model includes:

- Setting up agricultural industrial parks as pilot schemes, with government, donors, and the private sector coming together in public–private arrangements to provide comprehensive and market-oriented solutions to the problems that youth face in entering farming. Given the costs, and the need to experiment and learn along the way, programs should be geographically focused.
- Acquiring a large track of land, servicing it with infrastructure (roads, water, and electricity), and allocating it according to objective technical criteria to selected young settlers to farm.
- Teaming up with donors to provide focused training on-site in farm production and business management, to educated youth who are interested in farming (to form the pool of candidates from which to select youth settler farmers).
- Incentivizing the private sector—input dealers and lending institutions—to locate near the project site to provide services to settlers (and to adjacent smallholder farmers) on favorable terms.

Providing modern off-farm employment opportunities

- Promoting linkages between the project and processors, supermarkets, and other large buyers and exporters.
- Providing dedicated extension agents through a public–private arrangement on the project site for a few years to help settlers master the science and business of farming.
- Supporting a strong farmer organization among the farmers.

Once the pilot has demonstrated its effectiveness, it could be replicated in other parts of the country.

Ensuring gender balance in agricultural transformation

Women constitute half the labor force. Putting them on an equal footing with men in driving agricultural transformation and benefiting from it is not only good social policy—It is also good (and essential) economic transformation policy. But women face extensive discrimination in many African countries that limits their access to land, extension services, finance, and markets. These constraints lead to a vicious cycle: without ownership rights, women cannot use their farm plots as collateral for loans to purchase modern inputs, and without good access to modern inputs and extension services, women's productivity is lower than men's, which means that they earn less from their plots, and so are unable to advance. Here are some actions to break this cycle:

Putting women on an equal footing with men is not only good social policy—It is also good economic transformation policy

- Reform land rights laws to enable women to legally own land, as Ethiopia, Kenya, Rwanda, and Uganda have done. Accompany the formal change in laws with information campaigns to make women aware of their right to own land and facilitate their registration of lands.
- Consider changing laws governing marriage, divorce, and inheritance to remove barriers against women, as Rwanda has done.
- Promote and disseminate simple and cheap labor-saving technologies and inputs in small quantities to address women's limited access to credit and cash.
- Employ more female extension workers.
- Support farmer-to-farmer training approaches that use women as trainers, and encourage farmer field schools with flexible training schedules that accommodate other demands on women's time.
- Use modern information and communication technology, such as mobile phones, text messages, and radio and television programming, to reach more female farmers, and communicate extension messages in ways that make it easier for women with little formal education to access and understand them (such as through pictures and videos).
- Adapt credit products to female clients' needs, such as changing the terms of credit through microfinance institutions, or providing innovative types of savings instruments, such as female-owned *individual* accounts, mobile banking, and branchless banking.
- To help women circumvent credit, educational, and infrastructural barriers, provide bundled services, for example, packaging together loans, savings accounts, and access to inputs such as fertilizers, technology, and extension services.
- Support women farmer organizations to strengthen women's market power in input and output markets.

Harmonizing agricultural intensification, environmental sustainability, and climate change

Raising farm productivity requires intensification—more cropping intensity and increased use of fertilizers and other farm chemicals, irrigation, and mechanization. Improperly done, each of these activities could adversely affect the environment. Farmers will need information on practices that raise productivity in ways that are environmentally sustainable. The impacts of climate change also need to be considered. Research is needed on how climate change is likely to interact with these intensification technologies and approaches and reduce their effectiveness and on what could be done so that farm productivity can continue to rise despite the impacts of climate change. Focusing on these questions and helping farmers deal with them should be key parts of the policy agenda for agricultural transformation.

The intensification of farming, through continuous cropping and increased use of fertilizers, irrigation, and mechanization, that is required for agricultural transformation needs to be made environmentally sustainable and to take into account the potential impacts of climate change. Here some of the actions that are needed:

- Train extension officers to disseminate knowledge about the correct application of fertilizer, to minimize runoff, and encourage mixed crop-livestock production to increase organic fertilizer production.
- Promote small, closed, underground pipe irrigation to reduce water use and evaporation, and support well-run water user organizations to manage irrigation projects.
- Promote the use of small agricultural machinery, such as two-wheeled tillers and small four-wheeled tractors.
- Promote conservation agriculture and climate-smart agriculture.

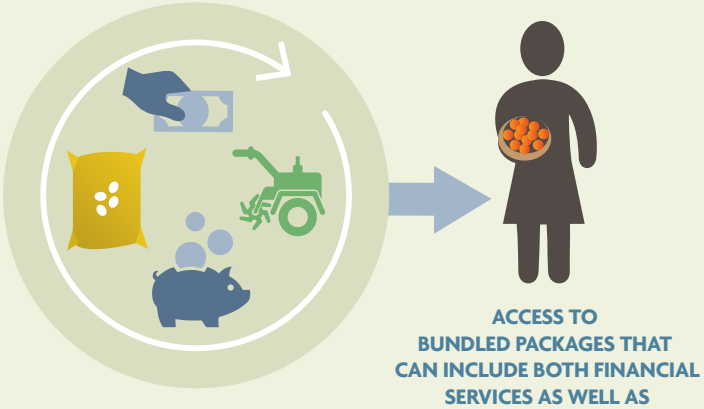
Achieving gender balance in farming

ACCESS TO CHEAP TECHNOLOGIES AND INPUTS

ACCESS TO LAND

MORE WOMEN AS EXTENSION OFFICIALS AND MORE INNOVATIVE TRAINING PROGRAMS ADDRESSING CONSTRAINTS FACING WOMEN

ACCESS TO DIGITAL FINANCE, MICROFINANCE, AND BASIC SAVINGS AND LOANS ACCOUNTS



ACCESS TO BUNDLED PACKAGES THAT CAN INCLUDE BOTH FINANCIAL SERVICES AS WELL AS AGRICULTURE INPUTS

A partnership for Africa's agricultural transformation

The spearhead of agricultural transformation will be farmers and private agribusiness entrepreneurs. But government has crucial roles to play, mainly supportive but in many cases leading efforts to catalyze innovations. The government's role in advancing agricultural transformation extends beyond the ministry of agriculture to the finance and planning ministries; trade and industry ministries; education, training, science, and technology ministries; and government agencies promoting investments. In effect, a "whole of a government approach" is required. It can be no less, since agricultural transformation must harness agricultural and industrial policies to drive overall economic transformation. This is an opportunity that many African countries are fortunate to have, and it is time they reached out and seized it—with enthusiasm! And Africa's international development partners need to support African governments, farmers, and entrepreneurs in this transformative agenda.

Notes

1. Johnston and Mellor 1961; Timmer 1988 and 2007.
2. Chamberlin, Jayne, and Headey 2014.
3. Takeshima 2010.
4. FAO Aquastat 2010.
5. Otsuka 2016.
6. Odame and Muange 2012.
7. Minde et al. 2008.
8. Liverpool-Tasie 2014.
9. Goyal and Nash 2016.
10. Lukuyu et al. 2012; Kugonza et al. 2015.
11. Morris et al. 2015.
12. Riddell and Westlake 2006.
13. Fuglie 2010.
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15. FAO Aquastat 2005.
16. Mastercard Foundation 2017.

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CHAPTER 1

Agriculture in African Economies

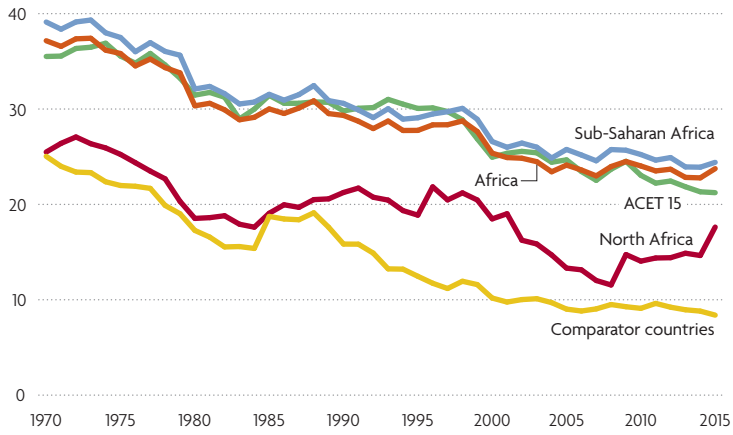
For many countries in Africa, agriculture can lead the way to economic transformation. But to do that, it has to be modernized and linked more closely with manufacturing and other economic sectors. This chapter offers an overview of the state of agriculture in Africa and the role it currently plays in African economies using some key structural characteristics and performance indicators. The presentation here is purely descriptive and is meant to set the stage for the analysis and recommendations in the subsequent chapters on how to transform African agriculture and leverage it to drive overall economic transformation on the continent.

Agriculture retains a key role in African economies, although its shares of production and employment have generally been falling. The sector has the potential to indirectly contribute significantly to production and employment in other sectors, particularly through processing, other agriculture-related manufacturing, and services. But currently most African countries are not effectively tapping this potential.

FIGURE 1.1

Agricultural value added in Africa and comparator countries, 1970–2015

Annual growth (percent)



Note: See box 1.1 for definitions of the ACET 15 and comparator countries.
Source: WDI online, accessed October 8, 2016.

Agriculture's contribution to gross domestic product

Across the continent, the share of agriculture in gross domestic product (GDP) dipped from almost 40% in the early 1970s to less than 25% in 2015 (figure 1.1). The share averages 25% in Sub-Saharan Africa, but just 18% in North Africa. Among the subgroup of countries that we refer to as the ACET 15 (box 1.1), the share is 21%. Overall, the share of agriculture in production in Africa's economies is much higher than in more industrialized or emergent countries (as in the comparator countries—box 1.1--where the average is less than 10%).

Potentially, agriculture's importance in production goes beyond its direct share in GDP, since agricultural output is the basis for agroprocessing, and the sector is also a source of demand for other agribusiness industries and services. But in Africa, this secondary impact on GDP is generally small. Agroprocessing value added is generally less than 20% of agricultural value added in Sub-Saharan Africa and below 40% in North Africa, although it is well over 100% in Mauritius and South Africa, an indication of the potential for agroprocessing in Africa.

The decline of agriculture's share in GDP in Africa follows the trend in economic development observed elsewhere. But what is different in Africa is that agriculture's decline has not been accompanied by a rise in manufacturing. Instead, the share of manufacturing in GDP has also been falling, with services gaining share instead—generally low-value services in the informal sector. Thus, the classic path to structural transformation—a declining agricultural share (of production and employment) and a rising manufacturing share—seems to be eluding Africa. But agricultural transformation can change this: it will increase productivity on African farms, raise the volume and quality of agricultural output, which can support agroprocessing and other agriculture-related manufacturing and also stimulate higher-value services in agricultural value chains. And all this will expand overall employment, particularly in off-farm activities.

Despite a declining share in GDP, agriculture remains important to GDP growth, through both its direct and indirect contributions. Trends in overall GDP growth generally mirror trends in agricultural growth—more so for Sub-Saharan Africa than North Africa (figures 1.2 and 1.3).

Pursuing two tracks to industrialization

African countries have the opportunity to pursue two tracks to industrialization—one that leverages their relative labor-abundance for labor-intensive and export-oriented light manufacturing, and another track that leverages their advantages in agriculture for globally competitive manufacturing based on agriculture.

BOX 1.1

The ACET 15 and the comparator countries

In addition to the whole of Africa, Sub-Saharan Africa, and North Africa (Algeria, Egypt, Libya, Morocco, and Tunisia), the chapter sometimes also shows and discusses trends in two sets of countries referred to as the "ACET 15" and the "comparator" countries. These two sets of countries were introduced in the inaugural 2014 issue of the African Transformation Report, (Growth with Depth), and are retained here for comparisons.

The ACET 15, a subset of Sub-Saharan countries, are Senegal, Burkina Faso, Ghana, and Nigeria in West Africa; Ethiopia, Kenya, Rwanda, Tanzania, and Uganda in East Africa; Cameroon in Central Africa; and Botswana, Mauritius, Mozambique, South Africa, and Zambia in Southern Africa. Rather representative, these countries comprise 70% of the population of Sub-Saharan Africa (in 2010), 76% of GDP, 85% of manufacturing value added, 65% of agricultural value added, and 80% of exports. All the subregions of Sub-Saharan Africa are represented (some more than others), as are the major official languages of English, French, and Portuguese. Countries in conflict or recently emerging from conflict are not included, since reconstruction is more pressing than economic transformation. For the 2014 African Transformation report, ACET conducted country case studies on economic transformation in each of the ACET 15 countries.

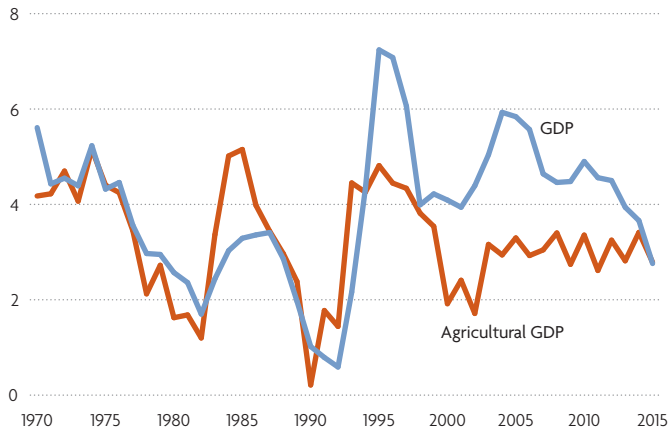
The comparator countries are Brazil, Chile, Indonesia, Malaysia, Singapore, South Korea, Thailand, and Vietnam. (In this report, we omit Singapore, a city-state with hardly any agriculture, from the comparator countries.) About 30 to 40 years ago, these countries had economies with several features observed in African economies today—widespread poverty, low productivity, low levels of technology, and limited exports. But they ignited and sustained long periods of high GDP and export growth, technological upgrading, and significant improvements in the lives of their people to become middle- or high-income countries.

Individual countries in the comparator set can also be related to particular ACET 15 countries. Indonesia and Brazil—with their large populations, agriculture, and oil—could be related to Nigeria. Brazil, a middle-income country with budding technological prospects, and Korea could point the way for South Africa. Chile, Malaysia, and Thailand could point the way for Ghana, Kenya, and Senegal in agribusiness and in attracting foreign direct investment for manufacturing. Chile, a big copper producer that has also managed to develop agribusiness, could point the way for Zambia, a large copper producer with large tracks of undeveloped agricultural land. And Vietnam, evolving from a statist economic approach to an attractive FDI destination, could hold some lessons for Ethiopia, which has roughly the same population and a government with a fairly heavy hand in the economy.

FIGURE 1.2

GDP growth in Sub-Saharan Africa tracks agricultural GDP growth, three-year moving average, 1970–2014

Annual growth (percent)

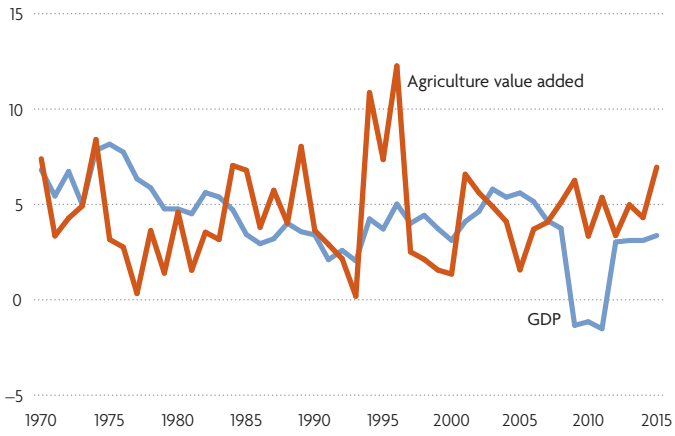


Source: WDI online, accessed October 8, 2016.

FIGURE 1.3

GDP growth in North Africa also tracks agricultural GDP growth, three-year moving average, 1970–2015

Annual growth (percent)



Source: WDI online, accessed October 8, 2016.

Contributing to economic transformation

Agriculture's contribution to employment

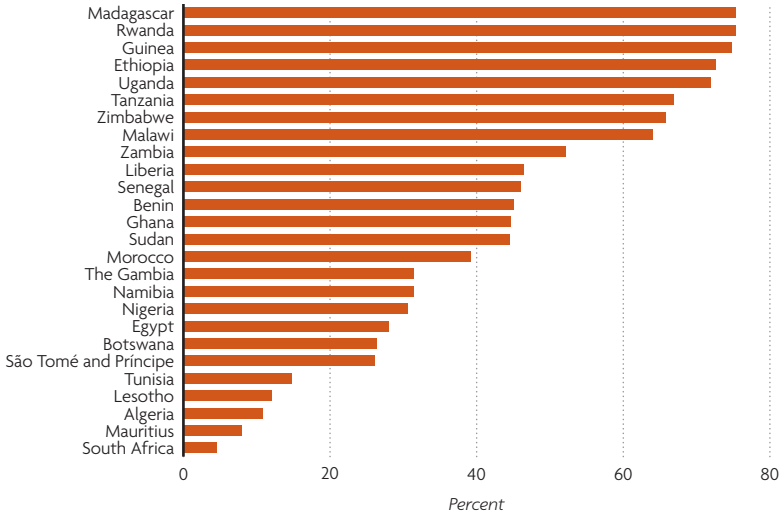
Agriculture plays an even bigger role in employment in Africa (figure 1.4). The share of agriculture in total employment ranges from a high of more than 70% in Rwanda, Madagascar, Guinea, Ethiopia, and Uganda to under 10% in Mauritius and under 5% in South Africa. For many countries, including some in North Africa, the share is between 20% and 50%. Agriculture's higher share in employment than in GDP reflects the sector's low productivity and helps explain the higher poverty levels in rural areas in Africa. However, as an indication of the unexplored potential of agricultural-related employment, agroprocessing makes up less than 2% of employment.[1]

Exports and balance of payments

Agriculture's share in the exports of African countries, like its share in GDP, has been falling. It is now under 10%, down from around 30% in the 1970s (figure 1.5). The comparator countries have experienced a similar decline, but the causes differ. For them, agriculture's declining share in exports reflects manufacturing's rising share, while in Africa it reflects the rising export share of natural resources, mainly oil and gas. The ratio of agricultural exports to agricultural GDP has also been falling in Africa, in contrast to the sharp rise in the comparator countries since 1991 (figure 1.6). In recent years some countries in Sub-Sahara Africa, particularly Kenya and Ethiopia, have been able to diversify their agricultural exports from traditional tropical beverages like tea and coffee to include horticultural products, particularly cut

FIGURE 1.4

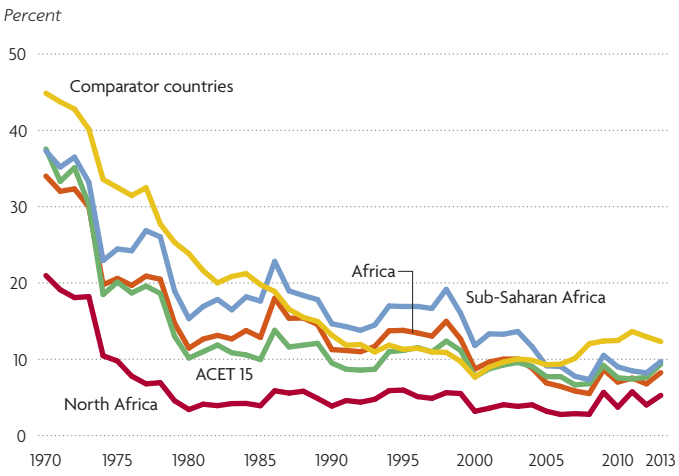
Share of agriculture in total employment, 2010–2015



Source: Based on data from the World Development Indicators and, for Nigeria, from African Development Bank (2015).

FIGURE 1.5

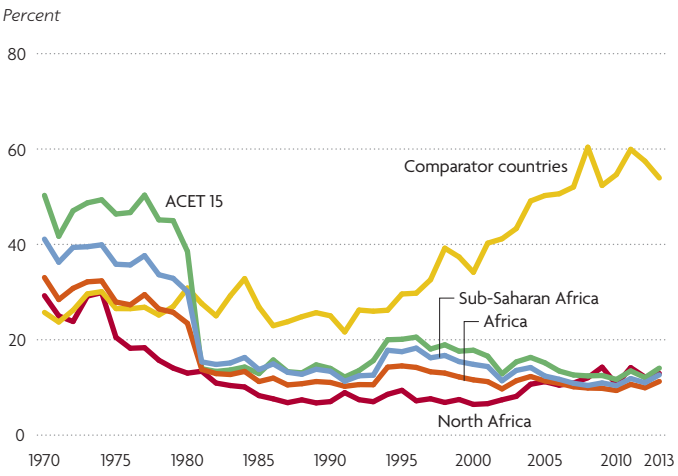
Agricultural exports as a share of merchandise exports in Africa and comparator countries, 1970–2013



Source: FAOSTAT online, accessed March 9, 2017.

FIGURE 1.6

Agricultural exports as share of agricultural GDP in Africa and comparator countries, 1970–2012



Source: FAOSTAT online and WDI online, accessed October 11, 2016.

flowers, and fresh vegetables. Apart from South Africa, no African country is a significant exporter of agro-processed products.

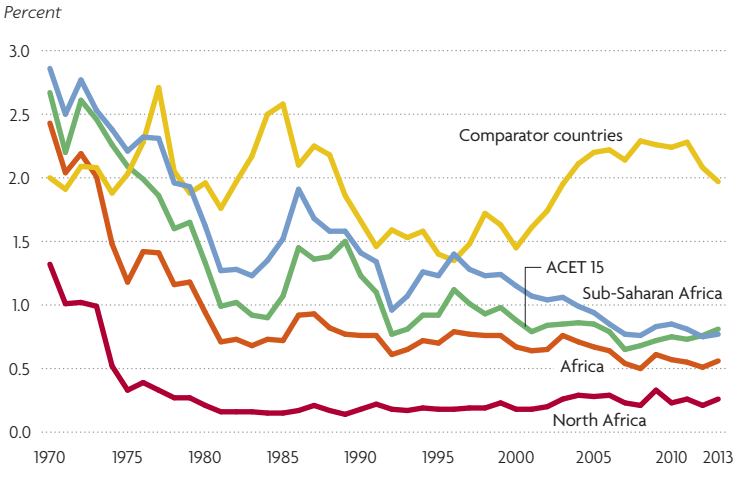
Despite agriculture's continuing importance in exports, the agricultural balance of payments in Africa is negative, largely because of rising agricultural imports, particularly of food. Agricultural imports in Africa in 2013 were around US$88.5 billion, with food accounting for more than three-quarters of the imports (US$67.9 billion).[2] In a reversal from the 1970s, when the value of Africa's agricultural exports was more than double the value of its agricultural imports, today agricultural imports are double agricultural exports (figure 1.7). Ironically, in the more industrialized comparator countries, the value of agricultural exports is double the value of agricultural imports, and the trend has been rising since 2000, not falling as in Africa.

Structural characteristics of African agriculture

This report discusses only crop and livestock production, with the focus mainly on crops, which accounted for 92.5% of total production of crops and livestock in 2014 (87.1% in North Africa, and 94% in Sub-Saharan Africa).[3]

FIGURE 1.7

Value of agricultural exports as a ratio of the value of agricultural imports in Africa and comparator countries, 1970–2012



Source: FAOSTAT online, accessed June 6, 2017.

Africa is rich in land, but there are barriers to using it

It is estimated that Africa contains more than half the world's uncultivated arable land.[4] However, not all of this land is easily available for farming. About 70% of the uncultivated land is in four countries—Democratic Republic of Congo, Angola, Republic of Congo, and Zambia, in that order (table 1.1). Two of these countries have suffered prolonged periods of conflict. And in many parts of Africa customary land tenure systems make it difficult to access land and to use it for commercial agriculture (chapter 2). With irrigation underdeveloped (chapter 3), most farming depends on rainfall, which effectively limits the potentially arable land that is actually usable for farming. Despite these limitations, Africa is still relatively land abundant, as reflected in its crop area per agricultural worker compared with other parts of the world (figure 1.8).

TABLE 1.1

Agricultural land availability in African countries

Country	Nonforested unused land (thousands of hectares)	Percent of available land	Cumulative percent of available land
Democratic Republic of Congo	84,824	46.5	46.5
Angola	18,889	10.4	56.9
Republic of Congo	12,872	7.1	63.9
Zambia	10,872	5.9	69.9
Cameroon	10,834	5.7	75.6
Mozambique	8,994	4.9	80.5
Central African Republic	7,049	3.9	84.4
Gabon	6,534	3.6	88.0
Sudan	5,803	3.2	91.2
Tanzania	4,313	2.4	93.5
Madagascar	2,718	1.5	95.0
Zimbabwe	2,142	1.2	96.2
Chad	1,520	0.8	97.0
South Africa	1,219	0.7	97.7
Kenya	807	0.4	98.2
Mali	800	0.4	98.6
Burkina Faso	655	0.4	99.0
Ethiopia	651	0.4	99.3
Rest of Africa	1,259	0.7	100.00

Source: Jayne et al. 2014.

Technology use is low

Africa's use of agricultural technology is generally low. Irrigation development (table 1.2), fertilizer usage (table 1.3), and mechanization are all well below optimum levels (see chapter 3). As a consequence, yields are low.

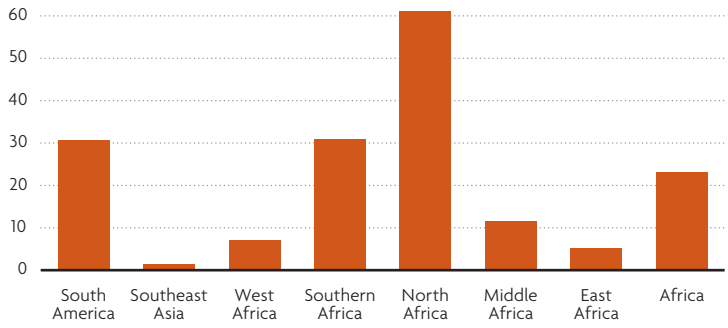
Most African farms are small

Farms in Africa are generally small. In many countries in Sub-Saharan Africa, the average size is below 3 hectares (table 1.4), and a majority of farms are under 2 hectares. Most smallholders (farmers with holdings of less than 2 hectares) are essentially subsistence farmers. They may sell surplus production after meeting their household requirements, but their main motivation is not commercial; they do not run their farming operations as a business.

FIGURE 1.8

Crop area per agricultural worker in Africa, South America, and Southeast Asia, 2015

Hectares per worker



Source: FAOSTAT online and Groningen Growth and Development Centre database online, accessed November 4, 2016.

TABLE 1.2

Irrigation potential compared with irrigation development in African and comparator countries

Subregion and country	Irrigation potential, 2013 (thousands of hectares)	Area equipped for irrigation (thousands of hectares)	Date
North Africa			
Algeria	1,300	1,065	2012
Egypt	4,420	3,422	2002
Libya	40	316	2000
Morocco	1,664	1,448	2004
Tunisia	560	405	2006
Sub-Saharan Africa			
Angola	3,700	12	2005
Benin	322	17	2008
Botswana	13	1.38	1992
Burkina Faso	165	46	2011
Central African Republic	1900	0.07	1987
Chad	335	26	2002
Comoros	0.3	0.09	1987
Côte d'Ivoire	475	66.93	1994
Djibouti	2.4	0.39	1999
Eritrea	187	13	1993
Gambia	80	1.1	1991
Ghana	1,900	30	2010
Guinea	520	95	2001
Guinea-Bissau	281	23	1996
Kenya	353	97	2003
Lesotho	13	0.07	1999
Madagascar	1,517	550	2000
Malawi	162	27	1992
Mali	566	176	2000
Mauritania	250	23	2004
Mauritius	33	21	2002
Mozambique	3,072	62	2010
Namibia	47	6	1992
Niger	270	88	2010
Nigeria	2,331	219	2004
Rwanda	165	8	2008
Senegal	409	69	1997
Seychelles	1	0.2	2003
Somalia	240	65	2000
South Africa	na	1,498	2000
Swaziland	93	45	2002
Togo	180	6	1996
Uganda	90	11	2013
Zambia	523	156	2002
Zimbabwe	366	124	1999
Comparator countries			
Brazil	29,350	4,454	2006
Chile	2,500	1,094	2007
Republic of Korea	1,782	807	2009
Thailand	12,245	5,060	2007
Vietnam	9,400	4,585	2005

na is not available.

Source: FAOSTAT–AQUASTAT online, accessed March 12, 2017.

TABLE 1.3

Inorganic fertilizer use in selected Sub-Saharan countries and Asia and Latin America, 2016

Region/ country	Share of cultivating households using fertilizer (%)	Fertilizer use across all households (kilograms per hectare)	Fertilizer use across fertilizer-using households (kilograms per hectare)
Sub-Saharan Africa			
Ethiopia	55.5	45	81
Malawi	77.3	146	188.8
Niger	17	4.5	26.3
Nigeria	41.4	128.2	310.1
Tanzania	16.9	16.2	95.6
Uganda	3.2	1.2	37.5
Average	35.2	56.9	123.2
Latin America		125.9	
East Asia		246.3	

Source: Based on data from Sheahan and Barrett (2016); FAOSTAT online, accessed October 12, 2016.

TABLE 1.4

Average farm size in selected African countries

Country	Farm size (hectares)	Year
Botswana	1.9	2004
Burkina Faso	3.9	1993
Cameroon	1.6	1972
Côte d'Ivoire	3.9	2001
Ethiopia	1.0	2012
Ghana	3.2	2006
Kenya	2.1	2010
Madagascar	0.9	2005
Malawi	1.4	2009
Mali	4.1	2005
Nigeria	1.4	2010
Rwanda	0.7	2006
Senegal	4.3	1998
Tanzania	2.4	2003
Uganda	0.9	2006
Zambia	3.7	2008

Source: Based on data from Jayne et al. (2014).

They use few purchased inputs and little mechanization, depending mainly on machetes and hand-hoes. Large and commercially oriented farmers are located mainly in parts of Northern, Eastern (particularly Kenya), and Southern (particularly South Africa, Zambia, and Zimbabwe) Africa. But there has been a shift in recent years toward medium-size commercial farming operations in a number of countries.[5]

Many farmers are old and a majority are women

On a continent where close to 60% of the population is under 24 years old, the average age of farmers is estimated by some sources to be as high as to 60 years.[6] Although other estimates give much lower figures (the LSMS gives an average of about 40 years from national surveys of 29 countries), there is consensus that African farmers are ageing.[7] And it is generally estimated that a majority of farmers are women.[8] The education level of farmers is low, in part because education systems in Africa have neglected agricultural training, reflecting a common belief that farming is an occupation for people without schooling.[9] As access to education has expanded, fewer youth are staying on the farm. Further discouraging educated youth from a career in farming are the reliance on traditional technology that entails back-breaking manual labor, challenges that keep profitability in agriculture low and volatile, and the lack of amenities in rural areas.

Weak performance of African agriculture

Both land productivity (output per unit of land—yields) and labor productivity (output per agricultural worker) are low in African agriculture relative to other parts of the world. Africa is below the comparator countries in yields (figures 1.9 and 1.10). And although the yields have been rising, they have not risen as fast as in the comparator countries. North Africa does better than other subregions, with tuber yields higher than in comparator countries and with a smaller gap in cereal yields.

While labor productivity in agriculture is also lower in Africa than in comparator countries, the gap is not as wide as in yields, reflecting Africa's relative land abundance (more crop land per agricultural worker) and the more labor-intensive cultivation in comparator countries, particularly in East Asia (figure 1.11).

Agricultural growth is rising but is volatile

Since the 1990s, agricultural growth in Africa has outpaced that in the comparator countries (figure 1.12). Agricultural production per capita has also been rising, particularly in North Africa (figure 1.13). However, agricultural growth has been very volatile, again particularly in North Africa. And growth has not lived up to expectations. Between 2003, when African Heads of State set a target of 6% annual growth in agriculture in the Maputo Declaration, and 2015, agricultural growth has averaged just 3.2%—just half of the target.

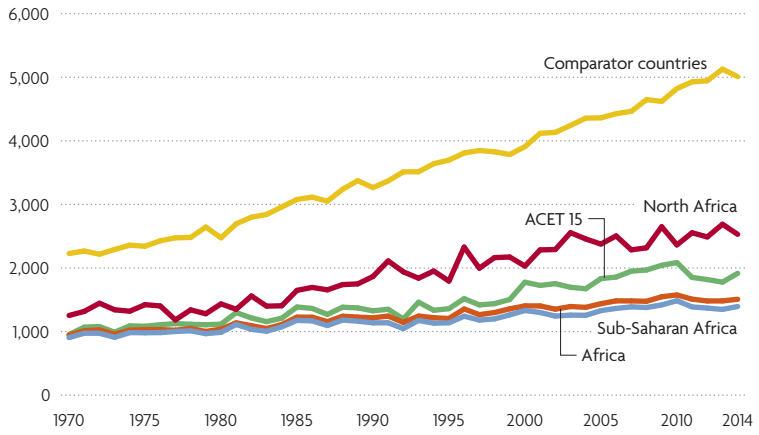
Food imports are high and rising

Food imports by African countries have been rising since the mid-1990s, with the trend especially marked in North Africa (figure 1.14). In 2013, Africa spent almost US$68 billion on food imports, of which Sub-Saharan Africa accounted for US$37 billion. Food imports have also risen sharply in the comparator countries, but these countries generally have large and rising exports from manufacturing to compensate for the balance of payment effects of the food imports.

FIGURE 1.9

Cereal yields in Africa and comparator countries, 1970–2014

Kilograms per hectare

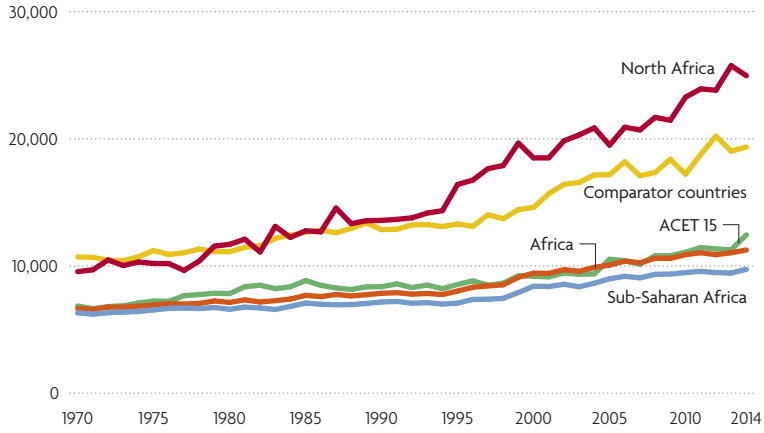


Source: FAOSTAT online, accessed March 9, 2017.

FIGURE 1.10

Tuber yields in Africa and comparator countries, 1970–2014

Kilograms per hectare



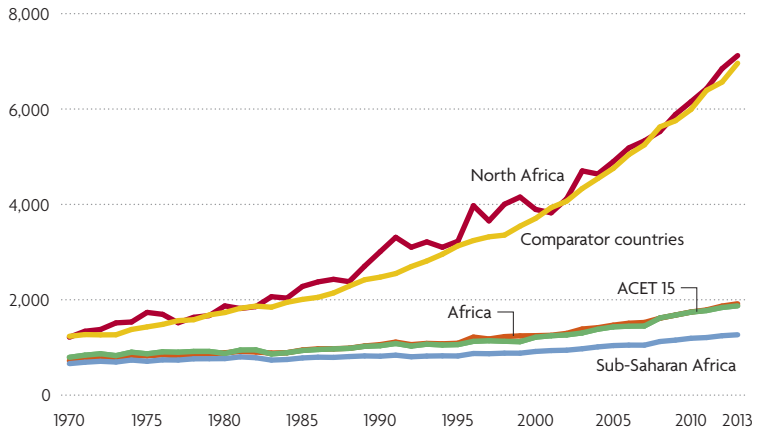
Note: Output includes cassava, potatoes, sweet potatoes, taro (cocoyam), and yams, but the composition is different by region.

Source: FAOSTAT online accessed March 9, 2017.

FIGURE 1.11

Labor productivity in Africa and comparator countries, 1970–2012

2004–06 US$

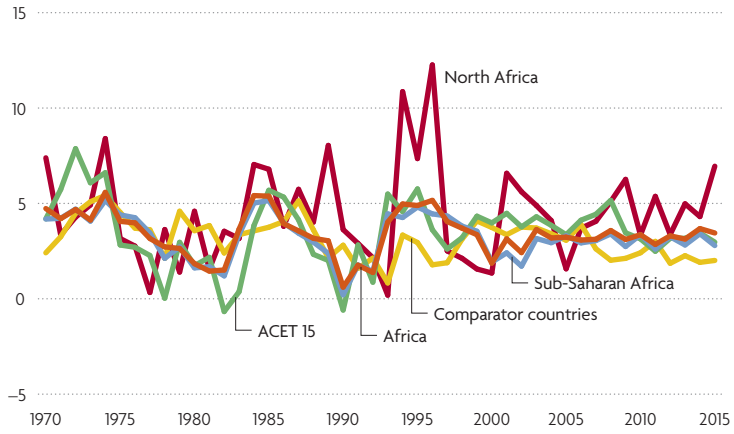


Source: IFPRI annual report 2015 online, accessed October 19, 2016.

FIGURE 1.12

Annual agricultural growth in Africa and comparator countries, three-year moving average, 1970–2015

Percent



Source: WDI online, accessed October 8, 2016.

Budget spending on agriculture has been low and uneven

In the Maputo Declaration of 2003, African leaders agreed to allocate 10% of their budgets to agriculture. While the average share has risen markedly among the ACET 15, for Africa as a whole agriculture's share of budgetary expenditures started trending downward after the Maputo Declaration, and in Sub-Saharan Africa there has been no noticeable change (figure 1.15). Performance has been mixed for individual countries, with increases among some and declines among others (figure 1.16).

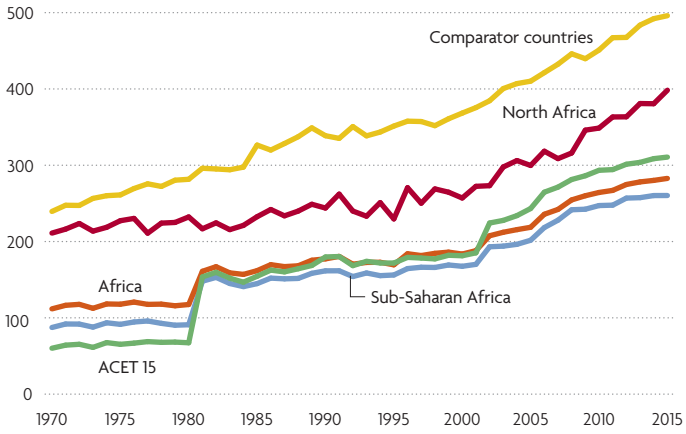
Conclusion

In this chapter, we have tried to convey a portrait of the state of African agriculture, focusing on some important performance and structural features. The chapters that follow discuss how to change the structural features and transform African agriculture so as to increase its performance and its contribution to overall economic transformation.

FIGURE 1.13

Annual agricultural value-added per capita in Africa and comparator countries, three-year moving average, 1970–2015

Value added per capita (2010 US$)

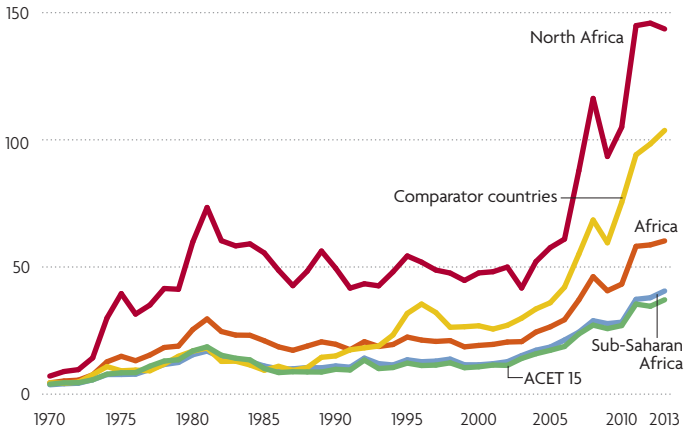


Source: WDI online, accessed March 10, 2017.

FIGURE 1.14

Food imports per capita in Africa and comparator countries, 1970–2012

Food imports per capita (2010 US$)

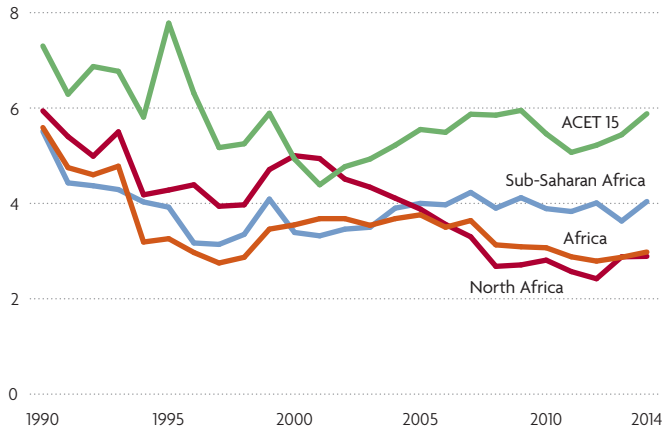


Source: FAOSTAT online, accessed March 12, 2017.

FIGURE 1.15

Government agricultural spending in Africa, by country group, 1970–2014

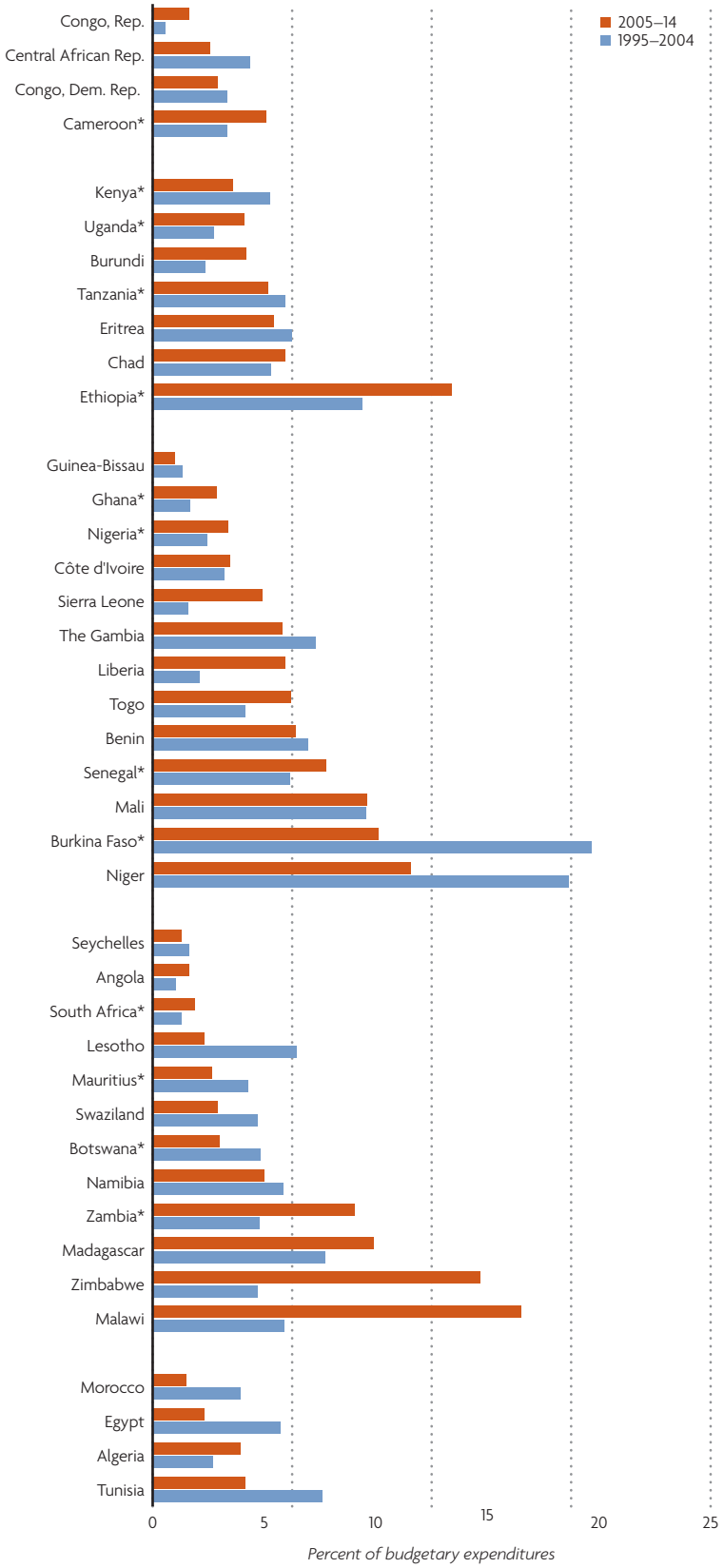
Percent of total expenditures



Source: ReSAKSS online, accessed October 8, 2016.

FIGURE 1.16

Government agricultural spending in Africa 10 years before and after the Maputo Declaration (of July, 2003) by country, 1995–2004, 2005–2014



* ACET 15 country.

Source: ReSAKSS online, accessed October 8, 2016.

Notes

1. Yeboah and Jayne 2017.
2. Food imports comprise food and live animals, as defined by the Food and Agriculture Organization of the United Nations.
3. According to International Standard Industrial Classification (ISIC) divisions 1–5, agriculture also comprises forestry, hunting, and fishing, which this report does not consider.
4. Leke et al. 2010.
5. Jayne et al. 2014.
6. AGRA 2016; FAO 2014.
7. AGRA 2016; FAO: http://www.un.org/en/ecosoc/integration/pdf/foodandagriculturеorganization.pdf; http://www.helpage.org/silo/files/the-ageing-of-rural-populations-evidence-on-older-farmers-in-low-and-middleincome-countries.pdf;http://www.un.org/en/ecosoc/integration/pdf/foodandagriculture organization.pdf; http://www.gallup.com/poll/168593/one-five-african-adults-work-farms.aspx.
8. This refers to the number of farmers, not the labor input on farms. The World Bank, in an analysis of individual labor input data from Ethiopia, Malawi, Niger, Nigeria, Tanzania, and Uganda, puts the female share of labor in crop production across these countries at 40%. (http://www.worldbank.org/en/programs/africa-myths-and-facts/publication/women-agriculture-and-work-in-africa).
9. Maiga and Kazianga 2016.

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CHAPTER 2

Securing Land Tenure and Easing Access to Land

Africa possesses nearly 60% of the world's uncultivated arable land[1] but achieves less than a quarter of the continent's potential agricultural productivity.[2] Thus it has yet to realize its comparative advantage in agriculture. Doing so requires easier access to land by small farmers and the emerging class of modern commercial farmers. It also requires expanding production by boosting productivity and modernizing agriculture. And that requires farmers to have secure title to land, their main agricultural asset, to motivate them to invest in their farms and to enable them to use their land as collateral for loans for investment.

Secure land rights and easier access to land were crucial in transforming agriculture in economies such as China, South Korea, Taiwan (China), and Vietnam.[3] But such transformative impacts have not yet reached Africa. Why?

This chapter attempts to answer that question by reviewing Africa's land tenure systems and suggesting measures to reform them to improve security of tenure and access to land while protecting the rights of local communities and women.

Securing land ownership and use

Before Africa was colonized by Western countries, land was owned communally based on local customs and traditions for using and administering land. The colonizers brought with them a Western concept of property rights based on individual ownership and recordation of land in a public register. In Africa, only about 10% of arable land is registered (compared with 95% in Western Europe). Africa's registered land is largely under individual ownership, though some countries have started to register communally owned land (table 2.1). Otherwise, the customary tenure system, with much of the land owned communally, still predominates, especially in Sub-Saharan Africa.

Africa's customary land tenure systems have some advantages, mainly providing a safety net that has helped avoid destitution in the countryside. While generally adequate to support low-productivity agriculture, these systems cannot support modern commercial agriculture, for two major reasons.

First, these customary tenure systems are no longer secure, having become increasingly associated with uncertainty over ownership and use of land. That uncertainty leads to land disputes, which seem to be escalating as demand for agricultural land and land values rise. The uncertainty discourages long-term investment, while disputes reduce productivity (often locking the land out of investment and production). The number of land disputes is astonishing in some countries. In Uganda, for example, about half the judicial system's case load concerns land disputes; these disputes are associated with estimated losses of 5%–11% of agricultural production.[4] In Ethiopia, one-third to one-half of judicial cases touch on land disputes, while in Ghana half the new civil cases relate to land disputes.[5] Large commercial agricultural investments also give rise to land disputes, primarily a result of inadequate consultation with local communities and claims of insufficient compensation for expropriated land for investors.[6]

Second, as customary tenure lands are unregistered, owners cannot use the land as collateral for credit for investment. Empirical research has produced mixed results on the impact of tenure and registration on credit, reflecting the need for other complementary factors such as well-functioning land, agricultural and credit markets, and supportive enforcement institutions. But some

TABLE 2.1

Estimates of registered and unregistered rural arable land in Africa

Land tenure system	Sub-Saharan Africa[a] (%)	North Africa[b] (%)	Africa (%)
Customary (unregistered land) (largely communally owned)	90–95	25–50	90
Modern (registered land) (largely individually owned)	5–10	50–75	10
Total	100	100	100

a. Customary land tenure consists mainly of communally owned land, especially in West and Central Africa, while modern land tenure (registered land) consists largely of individually held land. b. Arable or irrigated land ranges from 1% of total land in Libya to 15% in Morocco.

Source: Based on data from AU- AfDB-UNECA Land Policy Initiative 2009 and Byamugisha 2013.

studies, including one in Uganda, have nonetheless found a positive and significant impact of land tenure on credit.[7]

With customary land tenure still so common, modernizing agriculture and raising productivity require strengthening tenure security by addressing the underlying causes of insecurity. Key actions include registering customary land rights (for communally as well as individually owned land) and bolstering institutions for resolving land disputes.

Registering customary land rights

Registering customary land rights has to be planned and executed carefully, or it can generate even greater tenure insecurity[8] and enrich the elite at the expense of the poor.[9] Registration should treat communal land rights separately from individual land rights. Reforms must guard against premature and involuntary conversion of communal ownership to private individual ownership. Nor can conversion always be assumed to be the preferred choice. In Mexico, even after community members were given a choice to individualize their rights over communal land (ejidos) during the 1992–2006 reform period, only 35% of ejido land had been formally converted as of 2015. Many farmers decided to keep most of their land under common use because they considered the net benefits to be greater than those from individual use (box 2.1).[10]

Registering communally owned land. Several countries in Africa have launched similar exercises to register communally owned land, including Botswana, Ghana, Mozambique, Namibia, South Africa, Tanzania, and Uganda. Box 2.1 reviews the experiences of Mozambique and Tanzania, as well as of Mexico, which has completed registration of communally owned land in two reforms nearly a century apart.

Mexico's second land reform program (1992–2006) had little impact on agricultural investment because the necessary complementary public investments were inadequate. The government prioritized private lands over communally owned lands in the allocation of complementary public investments.[11] Nonetheless, the impact on agricultural productivity was strongly positive as land sales, rentals, and consolidations increased as people moved out of farming, especially elderly (and less productive) farmers and others who opted for rental income and alternative off-farm economic opportunities.[12] This experience suggests that demarcating the external boundaries of communally owned land and registering it can be more cost-effective, faster, and more appropriate than registering parceled land within a community. Larger areas can be dealt with quickly once communal land-owning groups have been identified and formalized on the basis of by-laws governing land relations and transactions and investment ventures between communities and outsiders.[13]

While no country in Africa has formalized and documented communal land rights countrywide to the extent that Mexico has, initiatives in Mozambique and Tanzania (see box 2.1) have the potential to be customized and (drawing on global experience) scaled up to accelerate documentation of communal land rights across Africa.[14] Although empirical studies have not assessed the impact of the Mozambique and Tanzania initiatives, lessons can be drawn from several general assessments. A key lesson from Mozambique's experience is that, even without a legal requirement to survey the external boundaries of community land, registration of communal land can be very slow and expensive because of the time needed to organize and formalize communities. Yet these two steps must be taken unless the owners of communal land and the rules of engagement are clearly identified in customary law, as with the long-established customary authorities in Ghana, or are established as statutory administrative units, as in Tanzania.[15]

Registering individually owned land

Africa has had more experience in formalizing individual land rights through land titling and registration than in formalizing communal tenure systems. Until recently, systems for land registration were slow and costly.[16] The cost of first-time land registration exceeded US$200 per land parcel in many countries. And in 2015 it took twice as long and cost twice as much to complete a subsequent land transfer for registered land in Sub-Saharan Africa as in Organization for Economic Co-operation and Development (OECD) countries (58 days and 8% of the property value versus 22 days and 4%).[17]

More recently, use of systematic and participatory approaches, preceded by campaigns to raise awareness of land rights and combined with low-cost remote sensing and GPS technologies to map land, have expedited the demarcation and registration of individual land rights and improved cost-effectiveness.

Rwanda, for example, completed the demarcation of all individually owned land in the country (11.3 million parcels) and issued more than 8 million title deeds within five years from around 2010 to 2014, at an average cost of US$8 per parcel. Ethiopia has been formalizing land rights in a graduated bi-level approach. It started in the late 1990s with a basic level of agreement on land boundaries, but without mapping them, and issued certificates to millions of landholders, mainly in the five-year period 2002–2006, at less than US$1 per parcel. This initiative

BOX 2.1

Legalizing and registering communal land rights in Mexico, Mozambique, and Tanzania

Mexico. Before the revolution of 1910, land had been expropriated from indigenous communities and concentrated in large estates, or *haciendas*. Although agriculture was booming, the extreme poverty and inequality ultimately sparked the revolution. The first land reform following the revolution took land from the *haciendas* and reallocated it to peasant households, eventually creating 32,000 communal plots (*ejidos)* that covered about 52% of Mexico's land area. Members of the *ejidos* were granted rights over all the land in the community, but they were incomplete rights, mainly use rights, and peasants could not sell, rent, or mortgage the land. After several decades, much of the land was in the hands of older (and less efficient) farmers, making it hard for new generations of farmers to gain access to land.

Partly for this reason, a second land reform, the Program for the Certification of *Ejido* Rights and Titling of Urban Plots (*PROCEDE*), was rolled out in 1992 and completed in 2006. It allowed members of *ejidos* to change their tenure regime from communal to private property if two-thirds of members voted in favor, thus permitting *ejidos* to sell or rent land parcels to outsiders, mortgage it, or enter into joint ventures with outsiders. *Ejidos* could also sell or rent out land use rights on individual agricultural parcels to other members within the community. The program also supported formalization of community groups as land owners, the establishment of community self-governance institutions, and the surveying of land and the registration of communal and individual land rights. When the program ended in 2006, about 100 million hectares of land had been measured and mapped, with 3.5 million households receiving certificates to individual, common-use, or housing land. The program also improved governance: more than 30,000 *ejidos* formalized internal bylaws, with more than 90% electing representatives through a democratic process.

As of 2015, 35% of *ejido* land was held under individual ownership, with 7%–10% entirely out of the control of *ejidos*. The program provided a strong legal basis for numerous contracts and joint ventures between the remaining *ejidos* and entities from outside the communities.

Mozambique. The mechanisms for formalizing customary land rights in Mozambique have largely followed a legal process known as "community land delimitation." The 1997 Land Law defines delimitation as "identification of the boundaries of the areas occupied by local communities, including the entry of the information into the National Land Cadastre." Delimitation identifies the community and the extent of its landholdings, while "sketch maps" show general boundaries agreed on with neighboring communities. As of November 2014, only 427 communities —less than 10% of the country's "rural communities"—had been delimited and given certificates. The cost per unit to delimit and certify a community was US$2,000–US$10,000. Various reviews recommended shifting toward more systematic delimitation, methodical strengthening of the capacities of land administration services, and careful engagement of local institutional actors.

Tanzania. Communal village lands constitute about 70% of Tanzania's land area. Village lands are administered by an elected village council and supervised by its assembly, both constituting the country's lowest administrative unit and replacing traditional institutions of land administration. With support from the World Bank, the surveying and registration of village lands (a requirement before village authorities are allowed to manage the lands) were accelerated in line with the Village Land Act 1999. The act empowers village authorities to determine the use of land, allocate it to village residents, register it, manage common-use land, and engage in transactions with outsiders, including investors. As of 2012, more than 11,000 of about 12,000 villages had had their external boundaries surveyed, and at least 7,000 had registered their land. The average cost of surveying and registration was US$500 per village.

Source: Barnes, Digiano, and Augustinus 2015; Monteiro 2015; Byamugisha 2013.

was followed in 2012 by a still ongoing second level of certification that adds the boundary mapping, at less than US$5 per parcel, and a computer-based system for registering transactions.[18]

A key lesson from both countries is that getting neighbors to agree on boundaries, using a simple low-cost technology, involving stakeholders, and using image maps (that avoid the need for expensive, detailed surveys) to identify boundaries are appropriate, feasible, and cost-effective approaches to formalizing land rights for agricultural land.

Bolstering institutions for resolving land disputes

Registering land rights needs to be accompanied by activities to bolster formal and informal institutions

responsible for resolving land disputes, often through a multifaceted approach. One element includes strengthening judicial systems by increasing their financial and human resources, training judges, addressing case backlogs, creating specialized tribunals, and establishing alternative dispute-resolution forums, notably to make adjudication services accessible and affordable for all landholders.[19] Informal institutions that have traditionally administered land under customary tenure also need to be strengthened, so that they can operate alongside formal institutions. Mexico has done this through its ejidos, and Ghana is doing so by establishing customary land secretariats.[20]

Making access to land easier

Africa's land markets are too weak, narrow, and segmented to provide households and investors with easy access to land to expand and modernize agriculture. Land sales and rental markets exist in East and South Africa and have a long history in West Africa, but they are largely informal and flawed.[21] For example, in Malawi and Zambia, land rental markets exist mainly in land-scarce localities and entail heavy transaction costs.[22] Most land markets are active in areas where land tenure has evolved from communal to individually owned land. For example, in 2005/06 in central Uganda, where land is individually owned, 59% of land acquisitions were made through land market purchases. In the same period in northern Uganda, where land is communally owned, only 6% of land acquisitions were made through land market purchases while 91% occurred through inheritance.[23] In some countries, including Ghana, Mozambique, Malawi, and Zambia, customary law (reinforced by statutory law) prohibits the sale of customary land, although "disguised" sales markets are active. Land rental markets function but are used mainly for short-term leases of fewer than five years.

The slow evolution of land tenure from communal to individual ownership, combined with weak traditional institutions of land administration, have made inheritance virtually the only channel to access farmland, constraining access to abundant communally owned land. For example, in Ghana, a country with a large surplus of nonforested unused arable land, 60% of farm plots are under 1.2 hectares and 85% are under 2 hectares, the minimum size needed to commercialize and move out of poverty.[24] Similarly, while Zambia has more than 10 million hectares of nonforested unused arable land, 50% of farms there are smaller than 2 hectare.[25] In these and other African countries with abundant unused land, land has become scarce for community and noncommunity members alike.

Providing easier access to land for households and investors in Africa requires increasing security and the transferability of communal land rights by empowering and making accountable the land-owning groups, registering their land rights, and developing systems of transferring land. Given the importance of communal land ownership, especially as a social safety net and old-age insurance, rushing through or bypassing the evolutionary process of individualizing ownership and transferring land to noncommunity members may have negative social impacts unless such moves are based on conscientious and participatory choices and weigh the costs and benefits.[26] Such choices and calculations must be made by—or at the least closely involve—strong community land governance institutions, whether informal or formal, acting as custodians and trustees. Yet such strong institutions are now all too rare in Africa, as most of these institutions have been weakened and become less accountable.[27] Where formal institutions have been established, they have rarely met expectations.[28]

Developing local land governance institutions

The key question is what can be done to create or develop appropriate local land governance institutions that can lead the evolutionary process from communal to individual ownership and protect and manage the allocation and transfer of communally owned land? Institutional arrangements vary, but it is increasingly recognized that if a new land governance institution is created to be a trustee for its community members, it should have by-laws approximating customary tenure rules to govern land relations and transactions with outside members. Further, the by-laws should prevent the concentration of power, provide for checks and balances, be transparent and consistent with democratic values (as is the case in Mexico and Tanzania), and be amended only by a qualified majority, as in Mexico's *ejidos*.[29]

A review of reforms of customary tenure institutions suggests that in much of Africa the most common approach is to legally recognize customary land tenure and to either legally empower customary tenure institutions to continue administering land according to customary practice with a high degree of autonomy, or with some degree of control by the state to replace customary authorities with formal ones (box 2.2). For example, Botswana, South Africa, Tanzania, and Uganda have replaced traditional authorities as decision making bodies with state-sanctioned formal administrative bodies—decentralized land boards

Improving access to land

DEVELOPING LOCAL LAND GOVERNANCE INSTITUTIONS

EASING RESTRICTIONS ON LAND RENTAL MARKETS

BRINGING IDLE LAND INTO USE

in Botswana and Uganda, community land administration committees in South Africa, and village councils in Tanzania. These new formal bodies make decisions on land allocation, cancellation of allocations, registration, and transfers; they also resolve land disputes.

In contrast, Ghana and Mozambique have empowered customary governance institutions to continue administering land according to customary practice with full autonomy, primarily to allocate land and cancel allocations, while land registration is assigned to state-appointed bodies. The traditional authorities in Ghana also initiate planning schemes (a requirement before land can be registered), collect and share land revenue with the community, and resolve land disputes,[30] as do those in Mozambique and Namibia.[31] In Namibia, traditional land governance authorities have been empowered to continue administering land according to customary practice, as in Ghana and Mozambique, but their land allocation and cancellation decisions are subject to approval by state-appointed community land boards.

Whether state-sanctioned or traditional, local institutions of communal land governance in Africa lack the capacity and resources to properly register communally owned land and manage land transfers, especially rentals and long-term leases.[32] Beyond remedying those shortfalls, it is important to learn from global and African experiences.

When it comes to developing capacity for registering communal land, experience in Mexico and Tanzania suggests that demarcating external boundaries of communally owned land and registering associated rights are cost-effectively feasible if new remote sensing and GPS technologies are used (see box 2.1). After registering community rights, which protects against claims or encroachment by neighboring communities and other outsiders, communities can take the time needed to demarcate and register individualized parcels within these external boundaries. The process of registering individual rights is more costly as it involves more plots and may require more detailed surveying. Mozambique and Tanzania followed the surveying and registration approach that prioritizes external boundaries over internal individualized plots, while Mexico undertook both demarcation of external boundaries of communally owned land and registration of individual parcels.

Unlike first-time registration, which only needs to be done once, land allocation, transfers, and registration or certification are recurring activities that require long-term capacity. Experiences in many countries suggest that these activities need to be carried out at the community level and often at higher statutory levels as well. For example, in Ghana, Mexico, and Namibia, short-term allocations, long-term leases, and transfers are carried out or endorsed by traditional authorities at the community level but are registered by higher level statutory bodies (box 2.3). This requires capacity development for both traditional authorities at the community level, as in

BOX 2.2

Two models of local institutions to govern communal land in Africa

Most of Africa has followed one of two common institutional models to govern customary land. Botswana aside, the performance of these institutional models has been inadequate, primarily because of lack of capacity and operational resources.

Model 1: Empowering traditional institutions to continue administering land according to customary practice: Ghana, Mozambique, and Namibia

In Ghana and Mozambique, traditional authorities have been empowered to continue administering land and manage natural resources under customary practice. They allocate land to community members, consent to its registration, and issue long-term leases to investors. Similar powers have been given to traditional authorities in Namibia, but their decisions have to be approved by state-appointed bodies.

In Ghana, traditional authorities vary but are of two main types: the "stool or skin" land ownership system with chiefs, and the family or clan system (*tendamba)*. The 1992 constitution recognizes these authorities as trustees, and their functions include allocating land to community members and investors and initiating the planning required before land is registered. But with limited capacity and funding, their performance has been inadequate, and there are questions of accountability and transparency, especially in a context of rising land values and demand for land from investors. Thirty-seven customary land secretariats have been established to bolster capacity, but they need more technical support and regulatory oversight.

In Mozambique, governance of customary land relies on communities of self-selected groups acting under by-laws that attempt to capture the prevailing customary tenure. Organizing and formalizing these communities and delimiting their land have been very slow, reflecting lack of capacity and resources.

In Namibia, traditional land governance authorities have been empowered to continue administering land under customary practice, but their decisions are subject to approval by state-appointed communal land boards. Their performance has been impeded by inadequate capacity (notably lack of legal knowledge) and shortage of resources.

Model 2: Replacing traditional with formal institutions in decisionmaking: Botswana, South Africa, Tanzania, and Uganda

New state-sanctioned formal administrative bodies are responsible for approving land use, allocation, and registration. Botswana's land boards, among the oldest of the formal land governance institutions in Africa, started off slowly as they built capacity. They have become perhaps the best performing in Africa, yet they still face challenges of inadequate operational budgets. Tanzania's village councils have completed the surveying and registration of community/village land, but lack of capacity and operational budgets have impeded registering individually owned land. South Africa's community land administration committees have been slow to become fully established, given the politics surrounding the role of unelected tribal leaders in land governance, and have had little impact on governance of customary lands. Perhaps the least effective land governance institutions are those of Uganda, which are only partially constituted and have done little to register communally and individually owned land or to resolve land disputes, largely because of inadequate funding and frictions between traditional authorities and the formal land institutions.

Source: Knox et al. 2012, Biitir and Nara 2016, and Monteiro 2015.

Ghana following the establishment of 37 customary land secretariats,[33] and for statutory bodies, as has been tried in Ghana, Mexico, and Namibia. For countries where responsibilities for land allocation, registration, and transfer have been assigned to state-appointed bodies, including Botswana and Fiji capacity development has to be at higher than the community level.

Easing restrictions on land rental markets

Even where land ownership has evolved from communal to individual tenure and land markets exist, markets face constraints that make access to land difficult and costly. For example, land rental markets face restrictions in Ethiopia, ostensibly to protect smallholders from being dispossessed, and in Uganda, to protect tenants from high rents and eviction. But in Ethiopia, in places where restrictions on land rentals were loosened, rentals increased, land access eased for the land-poor, and productivity climbed sharply.[34] But in Uganda, where restrictions were imposed or tightened, land rental activities diminished, with adverse impacts on the land-poor and on agricultural productivity.[35]

Global experience, especially in China and Vietnam, reinforces the findings from Ethiopia and Uganda and

suggests that removing such restrictions as rent ceilings and limits on lease duration has a significant and positive impact on accessibility to land (especially by the land-poor and emerging commercial farmers) and on productivity. It also provides rental incomes to less-productive farmers and helps them seek more rewarding opportunities in off-farm sectors.[36]

Improving land information systems

Liberalizing land sales and rental markets may not be enough to ensure that land markets work efficiently, however, given high transaction costs—remember that it takes twice as long and costs twice as much to transfer land in Africa as in OECD countries. In addition, and more opaquely, there is the heavy cost of bribes, which are widespread. In Kenya and Uganda, bribes may be as high as US$100 per land administration transaction.[37] Hence, the need is to ensure that the government, in enabling land transactions through registration, is more transparent and efficient. One key intervention is to computerize land records (box 2.4).

Even with paper-based systems, streamlining administrative measures can yield some efficiency gains. In Thailand, for example, streamlining has reduced the duration of property transfers to one day.[38] Streamlining administrative measures can also reduce corruption, as demonstrated in Karnataka, India, which saved users of land administration services an estimated US$16 million in bribes annually after the state computerized its land records.[39]

Bringing idle land into use

When land remains idle and functions merely as a highly illiquid form of savings, that impedes the development of land markets and access to agricultural land, especially considering the paucity of savings instruments in Africa. One outcome is speculative buying and the accumulation of idle agricultural land. To discourage this practice, a few African countries including Namibia, Rwanda, and South Africa have joined others outside Africa (such as Brazil, Colombia, Jamaica, Japan, St. Lucia, and the United States) in imposing taxes on agricultural land to encourage landowners to use it productively, sell it, or rent it to others.[40]

Speculative land is not the only idle land. Especially in land-abundant countries, much more land remains idle because of inaccessibility to input and output markets.[41] In Zambia, for example, most of the farmed land is near railway lines, highways, and townships, and the rest of the arable land is sparsely used. To provide infrastructure at least cost to encourage bringing this other land into production, Zambia has adopted an agricultural investment strategy of prioritizing critical infrastructure and other agricultural services in areas with at least 10 farm "blocks," each averaging about 200,000 hectares of high-potential agricultural land.[42] Similarly, Burkina Faso is investing in critical infrastructure and other agricultural services using a World Bank–funded US$133 million Bagre Growth Pole Project to bring into agricultural production large chunks of idle land in an isolated region.[43] These and other experiences suggest that idle lands can be brought into productive use by prioritizing them for investment in critical infrastructure and other agricultural-related services.

The existence of state land that is used unproductively or poorly allocated further reduces access to land for agricultural modernization. Government-owned land in Africa is substantial and in some cases is the most productive part of agricultural land. For example, in Botswana, the state owns 25% of the total land area, against 5% for freehold and 70% for customary land. As agricultural land has become increasingly scarce, some African countries are realizing that state land can be used more productively if allocated to the land-poor or to investors.[44] Ghana, for instance, undertook inventory of state-land

BOX 2.3

Developing land rental markets for communal lands in Botswana

In Botswana, customary land and the power to allocate and lease it are vested in decentralized land boards as trustees, away from chiefs and headmen, and remain vested in them until the land is allocated. Until 1993, entitlement to land allocation was limited to tribesmen in line with customary law; it has since been opened up to all Batswana citizens, including women.

Allocations of customary rights to arable and residential land have to be evidenced by a "customary land grant certificate," which grants exclusive, perpetual, and heritable use rights that are transferrable if the land is developed for the intended purpose. But acquiring a transfer right, as well as a mortgage right, requires converting tenure to a common-law lease, which can be granted on customary land by land boards (to Batswanans and foreigners). Leases are for 99 years for residential purposes and for 50 years for industrial and commercial purposes with a 50-year renewal option. The land boards also issue short-term leases of up to five years. These long- and short-term leases are transferable.

Botswana's land reforms are regarded as among Africa's most successful for introducing good land governance, though as elsewhere, the land boards face capacity weaknesses.

Source: Byamugisha 2013, World Bank 2011, and Knox et al. 2012.

BOX 2.4

How technology is improving land administration: Uganda's Land Information System

In 2005, Uganda began to modernize the way it administered land. A core component is the computerized Land Information System (LIS), planned for two phases. First, during a three-year pilot in 2010–2013 in six zonal offices, which held about 70% of registered land titles, the LIS was implemented along with a legal review and a program to rehabilitate land offices, to re-engineer business processes and work-flows, and to build institutional capacities. This pilot phase became fully operational in March 2013. The roll-out phase, which began in 2015, extended the LIS to 21 zonal offices. Coverage was extended to physical planning and evaluation. This second phase will also set up electronic links between land administration services and strategic clients and partners, including banks and real estate agents.

While it is still too early to draw comprehensive conclusions on the long-term impacts, in the short term, LIS has achieved several gains:

- *Quick land registration.* For all zonal offices, the average time decreased from 227 days in 2007 to 27 days in 2015/16. In the most efficient zonal office, Masaka, it fell to eight days. Even in the least efficient zonal office, Wakiso, it fell to 34 days, which was still much better than the 57-day average for Sub-Saharan Africa.
- *Decreases in search time.* The average time for verification of land ownership and encumbrances on the title fell from 50 days to 9 days in Mbarara zonal office and to 38 days in the worst-performing office, again, Wakiso.
- *Decreases in mortgage processing time.* The average time to process a bank mortgage fell from more than 50 days to 5 days in Mbarara, and to 35 days in the worst-performing zonal office (Wakiso once more).
- *Increases in annual revenue from land transaction fees.* Annual revenue rose from US$8 million in 2012/13 to US$102 million in 2015/16.

At the completion of the roll-out phase in 2018, it is expected that the time to complete land and mortgage registration and searches will fall to one day, further boosting land-related revenue because the valuation function will be fully computerized.

Source: Uganda Ministry of Lands, Housing, and Urban Development 2016.

in 2003–2010 covering 63% of state land as a basis for developing a policy to return land taken from communities and to improve management of the remaining state lands. After a partial inventory, however, only short-term policy guidelines were developed; a comprehensive policy will be developed after the inventory has been extended to cover all state lands.[45]

Malawi piloted a land reform program in 2004–2011 that redistributed to more than 15,000 rural families more than 20,000 hectares of an estimated 2.4 million hectares of agricultural government leasehold land that is greatly underused.[46] Tanzania, since about 2012, has moved to allocate unused land, including state land (under public institutions and state farms), to agricultural investors under a multistakeholder partnership called the Southern Agricultural Corridor of Tanzania (but the initiative has been hampered by encroachments on state land by land-poor Tanzanians).[47]

Despite a growing willingness to allocate underused state land for productive use, mechanisms are not always in place to allocate it transparently and competitively. For example, Uganda does not have a law to guide the divestiture of state land, and only recently has the Uganda Land Commission started an inventory to verify the occupation status of its land. Global experience suggests that to put unused state land into more productive use, African countries will have to set up transparent and competitive mechanisms for allocating the land to the land-poor and investors.[48]

Protecting the rights of local communities and enhancing women's land rights

Opening communal lands to investors could be good for agricultural productivity, but it cannot be sustained and will not modernize agriculture without the participation of local communities and the protection of their land rights. Some local communities have been dispossessed by investors—sometimes with the connivance of traditional land authorities and of governments—especially since the global surge in commodity prices and investor interest in land for large-scale agriculture.[49] The outcome is not beneficial to local communities or to investors, who are exposed to political and economic risks.

Action is thus needed to protect smallholders and local communities from dispossession by large actors in the land markets and to generally promote principles for responsible agricultural investment.[50] Such actions could include:

- Strengthening rural land use planning to identify surplus agricultural land that can be allocated to investors without displacing local people (as in Mozambique).[51]
- Encouraging direct deals between investors and landowners (as in Mexico) while discouraging expropriation, which often provides too little compensation.[52]
- Promoting business models that provide opportunities for smallholders working on their land as alternatives to large, land-based productive investments that require land acquisition with risks of dispossessing landholders. These models include contract farming, lease and management contracts, joint ventures, and small farmer group–owned businesses (cooperatives, associations, and trusts).[53]

Women are often locked out of land ownership by customary laws and yet are key subsistence producers. Thus, actions to promote land tenure security and access to land will be neither complete nor effective without revamping customary laws and taking other actions to enhance gender equality (see chapter 8). While many African countries have new laws recognizing gender equality, implementation is weak, especially in the face of customary practices, which nearly always discriminate against women. Relying on land markets alone has not provided women with enough access to and control over land.

Some countries, however, have made progress, including Ethiopia and Rwanda. These countries have undertaken legal and administrative reforms to support gender equality not only in their constitutions but also in land-related laws and in laws governing marriage, divorce, and succession. Nationwide programs to regularize and certify land tenure have been structured and implemented in ways that ensure adequate representation of women. Impact evaluation studies in the two countries show that the interventions increased access to land and land tenure security for married women and had positive impacts on productivity.[54]

Conclusion and policy considerations

To realize Africa's comparative advantage in agriculture, at least three land-related conditions need to be in place:

- Secure land ownership and use to motivate farmers to invest in their farms and to enable use of their land as collateral for investment loans.
- Ease access to land for African small farmers and the emerging class of modern commercial farmers.
- Protect land rights of local communities in communal lands newly opened to investors.

Meeting these three conditions requires critical land policy actions. First, securing land rights requires the following policy actions:

- Improving tenure security over communal lands by organizing and formalizing communal land-owning groups, demarcating the boundaries of their land, and registering it, as Mexico has done.
- Improving tenure security over individually owned land by undertaking systematic land titling, using simple low-cost mapping technologies, as Rwanda and Ethiopia have done.
- Strengthening formal and traditional institutions responsible for resolving land disputes.
- Enhancing and protecting the land rights of women by undertaking legal and administrative reforms to support gender equality in constitutions, in land-related laws, and in the laws that govern marriage, divorce, and succession, as Rwanda and Ethiopia have done.

Second, easing access to land requires the following policy actions in:

- Developing local land governance institutions to improve the allocation and leasing of communal lands, as Botswana has done.
- Easing restrictions on land rental markets, as Ethiopia is doing, following the footsteps of countries like China and Vietnam.
- Improving land information systems through re-engineering and computerization, as Mauritius, Rwanda, and Uganda have done.
- Bringing idle land into use through policy actions including taxing unused agricultural land to encourage land owners to use, sell, or rent it, developing transport infrastructure to open up inaccessible agricultural lands, and improving mechanisms for allocating unused state land for productive use.

Third, protecting the land rights of local communities from dispossession by large investors and generally promoting principles for responsible agricultural investment requires policy actions in the following:

- Strengthening rural land use planning to identify surplus agricultural land for investors to avoid displacement of local people, as Mozambique has done.
- Encouraging direct deals between investors and landowners, as Mexico has done while discouraging expropriation, which often provides too little compensation.
- Promoting business models that provide opportunities for smallholders to invest in their land as alternatives to encouraging large farm investments, which require land acquisition with risks of dispossessing landholders.

Notes

1. Leke et al. 2010.
2. Deininger et al. 2011.
3. For China, see Deininger and Jin (2007); for Republic of Korea and Taiwan, see Studwell (2013); for Vietnam, see Deininger and Jin (2003).
4. For the share of land disputes, see World Bank (2015a); for production losses, see Deininger and Castagnini (2004).
5. For figures on land disputes in Ethiopia, see Deininger, Selod, and Burns (2012); for Ghana, see Ghana Judicial Service (2010).
6. Examples include Ghana (Yeboah 2014), Ethiopia (Keeley et al. 2014), Mozambique, Tanzania and Zambia (German, Schoneveld, and Mwangi 2013) and Uganda (Atkinson and Owor 2013).
7. Petracco and Pender 2009. For the impact of tenure and registration on credit, see Deininger and Feder (2009) and Sanjak (2012).
8. Peters 2004.
9. Jansen and Roquas 1998.
10. Barnes, Digiano, and Augustinus 2015.
11. USAID n.d.
12. de Janvry et al. 2015.
13. Barnes, Digiano, and Augustinus 2015.
14. For initiatives in Mozambique, see Monteiro (2015); for Tanzania, see Byamugisha (2013).
15. Byamugisha 2013.
16. Deininger, Hilhorst, and Songwe 2014.
17. World Bank 2015b.
18. AU, AfDB, and UNECA 2015.
19. Byamugisha 2013.
20. For Mexico, see Barnes, Digiano, and Augustinus (2015). For Ghana, see Biitir and Nara (2016).
21. For East and Southern Africa, see Holden, Otsuka, and Place (2008); for West Africa, see Amanor and Diderutuah (2001).
22. Chamberlin and Ricker-Gilbert 2014.
23. World Bank 2015a.
24. Owusu-Baah 2014.
25. For the size of unused land, see Jayne, Chamberlin, and Headey (2014); for percentage of farms below two hectares, see Chamberlin and Ricker-Gilbert (2014).
26. Deininger, Hilhorst, and Songwe 2014.
27. Bruce and Knox 2009.
28. Bruce 2013.
29. Byamugisha 2013; Bruce 2013.
30. Biitir and Nara 2016.
31. Knox et al. 2012
32. Knox et al. 2012; Bruce 2013.
33. Biitir and Nara 2016.
34. Holden and Otsuka 2014.
35. Byamugisha 2014.
36. For China, see Deininger and Jin (2007); for Vietnam, see Deininger and Jin (2003).
37. For Kenya, see Transparency International Kenya (2012); and for Uganda, Transparency International Uganda (2013).
38. World Bank 2015b.
39. Deininger 2008.
40. Childress et al. 2009.
41. Chamberlin, Jayne, and Headey 2014.
42. NEPAD and OECD Investment Initiative 2011.
43. World Bank 2011.
44. For land scarcity, see Jayne, Chamberlin, and Headey (2014).
45. For state land inventories in Ghana, see Ahene and Byamugisha (2014).
46. For land redistribution in Malawi, see Tchale (2014).
47. World Bank 2016.
48. Deininger 2003.
49. Cotula 2013.
50. The principles were published in 2012 by the Committee on World Food Safety under the auspices of FAO.
51. German, Schoneveld, and Mwangi 2013.
52. For Mexico's experience, see Deininger, Hilhorst, and Songwe (2014); for expropriation and compensation, see Byamugisha (2013).
53. For a detailed discussion, see Vermeulen and Cotula (2010).
54. For Ethiopia, see Deininger, Ali, and Alemu (2011); for Rwanda, see Ali, Deininger, and Goldstein (2011).

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CHAPTER 3

Boosting Agricultural Productivity

Productivity is a key determinant of agricultural transformation. With higher productivity, farmers can grow enough food not only to feed their household members but also to sell surpluses and acquire cash to diversify their diets and satisfy their nonfood needs. As productivity rises, farm households accumulate assets and become confident enough to release household labor to both value-added agricultural activities and nonagricultural productive activities, further diversifying and increasing household income. Higher productivity will also generate surpluses to be used as cheap raw material to support a competitive industrial sector through agroprocessing. Further, food surpluses can lower food prices and the cost of living, thereby increasing the disposable income of nonfood producers and moderating wage increases to enhance the global competitiveness of African countries in labor-intensive manufacturing.

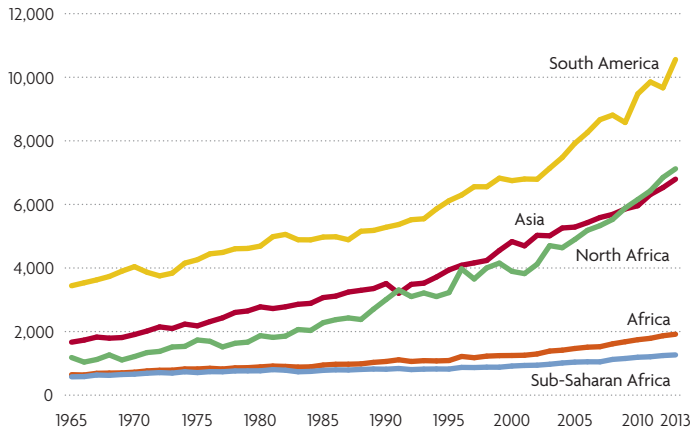
Agricultural productivity in Africa, both labor and land productivity, lags behind that in Asia, and South America (figure 3.1). But Africa's poor showing primarily reflects the poor productivity levels in Sub-Saharan Africa, as productivity levels in North Africa are comparable to the other regions.

Looking at land productivity by crop types (output per hectare or yields) provides further insights into Africa's performance relative to that in South America and Asia (figure 3.2). Although productivity levels in Africa did not lag far behind these two regions in the 1960s (except for roots and tubers), the gap widened over the period to 2013, and Africa fell much farther behind as productivity grew faster in South America and Southeast Asia. The differential productivity gains were particularly marked for cereals, reflecting the fact that the green revolution in agricultural technology by-passed Africa. But there are wide variations among sub-regions in Africa (figure 3.3). For cereals, yields in Southern Africa, around 4000 kg/ha, are comparable to those in South America and Asia, while those in West Africa are only about one-fourth. For roots and tubers and for vegetables, yields in North Africa exceed those in South America and Asia, whereas yields for roots and tubers in East Africa are about one-fourth and yields of vegetables in Middle Africa are about one-fifth those of North Africa.

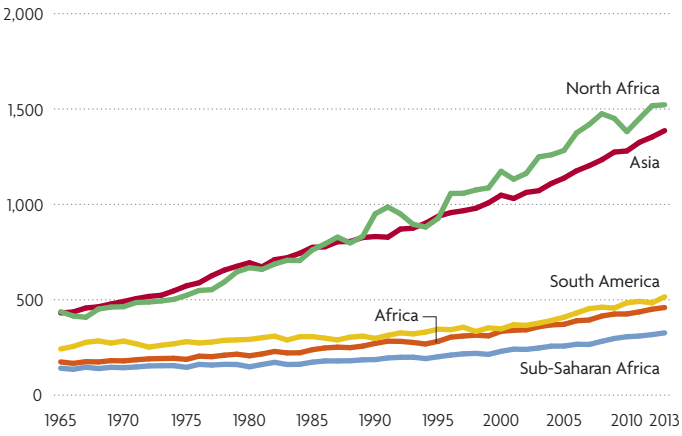
FIGURE 3.1

Productivity comparisons across global regions and African subregions, 1990–2011

Labor productivity (value of gross production per economically active person in agriculture), constant 2004–06 US$



Land productivity (value of gross production per hectare of agricultural land), constant 2004–06 US$

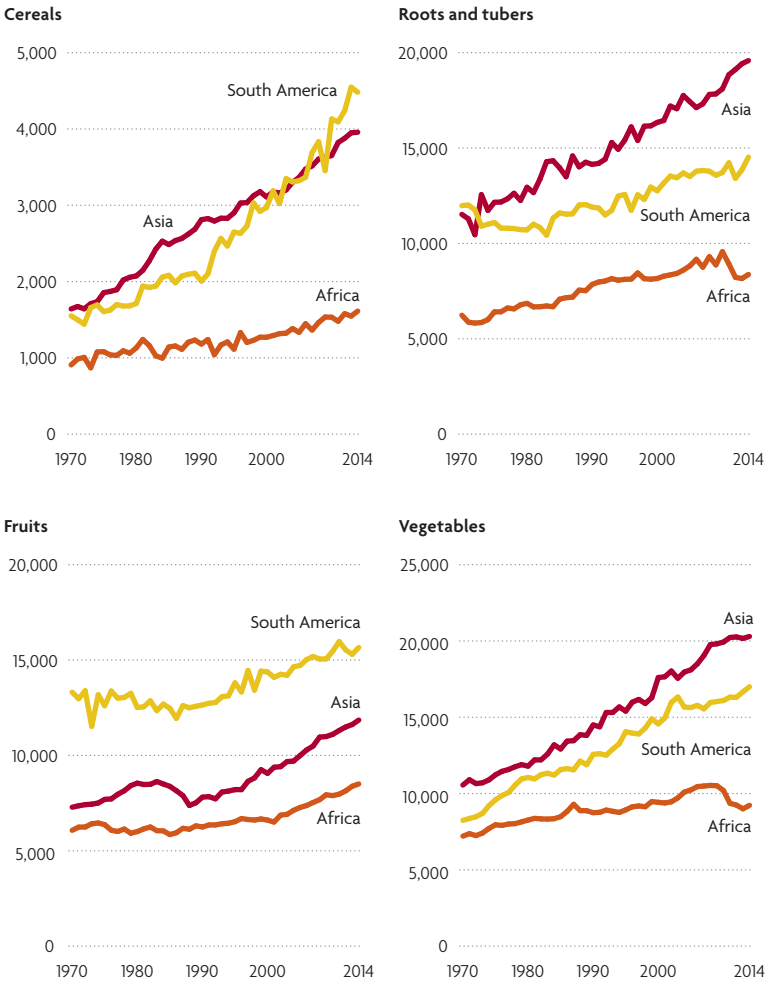


Source: IFPRI 2016.

FIGURE 3.2

Yield comparisons for Africa, South America, and Asia, 1961–2014

Kilograms per hectare



Source: Based on data from FAOSTAT online.

The green revolution that raised agricultural productivity in Asia and Latin America, particularly in wheat, rice, and maize, was based largely on the use of a yield-increasing package that included improved seeds, fertilizers, irrigation, and farm management techniques developed through research and transferred to farmers through agricultural outreach. Indeed, where this package of inputs has been adequately available in Africa, yields have risen.[1] For example, in the Kpong irrigation area in the Volta River region of Ghana, a combination of irrigation, improved seeds, fertilizer, power tilling, and extension services have boosted average dry paddy rice yields to 5.5 tons per hectare, comparable to irrigated rice yields in Asia and much higher than in the rest of Ghana.[2] Yields are similar in the Nakhlet Small-Scale Irrigation Scheme on the northern bank of the Senegal River in Mauritania.[3] Other examples are in Senegal and Tanzania, where irrigation and improved seeds and farming practices have pused yields to around 4.5 and 3.7 tons per hectare respectively, comparable to the average yield of 4.0 tons in tropical Asia. Even under rainfed conditions, significant improvement in yields have been attained in some areas in Ghana and Uganda with the adoption of improved rice seed varieties and farm practices. High yields in maize have also been attained in the highlands of Kenya with the adoption of hybrid varieties, and the application of inorganic fertilizer and manure in a mixed crop-cattle farming system. Further, maize yields are very high in South Africa, and as yields in general are higher in North Africa compared to Sub-Saharan Africa, so there is scope for intraregional learning among African countries in pursuing the "green revolution" agenda.[4]

This chapter reviews Africa's experience with these productivity-boosting packages and explores the key challenges. It also examines mechanization, which can increase production through both productivity increases and area expansion.

The productivity-raising agricultural package

The primary components of the green revolution package for raising agricultural productivity are improved seed varieties, fertilizers, irrigation and access to water, and farmers' knowledge of improved management practices. The main component is new seed varieties, but if any of these complementary elements is missing, profitability suffers and farmers are less inclined to adopt improved seeds. This is the situation in many African countries where farmers face challenges in acquiring not only improved seeds, but also the other components of the package.

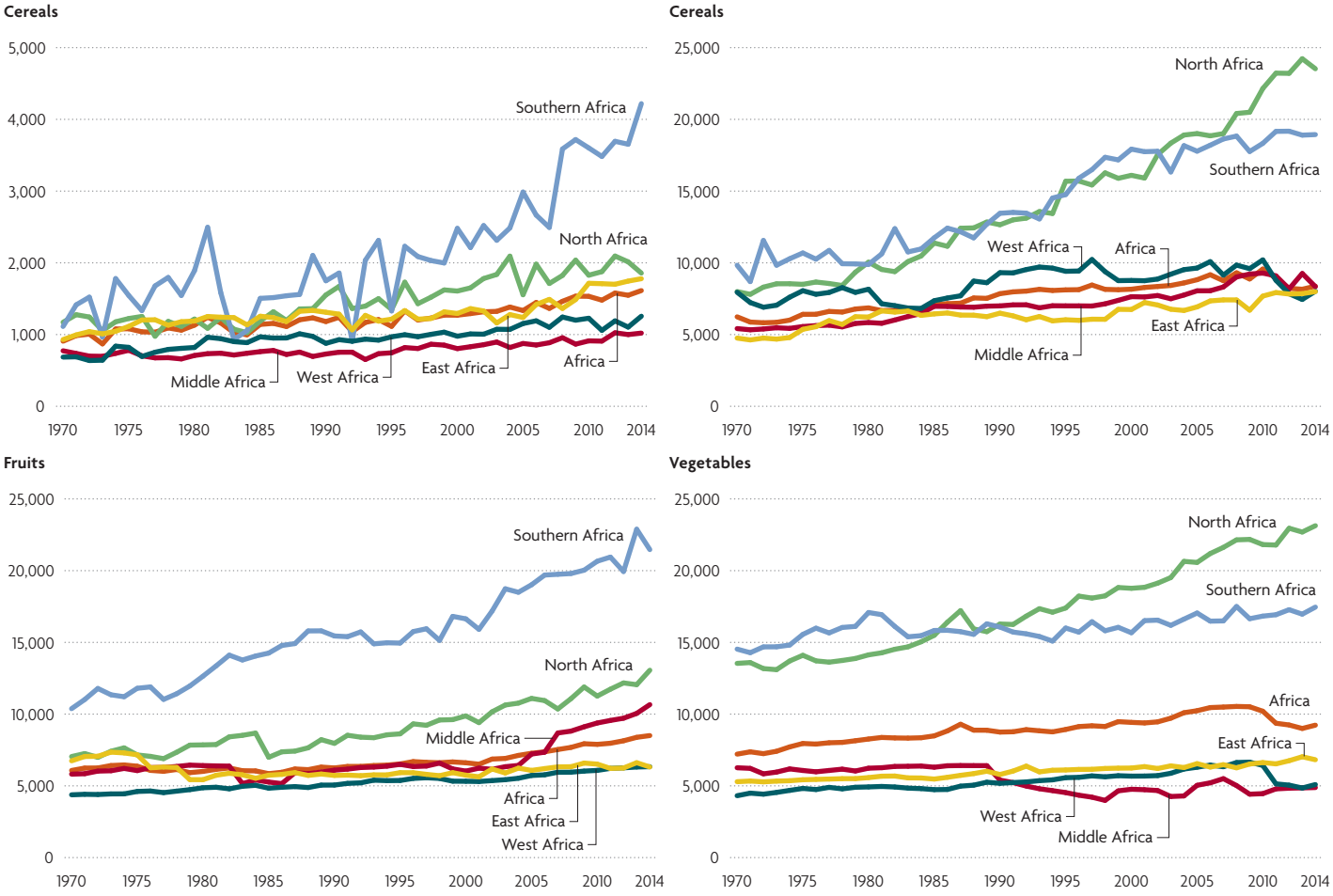
Planting improved crop varieties

Consistent with a 2003 study that found greater agricultural intensification (raising inputs to increase output) for export crops than for other crops,[5] adoption of improved seed varieties is generally higher for export crops (such as cocoa, cotton, and tea) than for staple food crops (such as cassava, maize, and rice). During 2001–2005, adoption rates of improved varieties were 44% for tea and 31% for cotton, or almost twice the average adoption rate for nonexport crops. Only about 24% of cereal cropland in Sub-Saharan Africa is planted

FIGURE 3.3

Yield comparisons in Africa, by subregion 1970–2014

Kilograms per hectare



Source: Constructed using data from FAOSTAT online, accessed June 22, 2017.

in improved crop varieties.[6] Of food crops, maize has the highest adoption rate (40%), followed by rice (34%) and beans (28%). Much of this difference in adoption rates between export and food crops reflects differences in the value chain structures that provide production, processing, and marketing support to farmers.

In recent years, however, adoption rates of nonexport crops have been catching up to those of export crops (figure 3.4). Contributing factors include improved access to fertilizers through subsidy programs and to high-yielding seeds through regional programs such the Program for Africa Seed System, which has been implemented in about 20 countries by the Alliance for Green Revolution in Africa (AGRA), an agricultural alliance that seeks uniquely African solutions to sustainably boost agricultural production.

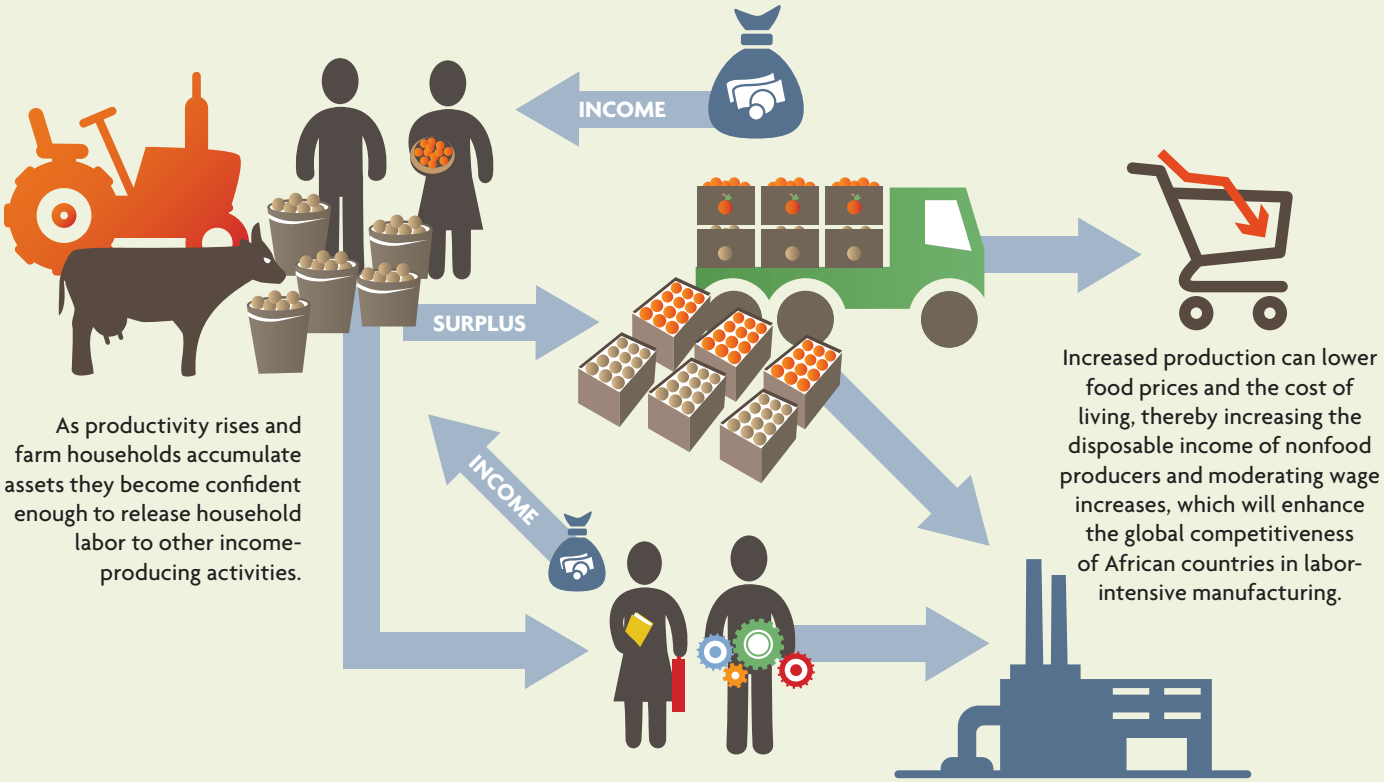
Improving farmers' access to improved seeds

Numerous varieties of modern seeds have been released in Africa over the past 10 years. For example, between 2007 and 2014, AGRA facilitated the release of 464 new and improved varieties of 15 important crop species, 312 of which are now commercially produced and available for sale to African farmers (figure 3.5).[7] Among the countries where AGRA has promoted and facilitated adoption of these modern varieties are Ghana, Liberia, Mali, Niger, Nigeria, and Sierra Leone in West Africa; Ethiopia, Kenya, Rwanda, South Sudan, Tanzania, and Uganda

Boosting productivity on farms

A key to achieving agricultural transformation on the continent is raising productivity levels on African farms.

With higher productivity, farmers can increase production and incomes and thereby reduce poverty among close to half of the African population that depend on farming.



A key part of the challenge of boosting productivity on African farms lies in making the green revolution package adequately accessible to African farmers and tailored to local conditions.

in East Africa; and Malawi, Mozambique, and Zambia in Southern Africa.

However, adoption of improved varieties remains low (see figure 3.4). One reason is that improved varieties are hybrids, so seeds must be purchased each season (saving seeds, which is common practice with traditional varieties, does not work with hybrids since the seeds will not produce true in the next season). Improved varieties also demand more fertilizer, adding to production costs for financially and credit constrained smallholder farmers and thus reducing their incentive to use them. Consequently, breeders of superior varieties do not see Africa as a strong potential market unless the seeds are subsidized. But even where subsidies are available, farmers may lack information about complementary improved management practices because of weak extension services. These setbacks are further exacerbated by a hybrid seed multiplication system that undermines local knowledge and preferences. Improved seeds are not always higher yielding than existing varieties or do not satisfy farmers' other criteria for taste, storability, maturity, and so on. An ongoing study lead by Tavneet Suri found that adoption of the higher yielding New Africa Rice (NERICA) in Sierra Leone did not come about because of its higher yield potential. The key to adoption was NERICA rice's early maturity, which allowed adopters to reduce the hunger season by 30 days.[8]

One way to make improved food crop varieties more accessible to smallholder farmers is to involve and organize the many actors along the value chain—from production to processing and marketing—to support farmers, as is done for most export and cash crops. One example is the Masara N'arziki Farmers Association (MAFA) agreement with Weinco, an input importer in northern Ghana (box 3.1). This and similar models can be replicated and enhanced in other parts of Sub-Saharan Africa.

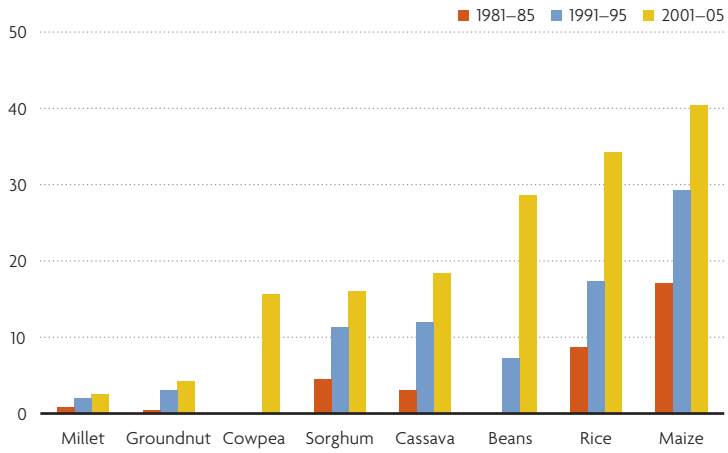
Other parts of an enabling environment are also important. One is a seed policy that provides clear guidance and facilitate importation and registration of hybrid seeds (box 3.2).

Another is the existence of large, strong, and well-organized farmer-based organizations that can organize more efficient procurement of inputs and sale of outputs for members, and that can reduce sales contract violations by its members. Stable exchange rates are needed to enable seed and fertilizer importers to maintain their imports and to lend money to farmers in the local currency to purchase inputs, without fear of losses due to large exchange rate fluctuations. Finally, public policies need to be predictable so that everyone along the value chain can plan with confidence and reduce their risks. For example, Weinco's contractual arrangement with MAFA was threatened recently when Ghana, facing an economic crisis, experienced a sharp depreciation in the exchange rate and abruptly interrupted the fertilizer subsidy program without an official announcement.

FIGURE 3.4

Trends in adoption rates of improved varieties of major food crops in Sub-Saharan Africa, 1981–2005

Adoption rate (percent)

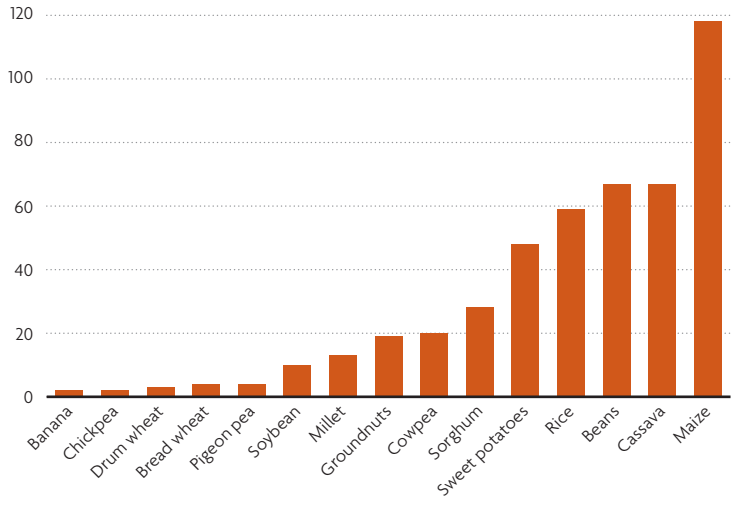


Source: Based on data from DIIVA database: http://www.asti.cgiar.org/diiva.

FIGURE 3.5

Modern seed varieties released by AGRA, 2007–2014

Number of seed varieties



Source: Based on data from AGRA (2015).

BOX 3.1

Agricultural contract agreement between the Masara N'arziki Farmers Association and agricultural input importer Weinco

Weinco, an agricultural input importer, sells superior quality maize seeds (Pioneer 30Y87) and other inputs to gender-based farmer organizations under the Masara N'arziki Farmers Association (MAFA), agreeing to buy their output at harvest at a price agreed to before harvest. The improved maize seed sold to MAFA farmers consistently yields 50%–100% higher output than the open-pollinated local modern variety and consistently brings higher profits. But its higher cost and fertilizer requirements make it difficult for independent smallholders to adopt. The guaranteed market and fertilizer credits offered at the beginning of the season through contractual agreement have allowed smallholder maize producers in northern Ghana to adopt Pioneer 30Y87. In addition to the guaranteed market, MAFA members receive extension services to improve productivity and adopt environment-friendly production practices that reduce the soil depletion associated with planting more seeds per hectare. After buying the maize from the farmers, Weinco sells it to large processors such as Premium Foods (a Nestle supplier) or large buyers such as the World Food Programme, with which it has a long-term procurement agreement.

Source: Authors' field observations.

BOX 3.2

Reduce the barriers to disseminating improved seeds

Current requirements for lengthy and expensive tests to register new seed varieties (imported or domestic) in many African countries practically guarantee that African farmers will not benefit from advances in other parts of the world or from private domestic R&D.

These barriers could be reduced by following the practices in such countries as India and South Africa, which allow the introduction of new varieties with no performance testing but which require truth in labeling to protect farmers from false claims (Gisselquist, Nash, and Pray 2002). This has been particularly effective in South Africa, where farmers benefit from a much higher rate of introducing new varieties than in other African countries, even accounting for the size of the market. Barriers can at least be lowered by mutual recognition of new varieties already registered in neighboring countries, the approach of the European Union (EU). This approach is being pursued in several regional regulatory frameworks in Africa, but progress has been slow. The two approaches are not mutually exclusive and countries could potentially consider unilateral action to reduce barriers while waiting for regional agreements to take shape (Keyser 2013).

Source: Goyal and Nash 2016.

Farmers who had factored the subsidy into their farm budgets were forced to plant late, reducing yields.

Kenya encourages farmers' use of improved seeds by supporting the development and strengthening of agro-dealers in rural communities. In recent years, input distribution has been transformed from a largely public system to a more liberalized system in which private, independent, agro-dealers have taken the lead. AGRA's Program for Africa Seed System has initiated and supported the Agro-dealer Development Programme (ADDP), which provides training, capital, and credit to build and develop networks of certified agro-dealers to enhance the quality, quantity, and range of seeds offered to hard-to-reach farmers. While the ADDP has improved access to improved seeds, the model has faced challenges. An analysis concluded that it fails to consider the heterogeneity of the smallholder farming population that the agro-dealers must serve and the diversity of agro-ecological and business environments in which they must operate.[9] Another challenge is that as many as half the agro-dealers are unavailable to answer technical queries from customers because selling agricultural products is not their only income earning activity.

Increasing the availability and use of fertilizers

To increase yields, improved seeds require proper fertilizer application. Inadequate fertilizer use lowers yields and profits, discouraging future adoption of improved seeds and fertilizers. More than half the productivity gains of the green revolution in Asia are estimated to derive from the increased use of inorganic fertilizers,[10] signaling the importance of fertilizer for boosting productivity in Sub-Saharan Africa.[11]

Although fertilizer use in Sub-Saharan Africa is low, it is probably higher than is generally acknowledged,

and there is wide variation among countries. Among six countries studied by Sheahan and Barrett, two of them (Malawi and Nigeria) had fertilizer usage levels comparable to the average in Latin America (table 3.1).[12] Both countries have government input subsidy programs. In Ethiopia, another country with a relatively high level of usage, the government sets and subsidizes fertilizer prices but does not consider it a formal subsidy program (table 3.1).[13] On average, 35% of cultivating households in the six countries use some inorganic fertilizer in the main growing season, including 77% of cultivating households in Malawi, 56% in Ethiopia, and 41% in Nigeria. Studies find a significant and positive correlation between the amount of fertilizer used and yield in Malawi.[14]

Cost is a major deterrent to increasing the use of fertilizer in Africa. Poorly developed agricultural markets, high transport costs, and low and variable output prices persist even as the prices of agricultural inputs rise. Because most crops grown by smallholder farmers are staples and nonexportable, while fertilizer is imported, currency depreciation often raises the price of fertilizer several times above output prices. Consequently, the value-to-cost ratio for fertilizer use declines, creating a disincentive to fertilizer use. This vulnerability of imported fertilizers to exchange rate fluctuation affects the credibility of governments' policies to increase fertilizer use through subsidy programs. In addition, the low crop response rates to fertilizer under many soil types and rainfall conditions mean the cost of fertilizer often exceeds the value of the additional output produced.[15]

Several African countries have also tried to promote fertilizer use through subsidies. Subsidies increase fertilizer use, and thus yield, but they have not always targeted the right farmers. And changes in the subsidy programs over time add uncertainty to farmers' planning, preventing them from making informed long-term investment decisions. Late arrival and distribution of fertilizers to farmers is a recurring problem with the public management of the subsidies. And crop yields may fall if fertilizers are applied at the wrong time in the crop growth cycle. For example, a recent study by the Tanzanian Ministry of Food Security, Agriculture, and Cooperatives found that fertilizers arrived late in almost all the regions visited.[16] Studies of fertilizer subsidy programs in Malawi and Zambia also found that late arrival and application of fertilizer were common.[17]

In response to such failures, several African countries have begun to introduce "smart" fertilizer subsidy programs. These programs are designed to ensure that the benefits in terms of gains in agricultural productivity and food security exceed the gains from investing the public resources in other areas. The programs also encourage farmers to purchase fertilizer on commercial terms (the price of fertilizer is market determined, but farmers get a subsidy to help them afford it) and so try to avoid crowding out commercial sellers or undermining investment in fertilizer distribution by suppliers and agrodealers.[18] Nigeria introduced a targeted fertilizer subsidy voucher pilot program in 2009–2011, and then upgraded it in 2012 as the Growth Enhancement Support Scheme (box 3.3). A study of the voucher system in Nigeria's Kano

TABLE 3.1

Comparison of inorganic fertilizer use in selected Sub-Saharan African countries and Latin America and Asia

Region/country	Share of cultivating households using fertilizer (%)	Fertilizer use across all households (kilograms per hectare)	Fertilizer use across fertilizer-using households (kilograms per hectare)
Sub-Saharan Africa			
Ethiopia	55.5	45	81
Malawi	77.3	146	188.8
Niger	17	4.5	26.3
Nigeria	41.4	128.2	310.1
Tanzania	16.9	16.2	95.6
Uganda	3.2	1.2	37.5
Average	35.2	56.9	123.2
Latin America		125.9	
East Asia		246.3	

Source: Based on data from Sheahan and Barrett (2016); FAOSTAT online, accessed October 12, 2016.

BOX 3.3

Nigeria's experience with a smart fertilizer subsidy program

Drawing on the lessons from targeted fertilizer subsidy voucher pilot programs in selected states during 2009–2011, Nigeria established the Growth Enhancement Support Scheme in 2012, which expanded the pilot programs to the national level, with some important changes. First, the scheme focuses on farmers who could not afford fertilizers without the subsidy. Second, it delivers vouchers to farmers electronically, through the e-wallet mobile phone platform, instead of in paper form. Farmers use the electronic vouchers to purchase subsidized inputs at their assigned redemption center (a selected private agro-dealer's shop). Third, the new scheme leaves responsibility for procuring and distributing fertilizer to the private sector. And fourth, the scheme added subsidies for maize and rice seed. Beyond increasing farmers access to fertilizers, research has found that the voucher system improved the timely delivery of fertilizer to farmers.

Source: Liverpool-Tasie and Takeshima 2013.

State found that vouchers are key for increasing farmers' participation in private fertilizer markets.[19] But there still are problems with the "smart" subsidy programs and further work is needed to improve fiscal sustainability and targeting, and to improve the availability of complementary factors so to increase productivity response to higher fertilizer usage (box 3.4).

To be fully effective, inorganic fertilizer needs to be applied not only at the right time, but also in the right quantities, in the right nutrient ratios, and with complementary micronutrients. Depending on the crop and the nutrient profile of the soil, complementary micro-nutrients (such as sodium and barium) may be necessary to enhance the performance of inorganic fertilizers and to significantly improve yields. Farmers are generally offered a uniform combination of nitrogen, phosphorus, and potassium throughout a country, regardless of soil needs. In Ghana, for example, fertilizer ratios of 15% nitrogen, 15% potassium, and 15% phosphorus or ratios of 23:10:05 are used regardless of where the fertilizer is being applied, whether in the forest area in the south or in the savannah area in the north. While this uniformity reduces fertilizer costs to farmers, it also reduces effectiveness since fertilizer ratios and micronutrients need to be adapted to soil-specific needs. This weakens farmers' incentives to use the fertilizers.

In addition to the use of inorganic fertilizers, optimum soil fertility requires the application of organic fertilizers and the use of appropriate soil management practices. Agricultural household surveys of 10 Sub-Saharan African countries found that about half the households do not use any form of soil fertility improvement, and that only about 22% use organic fertilizers. The low adoption rate of organic soil amendments is especially troubling since such inputs could be produced on the farm and require mainly labor inputs. The weak capacity of agricultural extension services to advise farmers on organic soil fertility management practices is a primary reason for the low adoption rate.[20]

The contribution of fertilizers to agricultural productivity could be much greater if the soil-quality-related constraints on agricultural productivity were addressed through a broad program of soil fertility management,[21] including integrated soil fertility management and conservation agriculture (discussed in chapter 9). In addition, programs to promote fertilizer use should be accompanied by soil mapping services so that fertilizers can meet the soil nutrient needs of particular locations.

Improving farmer education and farm management

Improved management practices increase potential yields (the yield function shifts upward; figure 3.6). That means that the actual productivity increases that famers can realize using improved seeds and fertilizers depend on farmers' knowledge of optimal agronomic practices. To apply such practices, farmers need to know what improved varieties are available and how to cultivate them, including the proper use of fertilizers and other complementary farming practices, which vary by soil type and other agro-ecological features. For example, to achieve high rice yields, farmers need to do more than simply plant improved high-yielding varieties; they also need to apply the right type of fertilizer in the right amounts and to use modern agronomic practices, such as bunding, leveling, and straight-row planting.[22] Similarly, realizing higher yields from improved maize and other upland crop production requires rotating crops with leguminous plants that fix nitrogen in the soil and applying organic fertilizers (manure, compost, and crop residues).[23]

Rural advisory services in many African countries are not reaching most farmers, but they are particularly failing to provide information and services to female farmers.[24] Even though women are often the main farmer in a household, men are typically treated as the lead farmer. Rural advisory services focus on men's market-oriented interests, assuming that women are subsistence farmers

BOX 3.4

"Smart" fertilizer subsidies need to get smarter

The resurgence of input subsidy programs in Africa has arguably been the region's most important policy development for public agricultural spending in recent years. Ten African governments (Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Nigeria, Senegal, Tanzania, and Zambia) spend roughly US$1.2 billion annually on input subsidies alone, primarily on fertilizers.

Evidence has recently been accumulating on some of the largest targeted fertilizer subsidy programs in Sub-Saharan Africa —Ethiopia, Ghana, Kenya, Malawi, Nigeria, Tanzania, and Zambia —based on farm-level surveys. The analysis points to several conclusions with important policy implications:

- Crop response rates of smallholder farmers are highly variable and usually low because of the inability to use fertilizer efficiently and profitably due to low water availability and poor soil, to chronically late deliveries of fertilizer, to poor management practices, and to insufficient complementary inputs to enable farmers to obtain higher rates of fertilizer efficiency.
- The increment in total fertilizer use is smaller than is distributed through the program because even with "smart" subsidies, the crowding out of commercial fertilizer sales—as well as outright diversion and theft—remain major problems.
- Subsidies are unlikely to address their multiple objectives effectively. It is often argued that subsidizing fertilizer is desirable both to boost agricultural production and to help poor farmers. Yet there is strong evidence that most of the benefits do not go to poor farmers (targeting is regressive with respect to asset wealth and landholding size), and the gains in overall food production have been transitory and much smaller than the costs (see table).

The programs in Kenya, Malawi, and Zambia are "targeted," and in fact Malawi pioneered the new wave of "smart" subsidies, yet there is still work to be done to ensure that subsidies actually reach the intended beneficiaries, and that fertilizer response rates rise substantially to justify their costs. The latter requires more efforts on the complementary elements of the green package.

Benefits are low in relation to costs—and go to richer farmers

Country	Characteristics of recipient households acquiring subsidized fertilizer	Financial benefit–cost ratio	Economic benefit–cost ratio
Malawi	Households with larger landholding and asset wealth get more	0.62	0.80
Zambia	Households with more land get slightly more	0.56	0.92
Kenya	Households with higher landholding receive more subsidized fertilizer	0.79	1.09

Note: Ratios are estimated based on five-year estimated response rates. The ratios reported here use baseline calculations, making adjustments to the average partial effect of 1 kilogram of subsidized fertilizer on total smallholder fertilizer use. Costs are those of the fertilizer only, while reported yields were those observed using both the fertilizer and seeds. For this reason, the benefits overestimate the benefits of fertilizer use alone, and the benefit–cost ratios could be considered upper bounds of the ratio for subsidized fertilizer.

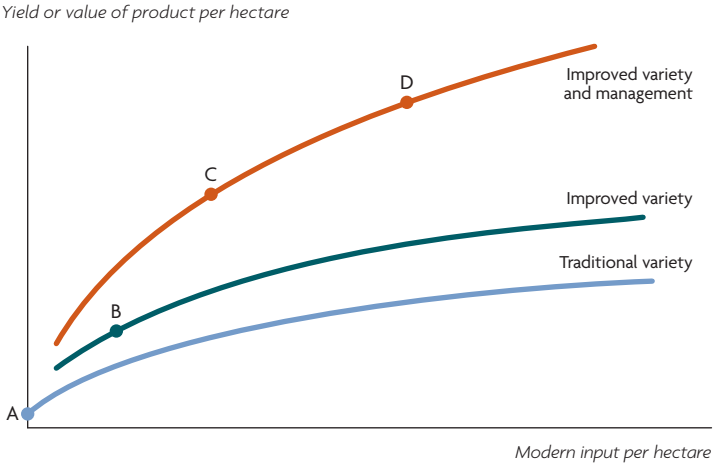
Source: Goyal and Nash 2016.

and are not active in agricultural markets.[25] A recent World Bank evaluation of Ethiopia's Rural Capacity Building Project found that improving women's access to extension services improved their crop cultivation practices and led to higher yields.[26]

Rural advisory services take various forms, including traditional government extension, private sector extension and training programs delivered through contract farming, new forms of public sector extension and training using modern information and communication tools, and peer-to-peer learning schemes, such as farmer field schools. Traditional government extension services are no longer adequate as the sole means of reaching farmers, and even though governments are beginning to re-prioritize these services they cannot afford to provide them at the quality and scale required (box 3.5). As a result, private actors such as input companies have stepped in to combine extension services with input sales, as part of their product marketing. However, farmers often find private extension services to be too expensive without government support. In addition, the focus of private extension services can be narrow, with input dealers, for example, covering only the inputs they sell. To reduce the cost of delivering extension services in hard-to-reach places governments have begun to experiment with E-extension, using modern communication technologies, such as mobile phones. Collaboration among the government, mobile phone companies, and a

FIGURE 3.6

Potential crop yield or value rises with the use of modern input and management practices



Source: Otsuka 2016.

private sector partner that can develop and update the curriculum is key to making e-Extension services a reality for smallholder producers (box 3.6).

To increase women's access to extension services, many programs are now using farmer-to-farmer extension approaches.[27] For example, the East Africa Dairy Development Project has been using a gender-responsive volunteer farmer trainer approach to disseminate information on improved feed technologies and management strategies to dairy farmers in Kenya, Rwanda, Tanzania, and Uganda. It has been effective at training women to provide extension services, as well as increasing the number of women receiving them.[28]

Innovative communication- and learning-based approaches for reaching female farmers efficiently and effectively have been in introduced in East Africa. For example, "Shamba Shape-Up" uses television programming to increase access to advisory services (box 3.7). While the reach of such "edutainment" is limited to farmers

BOX 3.5

Re-prioritizing extension services

Attention to extension services in Africa peaked in the 1980s and early 1990s, when money was directed into systems that mainly promoted agricultural technology adoption in a centralized, linear, one-size-fits-all method. In the late 1990s, public spending on extension declined in most countries in Africa. This was the result of two inter-linked factors: the deficiencies of the method and pressures to cut public expenditures under the World Bank and IMF sponsored structural adjustment programs.

The balance between R&D and extension was also an issue, with critics suggesting that many of the extension agents had nothing to extend owing to weak R&D—and that extension systems tended to be the poor relation at the bottom of the funding chain. As a result, most extension budgets were spent on salaries, with little left to fuel vehicles for farm visits.

African governments are now beginning to increase their focus on extension. In funding the new generation of extension programs, the lessons from the past need to be taken into account to better balance spending across subcategories and make extension more effective.

Source: Goyal and Nash 2016.

BOX 3.6

e-Extension services in Kenya

In 2013, the Kenyan government launched e-Extension services in a bid to reach more farmers with agricultural advisory services and ease the burden on overwhelmed extension officers. The system is expected to reach 7 million farmers annually, a more than threefold increase over the 2 million farmers reached by conventional one-on-one services. The e-Extension program is designed to increase food security by using smart modes of mass communication to reach farmers. The program trained more than 654 e-Extension agents and equipped them with a laptop computer and a smart phone. The agents are positioned at the ward level and reach out to farmers through mobile phones, video training, WhatsApp® messaging tools, and other modern communications technologies. The material used by the agents come from a number of government-sponsored websites that post tailor-made advice for different products, counties, and wards.

BOX 3.7

Innovative media and communications-based approaches to reach women farmers: Shamba Shape-Up and Africa Knowledge Zone in East Africa

Mediae, a communications company in Kenya, produces a farm reality television program "Shamba Shape-Up," which attracts a combined audience of 11 million in Kenya, Rwanda, Tanzania, and Uganda. Many international and national agricultural research centers have been testing the idea that information on improved agricultural practices, including climate-smart practices, can be disseminated widely and equitably using this format. Each episode can be viewed on the Shamba Shape-up website (http://www.shambashapeup.com/). Clips are featured on the "Africa Knowledge Zone" website (http://www.africaknowledgezone.org/). Viewers can send a text message to receive a file that includes pictures and simple instructions on the farming techniques highlighted. The show's Facebook site, which allows farmers to share experiences with different practices, is the biggest and most rapidly growing farming social media site in East Africa, with thousands of followers.

In each episode of "Shamba Shape-Up," upbeat presenters and guest experts help farm families give their "shamba," or farm, a makeover. They cover common challenges such as water scarcity and animal diseases and offer strategies to boost production and reach new markets. The fun and instructive episodes feature both women and men dealing with their specific challenges and solving them with the assistance of agricultural experts. The show began in 2011 and by January 2014 had generated 31,457 mail requests for more information and its Facebook page had 23,017 "likes." An evaluation in 2014 by a team led by the Statistical Services group at University of Reading estimated that in Kenya's agrarian region more than 400,000 households benefited from "Shamba Shape-Up." The increased income for dairy farmers alone was at least US$24 million in 25 counties.

Source: Kristjanson 2016; AECF 2014.

who have access to a TV, the concept can be adapted to radio drama to increase its range.

Another cheaper, but effective option is farmer field schools, a form of adult education based on the concept that farmers learn best from field observation and experiments fostered through group learning. This concept was initially designed to help farmers learn and tailor integrated pest management practices to the changing ecology, but it is now used to help farmers acquire new skills and knowledge that would otherwise be provided by extension services. Unlike conventional extension, the farmer field schools approach uses field experiments and farmer-to-farmer learning to instill new skills. Adoption of conservation agriculture practices is increasing fast in countries where farmer field schools and national and international nongovernmental organizations and research institutions are promoting it.[29] An East Africa study found strong evidence of a positive impact of farmer field schools on productivity in Kenya, Uganda, and Tanzania.[30] Women achieved the highest productivity benefits, showing the promise of farmer field schools for delivering extension services to women. An important enabling factor that increased farmers' participation is rural infrastructure, particularly paved roads. Farmers who lived near tarmac roads were more likely to take part in farmer field schools than farmers who lived far from paved roads.[31]

The Smallholder Horticulture Empowerment Project (SHEP), a farmer education program, was promoted in four provinces in southwestern Kenya over 2006–2009 by the Japan International Cooperation Agency (JICA). The project promoted the concept "Grow crops with potential customers in mind" instead of the traditional "Look for customers after growing crops." Toward that end, the project supported farmer groups in conducting market research, selecting crops, and establishing an action plan for each group and provided technical support to carry out the action plan. The model, which increased farmer groups' income by 67%, has been scaled up nationwide.[32]

Expanding irrigation and access to water

One of the key factors contributing to agricultural productivity growth in the green revolution in India was public investment in irrigation.[33] Irrigation has spatial and temporal productivity benefits. It allows agricultural production on drylands, which cover three-quarters of the agricultural land area in Sub-Saharan Africa.[34] Rainfed agriculture in drylands is either unfeasible or extremely risky, and irrigation makes it possible to produce crops and reduce production risks.[35] Additionally, irrigation allows dry season production, expanding the period of availability of vegetables and other crops. Irrigated crops

are healthier and of better quality, especially in drylands. Returns to irrigation are high. Irrigation in drylands increases yield by an estimated 91% and total factor productivity by about 3%.[36]

Despite its huge potential to boost agricultural productivity, irrigation's contribution to agricultural output in Africa remains small. There has been little change in irrigated area in Africa for more than half a century, increasing from 7.4 million hectares in the 1960s to 13.6 million hectares today.[37] In 2006, African countries irrigated just 5.4% of their cultivated land, compared with a global average of around 20% and an Asian average of almost 40%.[38] Only 4% of Sub-Saharan African cropland is irrigated.[39] Geographic coverage is also skewed. A large proportion of irrigated land is concentrated in North Africa (Egypt, Morocco, and Sudan), Madagascar, and in South Africa (figure 3.7).[40]

The potential for expanding irrigation in Africa is enormous (see table 1.2). While Morocco, Egypt, Sudan, and South Africa have developed most of their potential in irrigation, in Sub-Saharan Africa, outside South Africa, less than 10 percent of the irrigation potential has been tapped. The greatest potential is in Mozambique, followed by Ethiopia, Nigeria, and Ghana. Cameroon, Chad, Ethiopia, Mali, Niger, South Africa, Sudan, Tanzania, Togo, and Uganda each have at least 100,000 hectares of land that could be irrigated.[41] In these countries, small irrigation systems promise both social and economic benefits because of the prevalence of small farms. Ethiopia has established a program for small-scale irrigation under the Agency for Agricultural Transformation with the objective of promoting efficient use of improved irrigation.

Publicly managed rural infrastructure faces many challenges that help to account for the slow development of irrigation potential. Problems include inadequate maintenance, poor service delivery, inadequate cost recovery, deteriorating infrastructure, inefficient infrastructure use, lack of integration of irrigation and drainage systems, and unsustainable or unstable public funding. Political support for infrastructure is often weak, and investment costs are high. Water for irrigation must compete with water for domestic and industrial uses. Irrigation also is associated with growing environmental degradation and social conflict. And local water user associations suffer from low capacity to manage small-scale irrigation systems.

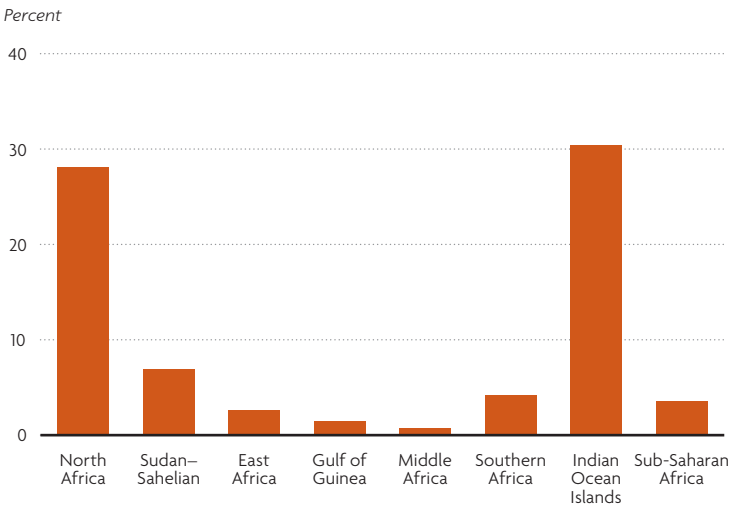
Most irrigation infrastructure is either large scale and dam-based or small scale and based on groundwater, small reservoirs, river diversion, or water harvesting. Because big dams are expensive to build and maintain, and complex to operate and manage, they are no longer being built for a single purpose; irrigation is just one objective among others. Smaller scale irrigation projects are more viable options for increasing agricultural productivity among smallholder farmers, but management challenges need to be overcome.

One approach to reducing fixed costs and enhancing the quality and responsiveness of irrigation operations and maintenance has been to transfer public sector responsibility for operating and managing irrigation works to water user associations, which act as intermediaries between farmers and the state owners of irrigation infrastructure. An example is the Nakhlet Small-Scale Irrigation Scheme on the northern bank of the Senegal River in Mauritania, which irrigates 27.5 hectares of land. Nearly 30 farmers cultivate 119 fields and realize an average rice yield of 5.5 tons per hectare compared with an average of 5 tons per hectare countrywide.[42] To work, such schemes require land tenure reform (to incentivize long-term investments and enable the land to be used for collateral), efficient and responsive management of infrastructure by trained water user associations, adequate inputs and markets, and access to affordable credit.

The type of irrigation system that is most suitable depends on an area's agroecological conditions and government budget constraints. Large-scale irrigation systems serve multiple purposes beyond the agricultural sector, whereas small-scale irrigation schemes are less expensive to build and can yield results more quickly. An important consideration is the internal rate of return, which is high

FIGURE 3.7

Share of cultivated area in Africa that is equipped for irrigation, 2010



Source: Based on data from You et al. 2010.

for irrigation projects in Sub-Saharan Africa:[43] more than 20% for small-scale projects in all subregions except the southern region, where it is 13% (table 3.2).[44]

Other considerations in deciding between large-scale and small-scale irrigation systems include potential productivity gains, economic costs and benefits, and poverty reduction and equity impacts and environmental impacts. Table 3.3 presents the main results from an analysis drawn from East Asia's experience in investing in irrigation and relates it to the context of Africa.

The factors presented in table 3.3 imply that Africa's water supply strategy for increasing productivity in areas where irrigation is still underdeveloped should include both large- and small-scale schemes. Large, multipurpose water supply schemes can serve multiple strategic goals beyond irrigation, including providing water for domestic and industrial use, generating hydropower, and

TABLE 3.2

Investment cost and average economic internal rate of return for large-scale and small-scale irrigation investments in Sub-Saharan Africa, 2008

	Large-scale irrigation		Small-scale irrigation	
Subregion	Investment cost per million hectares (US$ millions)	Average internal rate of return (%)	Investment cost per million hectares (US$ millions)	Average internal rate of return (%)
Sudano-Sahelian	508	14	4,391	33
Eastern	482	18	3,873	28
Gulf of Guinea	1,188	18	8,233	22
Central	4	12	881	29
Southern	458	16	413	13
Total	2,640	17	17,790	26

Note: See note 43 for underlying assumptions.

Source: You et al. 2009.

TABLE 3.3

Considerations in deciding between large-scale and small-scale irrigation systems in Africa based on experience in East Asia

Irrigation system type	Productivity gain	Economic costs and benefits	Poverty reduction and equity
Large scale	• Improved irrigation techniques (sprinkler or drip irrigation) are used. • Productivity could be further improved through better water service delivery.	• Initial investment is high (infrastructure for water storage and water supply; institutions for operation and management). • Requires good estimates of area to be irrigated, through stakeholders' involvement from the design stage. Overestimation leads to inefficiency, due in particular to development of informal irrigation systems upstream and around the planned irrigated area, and to unplanned extension of the initial irrigated area due to social and political pressure. • Many systems have a poor cost-recovery record.	• Supports production of part of national strategic food requirements (cereals, rice, maize) and improves the resilience of farms to droughts (in North Africa, the irrigation sector contributes up to 40%–50% of national production in dry years). • Inequitable access to water as not all farmers benefit directly from the investment.
Remarks	• Both large- and small-scale systems can improve productivity. However, efforts should focus on areas where rural people are vulnerable and productivity is low and where high returns (social, economic and financial) from a little extra water can make a big difference.	• Economic cost is higher than for small-scale systems. • Need to start cost-recovery system to ensure sustainability. • Imports of strategic crops (rice, cereals) may decline. • Investment costs tend to be lower in rainfed areas using supplemental irrigation than in fully irrigated areas; economic benefits are also lower, but social and natural benefits are high.	• Large impacts on national resilience to drought and production of strategic crops and export crops. • Small impacts on poverty at the individual level.
Small scale (community sharing and individual irrigation systems)	• Significant contribution to productivity by allowing year-round cultivation and crop diversification. • Private systems predominate, and farmers invest to improve intensification of land use and productivity.	• Lower investment cost per hectare but higher operating cost than for large-scale; however, new technologies can reduce these costs and provide opportunity for mechanization at the farm level (such as treadle pumps, drip kits, solar energy for low pressure irrigation systems). • Energy requirement in operations is an important consideration in irrigation design. • Reliable water supply when groundwater is the main source. • Less reliable water supply in river diversion and run-off schemes. • Small-scale systems yield more benefits when clustered. • Institutional organization of users is important where the water source is shared (deep well or small surface reservoir), but not in individual systems, which is an advantage for reliable service and accountability.	• Have much larger impacts on poverty reduction and nutrition than large-scale systems. • Strong way to help farmers break out of the poverty cycle and secure a minimal income with small investments. • Have significant impact on nutrition. • Have mixed impacts on equity: • Conflicts can arise on water allocation between upstream and downstream users. • Arbitration may be needed to resolve water use rights between groups (pastoralists upstream and farmers downstream). • Requires access to land, coupled with gender mainstreaming.

Source: Lebdi 2016.

providing ecosystem services. In North Africa, where irrigation systems are well developed, countries have relied on decennial plans for agricultural water management, with water infrastructure development as the main pillar (big and small dams, shallow and deep wells, and geographical water transfer networks). Today, countries benefit from the transformation of their agricultural systems through the development of their water supply systems and can shift their focus from improving productivity to improving product quality and markets. Tunisia's water supply strategy includes management of "virtual water." A water-scarce country, Tunisia exports many irrigated cash crops (including vegetables, fruits, dates, olives, and olive oil) off-season to European markets, when prices are at a premium, while importing agricultural products such as fodder and cereals. Through this agricultural trade, Tunisia gains considerable virtual water: for every cubic meter of water used in its cash crop exports it gains the equivalent of 7 cubic meters of water in the food it imports.[45]

Mechanization—expanding cultivated area and raising yields

Mechanization (focusing primarily on tractors and power tillers) can also support agricultural transformation in Africa, in at least three important ways.[46] First, Africa has a high land to labor ratio relative to Southeast Asia, and in some parts of Africa, including North and Southern Africa, the ratio is also higher than in South America. By supplementing (relatively scarce) labor, mechanization can enable additional lands, including those with highly compacted soils, to be brought under cultivation.

Second, mechanization can ease labor constraints that are beginning to emerge in some farming systems in Africa. African farmers are aging (their average age is 60[47]), and not enough young farmers are replacing them. In addition, rising migration to urban areas and increased employment opportunities in nonfarm services in rural areas are creating upward pressures on rural wages in several places in Africa,[48] even though agricultural land productivity, measured by yield, is still much lower than in the post-green revolution Asian countries. The situation is especially acute during seasonal spikes in farm labor demand.

Third, mechanization can complement the agricultural yield-raising package discussed above (improved seeds, fertilizers, irrigation, and farm management techniques). Implementation of the package boosts demand for labor inputs, and mechanization can provide a partial response.

Mechanization in African agriculture is very low. Data collected by the World Bank from national agricultural ministries (and standardized in terms of four-wheeled tractors) illustrate these low levels of mechanization (table 3.4). However, these figures fail to reveal the diversity of mechanization types within and across countries. And some countries with very low tractor density, such as Ethiopia, Ghana, Nigeria, and Tanzania, are making some of the most notable progress in mechanization. However, the rise of tractor use in these country is correlated with the rise of medium and large farmers who both use one and rent it out.

Challenges to mechanization in African agriculture

The expansion of agricultural mechanization in Africa faces seven major challenges. First, agriculture must provide adequate profitable opportunities to justify the large expense of agricultural machinery or mechanization services. Second, many African farmers lack information on how mechanization could improve their farm operations. Third, more than 80% of Africa's farmers are poor smallholders who cannot afford tractors or other power tools. Fourth, smallholders often have several small plots that are not contiguous and are therefore

TABLE 3.4

Tractors per 100 square kilometers of arable land in selected countries, 2014

Country	Tractors per 100 square kilometers
Burkina Faso	8.9
Ethiopia	4
Ghana	11
Kenya	26.9
Mozambique	12.7
Nigeria	5.7
Rwanda	1.3
South Africa	43
Tanzania	7.4
Tunisia	143
Zambia	20.7
Zimbabwe	35.6
Brazil	116
Chile	425
India	128

Source: World Bank 2014; FAOSTAT.

difficult and more expensive to service with tractors. Fifth, credit is hard for smallholder farmers to access and very expensive (see chapter 4). Sixth, the customary land tenure systems that prevail in large parts of Africa make it impossible to use land as collateral for loans (see chapter 2). And seventh, African countries manufacture almost no agricultural machinery, and so almost all of it has to be imported, along with the spare parts needed to maintain it.

In the past, several African governments have tried to address these mechanization challenges by importing agricultural machinery to use on state farms or to offer rental services to farmers. These approaches failed because of inefficiencies and poor governance in the state-run agencies and because other fundamental challenges were not adequately addressed. Recently, some governments have adopted more private sector friendly approaches, which rely on subsidies. These include subsidized machinery hiring services, credit subsidies, and credit-guarantee programs for agricultural machinery, discussed below. Like all subsidy programs, effective targeting and fiscal sustainability remain issues. Solutions to some of the fundamental constraints to mechanization, which are more likely to be sustainable, are discussed below.

Government-supported tractor hiring services. Many Sub-Saharan governments offer tractor hiring programs to small farmers (table 3.5). The experience of Ghana's Agricultural Mechanization Service Centers (AMSEC) program illustrates how such programs work and highlights their weaknesses.

To raise agricultural output among small farmers, Ghana launched a tractor hiring service in 2007. About 12 service centers, intended as private entities, were piloted in eight regions of the country, with the expectation that the number of service centers would expand to 69 in 2009, 84 in 2010, and 88 by August 2011. The Ministry of Agriculture had estimated that the country would need about 16,700 tractors by 2015, which would have to be imported because Ghana does not manufacture tractors. But only 5,000 tractors (with accompanying disc ploughs, disc harrows, trailers, and power tillers) had been imported and made available to qualified private-sector operators and some farmers by 2013.[49]

Each service center was allocated tractors with basic implements, plus a trailer. To reduce the capital cost of the machinery, which is a major barrier to entry, the government subsidized one-third of the cost of the tractors. The operators had to pay 20% of the subsidized equipment prices up front, with the balance to be repaid over a two- to three-year period. The subsidized program improved farmers' access to mechanized services and raised average mechanized area among surveyed farmers from 5.3 acres per farmer in 2008 to 7.8 acres in 2010, a 21% per year increase in mechanized area.[50]

Several African governments have sent delegations to Ghana study the program. An evaluation of the program by Benin found mixed impacts.[51] While the program improved the availability of mechanization services, reducing drudgery and boosting yield, it has had no impact on the prices paid by farmers for the services used perhaps because some services operated as monopolists in some districts. The yield increases also reflected the fact that access to tractor services came with the adoption of improved farm practices (row planting, recommended

TABLE 3.5

Sub-Saharan African countries with active government-run or -supported farm mechanized equipment hire schemes

Country	Type of program	Name of program/agency
Benin	Government tractor hire	
Cameroon	Government tractor hire	
Ethiopia	Government tractor and combine hire	Agricultural Mechanization Service Centers
Gambia	Government tractor hire	
Ghana	Subsidized specialized service provision	Agricultural Mechanization Service Centers
Kenya	Government tractor hire	Agricultural Development Corporation
Malawi	Government tractor hire	Plant and Vehicle Hire Organization
Nigeria	Subsidized specialized service provision	Agricultural Equipment Hiring Enterprises
Sierra Leone	Government tractor hire	Minister of Agriculture Forestry and Food Security
Swaziland	Government tractor hire	Rural Development Areas Mechanization Section

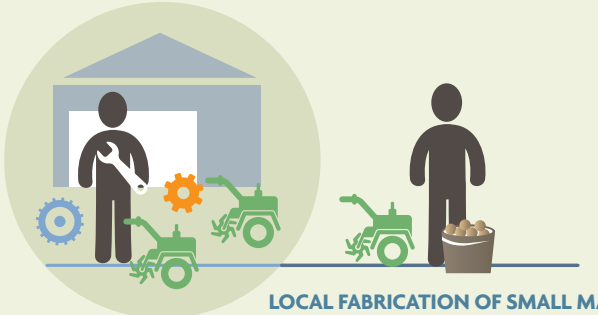
Source: Tokida 2011; Hassena et al. 2000.

Expanding the use of machines

FARMER-TO-FARMER TRACTOR HIRE

FARM ORGANIZATION TO FARMER MEMBER EQUIPMENT LOANS

USING SMALLER TRACTORS AND TWO-WHEELED POWER TILLERS



LOCAL FABRICATION OF SMALL MACHINES AND SPARE PARTS

planting density and spacing). However, the sustainability of the program is in doubt given the low profitability of the service centers because of low tractor utilization rates and the small operational scale of the centers.[52]

Credit subsidies and guarantee programs for mechanization. Several governments, often in collaboration with donors, have initiated credit schemes to help farmers purchase mechanization equipment and access machinery hiring services. Projects in Mozambique, Tanzania, and Zambia offer favorable credit terms for farmers and cooperatives to buy tractors and provide services to smallholders.[53] Tanzania's Agricultural Inputs Trust Fund provides credit to individual farmers for tractors and other agricultural inputs. The Tanzania Investment Bank also provides government-supported financing to importers and farmers.[54] In Nigeria, the government provides subsidized credit to farmers through the Agriculture Equipment Hiring Enterprise program, while the Nigerian Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) guarantees up to 75% of bank loans for mechanization and other agricultural investments. The government hopes to scale back its involvement to allow more private tractor imports to enter the market.[55] Historically, many government credit schemes for farm mechanization have suffered from poor repayment rates and high monitoring costs and loan guarantees. High monitoring costs remain a constraint for NIRSAL because moral hazard is a problem among both banks and borrowers.

Beyond subsidies to more sustainable solutions

While government-subsidized programs that involve the private sector address the inefficiencies of direct government provision of machinery equipment or machinery services, they have their own problems. In addition, the programs do not avoid the usual problems with subsidies, which include ineffective targeting, lack of fiscal sustainability, and undermining of private sector provision. While subsidies may be supportable on the grounds of the poverty of most farmers and the potential demonstration effects for technology adoption, subsidies must be temporary. Simultaneous efforts are needed to address the fundamental challenges to increasing mechanization in Africa, including encouraging and supporting the development of viable private sector approaches.

The first part of this chapter discussed ways to improve farm productivity and thereby the profitability of farming through yield raising practices. Effective implementation of those practices, along with easing constraints in land tenure (chapter 2) and credit (chapter 4), will create the conditions that make it financially attractive to farmers to invest in machinery, whether through outright purchase or through rental. This section offers examples of how to sustainably expand access to agricultural machines or mechanization services and reduce their costs.

Farmer-to-farmer tractor hiring services. Because most farms are small, purchasing a tractor for individual farm use is prohibitively expensive. In contrast, a program that helps farmers purchase farm machinery to rent out to other farmers in addition to using it on their own farm has important advantages. It helps the owner fully utilize the machine and thus to quickly recover its costs; it also expands mechanization access to nearby farmers who lack the capital or credit to purchase their own machines.[56] For the machinery hiring market to function effectively, there must be sufficient demand for mechanization among small and medium-size farmers and enough larger farmers capable of making the investment in tractors and supplying services. While data are not available to estimate the size of the machinery hiring market in individual countries or across Africa, private farmer-to-farmer service provision exists in many African countries, including Ghana, Nigeria, and Tunisia. In Ghana and Nigeria, where more in-depth research has been conducted by the International Food Policy Research Institute (IFPRI), this supply model appears to be vibrant in a number of locations.[57] Studies for Asian countries (Bangladesh, China, India, Indonesia, Nepal, Thailand, and Vietnam) have noted similar patterns of farmer-to-farmer service provision.

The IFPRI mechanization survey in northern Ghana provides detail on tractor ownership and service provision (table 3.6). Even relatively large farmers (more than 20 hectares) have incentives to hire out their tractors, as they do not cultivate enough area on average to meet the seasonal utilization capacity of a tractor. Large farmers hire out their tractor services to smaller farmers. Providing plowing service constitutes an important source of profits for tractor owners, although overall profitability rises when plowing services are combined with a mix of other services, such as maize shelling and transport.

Mechanization services provided by farmer organizations. Agricultural cooperatives and farmer groups can also jointly own tractors and other mechanized equipment for use by members. Collective ownership can help small farmers overcome the cost and scale constraints of

TABLE 3.6

Summary of tractor ownership and services from a 2013 International Food Policy Research Institute/Savannah Agricultural Research Institute survey in Northern Ghana

Category	Small farms (<5 hectares)	Medium-size farms (5–20 hectares)	Large farms (> 20 hectares)
Percent owning a tractor	3.8	25.1	71.1
Average land owned (hectares)	5.3	16.5	61.6
Average area cultivated (hectares)	2.9	9.5	38.4
Average number of tractors per owner	1.1	1.1	1.3
Average area plowed on own farm (hectares)	4.1	10.8	33.6
Average area plowed on others' farms (hectares)	188.2	167.4	199.6

Source: Chapoto et al. 2014.

owning individual tractors. However, joint ownership of productive assets can give rise to collective action problems such as free riding that impedes the effectiveness of cooperative tractor ownership.

In Egypt, mechanization utilization rates were lower and costs were higher per acre for cooperative-owned tractors than for government and privately owned tractor enterprises.[58] However, a more recent study in Nigeria found that cooperative-owned tractors performed better on utilization and cost metrics than government-owned tractors but worse than privately owned tractors.[59] In Ethiopia, which has one of the largest cooperative movements in Africa, cooperatives provide most of the tractor hiring services. Cooperatives also commonly provide services in Burkina Faso and Mozambique, where they are supported with subsidies and credit from donor projects and the government.[60] It is not yet clear whether these projects can overcome the limitations of collective ownership and become an efficient and sustainable solution for increasing access to mechanization services.

Using smaller tractors and two-wheeled power tillers. Access to mechanization could also be improved and costs reduced by using smaller but equally suitable machines that are cheaper and require less land to be fully utilized. Two-wheeled power tillers have spread rapidly in much of Asia, as have small four-wheeled 20–40 horsepower tractors in India.[61] Although African small and medium-scale farmers might also be expected to favor these smaller machines, tractors in the Africa are much larger than those in Asia (table 3.7). While farms tend to be larger in Africa than in Asia, farm size does not fully explain the difference in tractor size. One study finds that only 16 horsepower of mechanical power is needed to plow 20 hectares (Chancellor 1986), yet the average horsepower in the African countries shown in table 3.7 ranges from 40 to 102. There do not appear to be sufficient savings in cost per horsepower for large tractors compared with smaller ones to explain their dominance. While hiring out mechanization services is a way to make machine ownership profitable when machines cannot be fully utilized on the owner's farm, it is not typically the primary motivation for tractor ownership.[62] Moreover, in most other regions, tractor size was much smaller in the early stages of mechanization and increased as farms expanded and farm households became wealthier. The early adoption of large tractors in Africa does not follow this pattern.[63]

Several factors could explain the prevalence of larger tractors in Africa. One is that farmers develop a preference for high-horsepower tractors from observing the large tractors typically used on state and large commercial farms. Another reason is the prestige of owning large machines. And a third is that the products that are available on the market are strongly affected by government programs that import tractors and sell them at subsidized prices to farmers. This is often the case when African governments receive conditional aid money that requires them to buy machinery from a manufacturer that may not sell the appropriate-size tractor. However, this requirement is not true of all donors. The Japan International Cooperation Agency, long known for its support of mechanization around the world, is fairly flexible about the types of machines that aid recipients can purchase using grants from its Food Security Project for Underprivileged Farmers; the only condition is that the

TABLE 3.7

Average horsepower of four-wheeled tractors in selected Sub-Saharan countries, 2013

	Burkina Faso	Ethiopia	Ghana	Kenya	Mozambique	Nigeria	Zambia
Estimated average tractor horsepower	40–60	102	60–80	101	85	65–80	65

Source: World Bank 2014.

manufacturer's headquarters must be based in an OECD country, though the tractors themselves can be (and are) manufactured or assembled elsewhere.

India's experience with smaller machines is one model that could be emulated in African countries. The Indian government provides subsidies on a wide range of farm machinery, including different size tractors, power tillers, reapers, transplanters, and animal-drawn equipment, to ensure that efficiency considerations rather than the subsidy determine the types of machines being adopted. Recent subsidies have covered smaller tractors, which enable small farmers to purchase tractors and offer hiring services. In recognition of the multiplicity of actors along the value chain, these subsidies have been supported by the extension of long-term credit by local banks, mostly for the purchase of machines, and substantial public investment in research and development. Tanzania seems to have emulated this model. It had a program that subsidized power tillers, which saw beneficiary farmers shift from traditional hand and oxen methods.[64]

Local fabrication of small machines and spare parts. Keeping farm machinery functioning during peak plowing seasons requires easily accessible and good quality repair services, along with a reliable supply of parts. Under the rainfed agricultural system common in Africa, even a short delay while waiting for a part to arrive can cause farmers to miss the crucial period for plowing. Yields suffer when farmers are forced to plant their crops without proper land preparation. The delay also results in losses for tractor owners that hire out plowing services. In Ghana, tractor owners reported that frequent breakdowns during the peak plowing seasons were the largest constraint to utilizing the full capacity of their equipment.[65]

Because few machinery dealers provide after-sales services, repair services in most African countries are provided locally by private mechanic shops or individuals. Many dealers also import spare parts to supply to local repair shops. Repair shops are typically located in rural towns in the districts where tractor and other machinery owners are concentrated. Mechanics may travel from their town to the villages to meet the demand for simple repair jobs by tractor owners. In Kaduna and Nasarawa States, Nigeria, for example, more than 80% of repair jobs for surveyed tractor owners took place in the owner's village.[66] Repairs and maintenance are also provided by parts retailers, who are often small-scale businessmen.[67] Fabricators in cities and in rural areas who manufacture animal-drawn farm implements such as carts are often able to make simple repairs of tractors and tractor-drawn implements. While rural mechanics can provide basic services without formal training, additional training would enable them to handle more serious repairs and thus reduce the time machines are out of commission. Technical and vocational education and training institutions could be encouraged to provide specialized courses in the agricultural machinery used in their areas offered at times that fit the work schedule of local mechanics. Subsides could encourage participation.

Most tractors and large agricultural machinery used in Africa are imported, but some small machines, such as tractor-mounted maize shellers, are manufactured locally. In Ghana, such small machines are an important part of post-harvesting mechanization, which also creates off-season use for tractors and increases capacity utilization.[68] Other types of tractor-drawn implements and threshing machines are commonly manufactured in a number of African countries.[69] In Ethiopia, threshing machines for maize, wheat, rice, sorghum, and other crops were developed in the 1980s in partnership with government research and engineering agencies.[70] Such models are still in use in a few regions. In Kenya, local manufacturers of equipment such as treadle pumps and hammer mills are common in Nairobi and have begun to emerge in smaller towns such as Nakuru.[71]

Many African countries are experiencing a new wave of small-scale farm equipment design and manufacture tailored to local conditions. Many of these machines are based on designs that were developed in Asia. One example is the ASI rice thresher, adapted from a Vietnamese design to African conditions by AfricaRice and partners. With a capacity of 1,000–1,500 kilograms of paddy per hour, it is now being applied in Senegal, with the potential of being adopted in Burkina Faso, Côte d'Ivoire, Ghana, Mali, and Mauritania.[72] Similarly, AfricaRice and partners have adapted a mini-combine rice harvester from a Philippine design. The adapted model can harvest 2 hectares per day and requires half the labor of the ASI thresher. It is not yet clear, however, whether such machines can be successfully produced and more widely adopted than the large imported combines that have not gained widespread use.

In addition to smaller conventional machinery, equipment is also being developed for use in conservation agriculture, especially in East Africa (Kenya and Tanzania) and Southern Africa (Zambia and Zimbabwe).[73] Conservation agriculture is a set of soil management practices that minimize soil disruption and maintain biodiversity, while improving both crop yields and the environmental and financial sustainability of farming.

Conservation agriculture equipment designed and adopted in Africa includes animal-drawn rippers and direct seeders, as well as two-wheeled tractor-drawn strip tillers and seed drills, though these last two are more common in Asia. Some conservation agriculture machinery has been developed in Africa, including the Magoye animal-drawn ripper, developed in Zambia, and the and Palabana animal-drawn ripper, developed in Zimbabwe; both have spread to some degree throughout Southern Africa (table 3.8).

Trade policies. Most tractors and spare parts used in Africa are imported. That means that trade policies affect the price and affordability of mechanization.. African countries have eliminated import duties and value-added taxes (VAT) on imported tractors, with a few exceptions. Burkina Faso and Mozambique levy a 5% import duty, which is as high as 16% in practice in Burkina Faso.[74] Ethiopia exempts tractors from import duties only if they are cleared and purchased within six months of arriving at the port of Djibouti.[75] However, many countries still impose heavy duties on imports of spare parts (as high as 30%), preventing repair shops from building up adequate stocks and leading to long delays when breakdowns occur during the peak season.

High tariffs are also common for imported inputs for the manufacture of mechanization equipment and for tractor parts for assembly (completely and semi-knocked down).[76] Where there is the potential for locally manufactured equipment or locally assembled tractors to compete with imports, governments could encourage such activity by removing or lowering duties on these imported inputs.

Import procedures that result in long delays can also adversely affect the timely supply of machines to rural areas. For example, all machinery imported into Tanzania must be examined and approved by the Centre for Agricultural Mechanization and Rural Technologies, the

TABLE 3.8

Locally developed mechanization equipment used in Africa

Function	Machine	Description	Developer	Country
Land preparation	Tinkabi and Kabanyolo tractors	Mini-tractors designed in Swaziland and Uganda	Unknown	Uganda; Swaziland
	Magoye and Palabana rippers	Animal-drawn rippers that create 10–25 centimeter deep rip lines, easily adjustable	Magoye and Palabana research stations	Zambia; Zimbabwe
	Groundnut seeder	Developed by local company to directly seed groundnuts, which cannot be seeded with a Fitarelli seeder	Grownet Investments	Zimbabwe
Harvesting	Mini-combine	Able to harvest more than 2 hectares of rice per day; low cost may make it more appropriate for African rice farms than some other machinery introduced from Asia	AfricaRice, adapted from Philippine model	Senegal
Threshing	ASI thresher-cleaner	Can thresh 1–1.5 tons of paddy per hour; can be fabricated locally; does not require winnowing after threshing	Africa Rice, International Rice Research Institute, Senegal Institute of Agricultural Research, Senegal River Delta Development and Exploitation Company, adapted from Vietnamese model	Senegal with regional spillover to Burkina Faso, Côte d'Ivoire, Ghana, Mali, and Mauritania

Source: Diao, Silver, and Takeshima 2016.

TABLE 3.9

Import duties plus value-added tax on for tractors and parts in selected Sub-Saharan African countries, 2013

Percent

Import duty plus value-added tax	Burkina Faso	Ethiopia	Ghana	Kenya	Mozambique	Nigeria	Rwanda	Tanzania
Tractors	5–16	0	0	0	5	0	0	0
Spare parts	20	25–40	27	16	25	5	30	10

Source: World Bank 2014.

government agency in charge of machinery quality control and testing. A number of stakeholders have cited delays in this process as a major bottleneck.[77]

In countries where cost-effective domestic manufacture of agricultural machinery is not a likely near-term prospect, trade policy should facilitate imports of cheaper used tractors and other farm implements. Generally, there is little drop-off in performance and lifespan, but the cost is lower—sometimes even lower than the price of government-subsidized new tractors. Used tractors may also cost less to maintain, especially when the market for spare parts is more developed for second-hand brands.[78]

Conclusion and policy considerations

Increasing agricultural productivity in Africa will have important impacts not only on the agricultural sector, but also can be a catalyst for industrialization through agro-processing. However, agricultural productivity in Africa is low as the input packages behind the green revolution that led to yield increases in Asia are weakly adopted in Africa. Fortunately, there is evidence from a number of places on the continent where adoption of green revolution packages has led to higher productivity among smallholder farmers. This chapter has drawn on lessons from these examples and identified key enablers that can help replicate the local successes elsewhere.

Notes

1. Otsuka 2016.
2. Takeshima, Pratt, and Diao 2013.
3. FAO 2010.
4. Otsuka 2016.
5. Crawford et al. (2003) found that in Benin, Burkina Faso, Chad, Côte d'Ivoire, and Togo the increased fertilizer consumption appears to be related to the expansion of the cotton sector between 1980 and 2000. Only in Ethiopia was there a major increase in fertilizer use on food grains.
6. Brussaard et al. 2010.
7. AGRA 2015.
8. Details regarding the study can be found at: https://www.povertyactionlab.org/evaluation/promoting-adoption-new-rice-varieties-addressing-costs-early-adoption-sierra-leone.
9. Odame and Muange 2012.
10. Hopper 1993; Tomich, Kilby, and Johnston 1995.
11. Sheahan and Barrett 2016.
12. Sheahan and Barrett 2016.
13. Rashid et al. 2013.
14. Shively and Ricker-Gilbert 2013.
15. Jayne and Rashid 2013; Vanlauwe et al. 2015.
16. Ministry of Agriculture, Food Security and Cooperatives, Tanzania (MOAFC) 2007.
17. Dorward et al. 2008; Xu 2008. It is important to note, however, that benefit–cost analyses of fertilizer subsidies do not support the use of subsidies. Goyal and Nash (2016) determined that the financial and economic benefit–cost ratio of fertilizer subsidy in Malawi are 0.62 and 0.80.
18. Minde et al. 2008.
19. Liverpool-Tasie 2014.
20. Nkonya et al. 2015.
21. Goyal and Nash 2016.
22. Otsuka and Larson 2016.
23. Kajisa and Palanichamy 2013; Otsuka and Muraoka 2015; Vanlauwe et al. 2015.
24. Perez et al. 2015; Ragassa et al. 2012; World Bank and IFPRI 2010; Ragassa 2014.
25. Colverson 2015.
26. Buehren et al. 2013.
27. Khaila et al. 2015.
28. Lukuyu et al. 2012; Kugonza et al. 2015.
29. Kassam et al. 2015.
30. Davis et al. 2010.
31. Davis et al. 2010.
32. JICA 2014.
33. Evenson et al. 1999.
34. Morris et al. 2015.
35. Riddell and Westlake 2006.
36. Fuglie 2010.
37. Oates et al. 2015.
38. FAO Aquastat 2005.
39. You et al. 2010.
40. FAO Aquastat 2005.
41. FAO Aquastat 2005.
42. FAO 2010.
43. You et al. 2009. The theoretical interest rate at which the net present value of all positive and negative cash flows associated with an investment project equal zero.
44. The assumptions made by the author are that large-scale systems are dam-based, with a 50-year investment horizon and average unit costs are US$3,000/hectare for on farm development and US$0.25/cubic meter for water delivery and conveyance and US$10/hectare for operation and maintenance, which means the cost of the dam is not taken in account. For small scale, the unit cost is US$2,000/hectare for on-farm investment and US$80 for operation and maintenance, with a five-year cycle of investment. Small scale irrigation systems are based on

small reservoirs, farm ponds, treadle pumps and surface water harvesting structures.

45. Lebdi 2010.
46. The discussion in this section is based primarily on a background paper—"Agricultural Mechanization and Agricultural Transformation"—commissioned by ACET and JICA Research Institute and produced by staff from IFPRI, Washington, DC (Diao, Silver, and Takeshima 2016).
47. AGRA 2015.
48. Maiga and Kazianga 2016.
49. Benin 2013.
50. Benin 2013.
51. Benin 2013.
52. Houssou et al. 2013.
53. World Bank 2014.
54. CIMMYT 2012.
55. World Bank 2014.
56. Diao et al. 2014.
57. Houssou, Diao, and Kolavalli 2014; Takeshima and Adesugba 2014.
58. Seager and Fieldson 1984.
59. Oluka 2000.
60. World Bank 2013a; 2013b.
61. Diao et al. 2014.
62. Chapoto et al. 2014.
63. Takeshima et al. 2015.
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CHAPTER 4

Commercializing Agriculture

Increasing access to land and raising productivity, as discussed in chapters 2 and 3, are key pre-requisites for transforming African agriculture, but they are not enough. Another important pre-requisite is a commercial orientation to farming in Africa. This does not mean turning African agriculture into one based on large commercial farms. Instead, it means making agriculture profitable and helping African small farmers to transition from a mainly subsistence orientation to a commercial orientation, with farms run as businesses that interact more with markets for the purchase of modern inputs and for the sale of outputs.

This transformation requires having macroeconomic and regulatory environments conducive to commercial activities and reducing and managing production and other risks associated with agriculture, including those induced by government policies. It also requires input and output markets that work better. This would not only help existing farmers, it would also attract new farmers and increased finance to help modernize farming and upgrade value chains, including storage, processing, and logistics.

Systemic issues—macroeconomic and regulatory environments

If African agriculture is to be run as a business, it requires macroeconomic and regulatory environments supportive of business activities. In fact, a commercialized agriculture would in most African countries be the largest private sector in the value of output and in the number of business men and women. Governments will therefore need to prioritize agriculture in their private sector development strategies, and to consider the particular needs of agriculture in macroeconomic policies and business regulations.

Exchange rate management

The exchange rate is one of the most important policy variables affecting the level and volatility of prices facing farmers as they adopt a more commercial orientation that increases the purchases of inputs and the sales of output. In Africa, large proportions of agricultural inputs are imported, and farmers selling their output often have to compete on global export markets or with food imports on the domestic market. Keeping the exchange rate at levels that balance the need to keep imported inputs affordable and marketed outputs competitive and profitable for farmers is no mean task (particularly when the needs of urban food consumers also have to be considered—see below). But it has to be at the forefront of government agendas if they are serious about transforming agriculture.

As important as the level of the exchange rate are its movements over time. Large and unexpected movements are detrimental to planning, operations, and profitability in agriculture as in other businesses. And given the time-sensitive nature of planting and the time lag between planting and harvesting, exchange rate volatility can be even more destabilizing to agriculture. So, while policymakers must aim to influence the exchange rate to move over time to avoid overvaluation—and thereby lose international competitiveness—it must do this in ways that also avoid large and sudden changes.

Fiscal and monetary policies and their impact on interest rates and the availability of credit

Commercial agriculture will require higher levels of credit at affordable interest rates. As discussed later in this chapter, agriculture-specific factors constrain access of farmers to credit and increase the interest rates they face. But it certainly does not help if the availability of credit to all private sector activities in the economy is scarce and interest rates are high, the situation in many African countries.

The usual government response is to try to subsidize credit to agriculture. While there may in some contexts be valid reasons for subsidizing credit to poor farmers, before doing that or at least in conjunction with doing that, governments need to think about increasing access to credit for the whole private sector and bringing down the general level of interest rates. One way to do this is to strengthen fiscal discipline and thereby lower deficits that have to be financed in domestic markets, which reduces the credit available the private sector and the interest rates they face. (Foreign finance of the deficits could adversely affect the exchange rate, not to mention the potential adverse consequences of high external

debt). If fiscal and monetary policies can keep overall private sector access to credit and the general level of interest rates reasonable, even where governments have to subsidize credit to agriculture, the rates of subsidies required would be reduced.

Regulatory environment

The most important regulatory environment for commercializing agriculture is the land tenure system, discussed in chapter 2. Secure access to land in a manner that does not drag on for months or years (as in many African countries) will encourage new investors to enter agriculture and give confidence to existing farmers to invest in improving their farms. Similarly, efficient land rental markets will encourage those with land, but with little interest in farming, to rent or sell to more motivated and enterprising farmers. As shown later in this chapter and in subsequent chapters, modern farms need to be supported upstream and downstream by agribusinesses that supply inputs and services and that process their outputs. The regulatory environment needs to make it easy for these businesses to set up quickly and to run profitably, and this is one of the most powerful ways to help farmers.

Managing agricultural risks

A commercially oriented farmer will engage in a new activity only when the returns on investment exceed the risk-adjusted costs. Farming must be profitable enough to justify the investment.[1] High prices for farm outputs are good for farmers' profitability, but low prices are important to feed the population, support the processing sector, and give farmers who buy some of their food in markets a measure of food security. Since prices are generally market-determined, the key levers are lowering production costs, reducing transaction costs, and increasing sale volumes. Each requires efficient input and output markets, good logistics, and effective institutions.

Agricultural production is inherently risky. In Africa, the main risk arises from the dependence on rain since farming is still mainly rain-fed. The disease and pest burden is also heavy and can lead to losses as high as 30%.[2] The production risk is compounded by poorly functioning input markets that do not always have affordable inputs such as fertilizer available when they are most needed.[3] Counterfeit inputs are also a problem.[4]

Weak institutions contribute to the uncertainty and increase production and price risks. Formal property rights established by government and customary land tenure administered by local traditional hierarchies often conflict, with ambiguous or incompatible procedures for resolving disputes (chapter 2).[5] Other institutional weaknesses include inadequate market intelligence and information systems and deficient (and often unenforced) regulations and standards, which are needed to provide some guarantee for quality.[6] In addition, a lack of institutions for coordinating actors along the value chain impedes the harmonization of needed investments by farmers and other actors, including big trading houses and processors. This leaves the markets to poorly capitalized traders (sometimes referred to as briefcase traders) and artisanal processors, dimming the prospects for agriculture-driven economic transformation.

Many farmers are too poor to invest in risk mitigation tools (such as irrigation), while markets for transferring risk (insurance) are weak or nonexistent. The risk management practices used by some farmers can be costly and inefficient. For example, communal risk-sharing arrangements, such as group rotating saving schemes, can work well for managing individual risk during normal times. But they typically collapse after a widespread weather catastrophe that hits the incomes of all the group's members.[7] So even with the opportunities afforded by improved seeds and practices, farmers may shun the risk that extra investments entail.

Managing production risks

But agricultural production risks can be reduced (for example, through irrigation to lower dependence on rainfall—chapter 3) or transferred (through insurance). The low-hanging fruit seems to be in shifting farmers' risk perception, since they usually overestimate the risks.

Risk-averse subsistence farmers invest only what they can afford to lose—what is not essential to meet their basic needs—and so they tend to be cautious. Risk experiments with farmers in Uganda and elsewhere reveal insights that can help policymakers and development actors deal with farmers' risk aversion. Emerging evidence shows that farmers' risk aversion is sensitive to how risk is framed:[8]

- Because farmers are more sensitive to losses than to gains (loss averse), farmers may even be risk-preferring when risk is framed in terms of losses rather than gains—for example, "using fertilizer can cut crop yield losses by 10%" instead of "using fertilizer can increase crop yields by 10%."
- Farmers are ambiguity averse (avoiding risk when the probability of chance outcomes is unknown), overstating the probability of unlikely outcomes while understating the probability of likely outcomes.

- Receiving information about other farmers' behavior prompts farmers to adjust their behavior immediately, on average about 50%, toward the perceived social norm.
- Similarly, personal experience and knowledge of what others are doing modify reactions to risk. Those who grow cash crops become less averse to risk, as do those who know others who are taking on risk.
- Social context matters. People take fewer risks when such risk taking may impose costs on others in a shared social network, but assume more risk when expected gains could be shared.

Actions that can encourage farmers to grasp the opportunities that come with increased use of purchased inputs include making it possible for more risk-averse farmers to limit their exposure to losses by making incremental small investments—perhaps by marketing fertilizers and improved seeds in smaller packs to appeal to the more cautious.[9] Another action is to modify risk preferences through demonstration and communication. Encouraging farmers to mix with other farmers who have invested and prospered enables them to see the positive results of investment and innovation.

Managing price risks

Price volatility is a key risk for farmers. Some price risk is inevitable, but when it is large and unpredictable, it exposes all actors in the value chain to uncertainty. Many tools, mainly hedging instruments, have been developed to manage agricultural price volatility in developed country markets, but these tools are not easily transferable to Africa because the preconditions are rarely in place. The traditional risk management tool of governments is a national buffer stock. New approaches not involving direct government intervention are being tested, such as warehouse receipt systems and commodity exchanges, but they have not shown the hoped-for success so far. Contract farming is another risk management option if the right enabling environment is in place.

National buffer stocks. Governments want farmers to receive high prices for their output so there is an incentive to produce, yet they want food prices to stay low because of the politically sensitive nature of consumer food prices. Many governments see a solution in national buffer stocks that hold strategic reserves against production shortfalls. Governments set a floor price under which they buy grain from the market for storage (to boost demand and prices) and a ceiling price at which they sell to the market (to increase supply and lower prices). Setting the right price band is critical. If the floor price is too high, it will drive out the private sector, and purchases will exceed the buffer stock's budget and storage capacity.[10] To minimize market distortions and reduce running costs, the price band should be set to trigger government intervention only when shortages or surpluses are large.

Many African countries have buffer stock systems. In Kenya, the grain market is relatively free of government intervention, but the National Cereal and Produce Board still plays commercial and social roles. In recent years, the board has raised the price of maize by fixing a floor price well above market levels, making Kenya's maize prices among the highest in Africa.[11] The board also facilitates procurement, storage, maintenance, and distribution of famine food relief to deficit areas under the National Famine Relief Programme.

Good practices in stabilizing prices using strategic reserves are rare. Problems include weak stock management systems, lack of market information systems based on solid production forecasts and consistent price analysis, and ad hoc and opaque policies.[12] Buffer stocks should be seen as short-run solutions only, suited mainly for smoothing inter-seasonal price variability. The high costs of maintaining stocks over time to deal with infrequent price crises make them an inefficient mechanism for stabilizing prices in the long term.[13]

Warehouse receipt systems and commodity exchanges. Storage infrastructure is vital for managing price volatility. A warehouse receipt system allows farmers to store commodities after harvest in certified warehouses to avoid selling directly after harvest, when high supply depresses prices. Farmers may use receipts of stored commodities as collateral for loans.

To work well on the private side, a warehouse receipt system requires investment in warehouses (and similar infrastructure), financial institutions that accept warehouse receipts as collateral, well-established measurements of standards and quality, and strong producer organizations.[14] On the government side, a well-functioning warehouse receipt system requires supportive legislation, low and predictable market intervention, a strong regulatory regime that fosters orderly development,[15] and a legal environment that enforces contracts. Most of these preconditions are absent or weak in Africa, especially for food crops. However, a warehouse receipt system can succeed for export crops, a sector where farmers are more organized and traders are stronger.[16]

An improvement on the warehouse receipt system is the electronic commodity exchange, a market institution that provides an electronic platform where buyers

and sellers can trade, usually through a group of registered brokers. A commodity exchange requires trading and payments systems and operates on top of a warehouse receipt system, which is the delivery mechanism.[17] Goods are traded and paid for electronically and delivered through the warehouse receipt system.

Many countries in Africa are setting up warehouse receipt systems and electronic commodity exchanges. Some exchanges have increased market efficiency, such as the Malawi Agricultural Commodities Exchange, which has spatially integrated rice markets.[18] The Ethiopia Commodities Exchange (ECX) is perhaps the best known example of a successful commodity exchange in Africa. ECX trades more than 600,000 tons of commodity (mostly coffee) and reaches more than 3 million farmers.[19]

But the warehouse receipt systems and commodity exchanges (the South Africa Futures Exchange aside)[20] have a long way to go before they improve market efficiency, and their trades are very small. Vibrant agricultural commodity exchanges could greatly enhance the performance of Africa's agricultural markets, but so far, they have been unable to do so, especially in the key grain markets.[21] The Nigeria securities and commodities exchange traded less than 4,000 tons between 2007 and 2010, the warehouse receipt systems under the East Africa Grains Council traded 13,546 tons in 2015 and the warehouse receipt systems under the Ghana Grain council 47,230 tons in 2015. By comparison, the South Africa Futures Exchange trades 200,000 tons a day.[22]

Contract farming. A simpler, more accessible arrangement for managing smallholder price risk, especially as agroprocessing develops, is contract farming. It links farmers directly to markets and buyers, who can be bigger farmers, traders, processors, or even large retailers. The price is negotiated and agreed on in advance, protecting each party from market volatility. The power of this model is that, beyond securing ready access to markets, farmers also get a support package that can include seeds, financing, and extension services.

Increasing access to agricultural output markets

Africa imports huge and growing quantities of food to meet the demands of its rapidly urbanizing populations whose incomes are rising. These food imports are clear testimony to the continent's attractiveness as a food market and an unambiguous sign that its agricultural value chains are uncompetitive in local and international markets because they are unable to offer differentiated products of high quality that meet customer price points. The subsistence farming that dominates Africa's farming landscape has been hard pressed to respond to the demand in either quantity or quality.

Output market challenges

The subsistence orientation of African agriculture is driven largely by the production and market risks that farmers face. In addition to the production and price risks already discussed, farmers face wide price volatility in output markets, which is a difficult challenge for farmers interested in commercializing their farming. Market volatility means that farmers who produce for the market while meeting their household food needs through purchases in the market can have no certainty of being able to afford food when they need to buy it. Compounding this problem is the long lag between investing and getting returns. Because relying on the market for their own food can be too risky, farmers' best option is to produce food for home consumption first and to sell only the surplus to the market. Without instruments and investments to mitigate and manage output market risks, small farmers are unlikely to adopt a commercial orientation, even when new seeds and inputs, alongside rising market demand, provide opportunities for increasing their output and income.[23]

Output markets in Africa do not function smoothly. They may be fiercely competitive, but costs remain high because markets cannot exploit economies of scale. Transaction costs are also high because products are traded through numerous hands along the marketing chain. In more remote areas, producers have little choice of service providers or output buyers. Producers' ability to respond to market opportunities are further limited because there are few mechanisms to link market opportunities to pre-harvest services (input supply, extension, and credit).[24]

Another major risk to food crop farming has been the government's tendency to intervene (some would say interfere) because of political concerns over food security. And the market liberalization undertaken in many African countries in the 1980s and 1990s to improve the efficiency of agricultural output markets has yielded mixed results (box 4.1).

But even when governments do not intervene, traditional output markets in Africa are not necessarily free. In urban areas, especially, some traditional markets are controlled by cartels. In Uganda, for example, traders cannot get their products to the biggest market in Kampala (Owino market) without the approval of a cartel that decides who trades there, even though the market is owned by the city of Kampala.[25] In West Africa, "market

BOX 4.1

Agricultural liberalization—Which way?

Improving the performance of agricultural markets has been a priority of African governments and development partners, and liberalizing markets has been seen as a way forward. But although efforts to liberalize markets have been going on for some time, the results are mixed. Four main arguments are advanced to explain the disappointing results:

- High transaction costs and agricultural marketing risks (for input suppliers, producers, buyers, and processors) and a lack of coordination of market activities leave markets trapped in a low equilibrium of low inputs and low outputs.
- The state still intervenes in markets too much, or too arbitrarily, to give private traders and potential investors the confidence to invest heavily.
- Market liberalization has coincided with a sharp decline in state budgets and thus in public investment in key public goods needed to improve markets such as research, extension, and infrastructure.
- Market liberalization put too much emphasis on getting prices right. But farmers must have productive technologies and public goods to produce a marketable surplus. So, getting institutions and endowments (public investments) right is also key. Farmers in remote areas who previously had market access through state marketing boards have been largely deprived of markets.

Source: Poulton, Kydd, and Dorwar 2006, citing Kherallah et al. 2000; Jayne et al. 2002.

queens" (product association leaders at market centers who buy food from field suppliers and sell to retailers) dictate selling prices and who sells in the markets.[26] Their power is tolerated as part of a respected tradition, even though some analysts see them as exploiting farmers.[27]

While traditional open-air markets for agricultural goods still dominate, urbanization and the rise of the middle class have created a new market for high-quality, differentiated, and well-packaged goods, increasingly filled by supermarkets (box 4.2).

Accessing markets can be hard if the costs of reaching and transacting in the markets are very high or if market institutions are weak. Several steps can strengthen agricultural output markets: upgrading transport, intermediating markets, integrating markets, improving quality and standards, strengthening farmer organizations, enhancing the role of traders, and improving contract farming.

Upgrading transport

Weak transport infrastructure is a key impediment to accessing markets. Poor infrastructure means that transports costs are very high, making goods uncompetitive. Across four rural districts in Uganda, the farmgate price and the transport cost were approximately the same. For cassava, transport costs exceed farmgate prices.

Poor roads are the main culprit.[29] Due to poor road conditions, long-haul motorized transport in rural markets tends to involve considerable capital and maintenance costs for transporters, which also poses a barrier

BOX 4.2

Supermarkets and their impact on African farmers

Supermarkets are adept at creating value, and because some of this value gets to farmers, farmers can benefit from being part of supermarket channels. Farmers selling to supermarkets tend to earn 20%–50% more than farmers selling in traditional markets and to have 15% higher productivity. Such participation increases their likelihood of hiring labor by 20% and boosts demand for hired labor, especially for female laborers.

Selling to supermarkets requires farmers to upgrade their technologies to meet stricter requirements, but having a guaranteed market increases their ability and willingness to invest, reduces market risk, and allows them to specialize and operate closer to optimum scale. Being part of the value chain also increases access to product and market information and to technical assistance, while lenders are more willing to lend based on the assurance of a steady market.

All the same many small farmers and processors find it impossible to meet these requirements and are dropped from supermarket procurement lists or never make it onto the list.[28]

Source: Reardon and Gulati 2008; Emongor and Kristen 2009.

to entry by other firms.[30] However there is no easy fix for this challenge, as road construction is expensive. A program of road construction and maintenance that would expand Uganda's network of all-weather roads so that 75% of the population would be within a distance of 2 kilometers of such roads would require spending of 3.6% of GDP annually for 10 years.[31] For most countries, road construction will be a slow process, calling for short term to medium term cheap transport solutions.

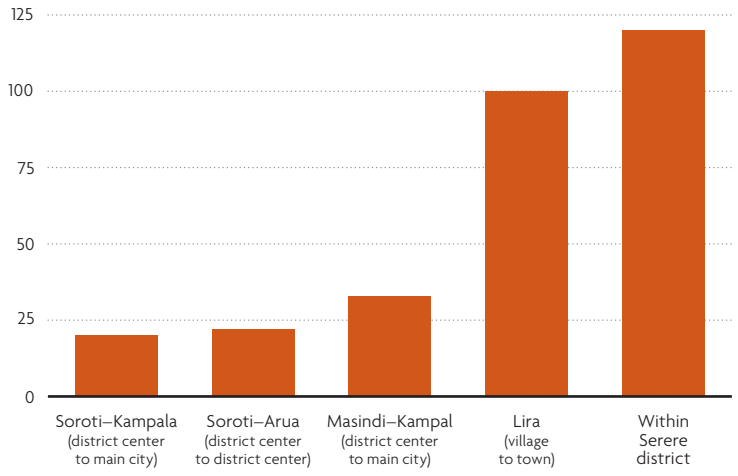
Of particular concern is the cost from the farmgate to the next market, which is the most expensive leg of the transport, often preventing farmers from even venturing into the market. In Uganda, the cost of transporting cassava within a district can be six times the cost of moving it from the main district center to the main city (figure 4.1).[32] Transport costs account for 76% of the marketing costs along the maize value chains in Kenya, Tanzania, and Uganda.[33] The first quarter of the distance between farmers and urban wholesalers accounts for 44% of those transport costs.

Lowering transport costs (especially for the "first mile" from the farm) requires the development of cheaper transport solutions in addition to better road infrastructure. Smallholder farmers produce only a small surplus for the market, well below the capacity of regular transport vehicles, making the unit costs of transporting their output extremely high. One solution for the "First Mile" challenge is the motorized tricycle (box 4.3).

FIGURE 4.1

Transport costs for cassava farmers in Uganda, 2012

Ugandan shillings per 100 kilogram bag per kilometer



Source: ACET 2015e.

Intermediating markets

Market participants incur heavy transaction costs due mainly to weak market intermediation institutions that leave participants vulnerable to cartels, cheating on weights, and adulterated products.[38] Without market institutions to reduce search, monitoring and verification, and storage and handling costs, any productivity cost advantage smallholder farms might have over imports is likely to be eroded by high transaction costs.[39]

Farmers usually rely on traders to access markets, mainly because they lack the resources and knowledge about markets—and because their job is to produce. These traders provide valuable services, often in even the remotest areas. In Kenya, Malawi, Mozambique, and Zambia, 72% of isolated villagers reported being served by 10 or more grain traders during the marketing season. Traders were the preferred intermediaries mainly because they paid cash.[40]

But some traders exploit farmers. One way is by using measuring devices that hold more than they are supposed to (such as some samples of the *gorogoro,* the standard measuring device for buying maize in Kenya[41]) or hold more than farmers think they do (such as Kia trucks sometimes used to weigh cassava in Ghana, which can hold 7.5 tons though farmers believe they hold 4.5 tons[42]). In these cases, farmers are underpaid for their output. However, other studies indicate that farmers get a fair price and that intermediaries' high margins are a reflection more of underdeveloped value chains, with many players and high costs, than of dishonest practices.[43]

New tools are improving market intermediation, often using modern information and communications technology platforms. At one end of the spectrum are mobile phone–based systems such as *eSoko* in Kenya, Tanzania, and Ghana, which provide farmers with updated information on market prices and help them negotiate prices with traders.[44] In India, traders had to raise their prices to farmers once farmers had access to text messages about market prices on mobile phones. More advanced systems, which combine price information with the ability to complete trades, have also been rolled out. The primary motivation of these tools is to cut out the trader. But these innovations have not yet undermined traders' dominance (box 4.4).

Integrating markets

Because the demand for most agricultural products is fairly inelastic (relatively insensitive to price changes), integrating local markets with national, continental, and international markets is key if farmers are to benefit

BOX 4.3

Tackling the "First Mile"—Motorized tricycles

Motorized tricycles with small load-carrying capacity offer one solution for tackling the "first mile" problem. The government of Ghana introduced these tricycles—also known as "motor kings" to farmers.[34] In the Brong-Ahafo region, about 97% of farmers and intermediaries surveyed can access a means of transport within 24 hours of harvest, compared with 50% before the tricycles were introduced.[35] About 33% of survey respondents can transport more of their agricultural produce than before, and about 94% report considerable savings on transport. Access to affordable transport has also reduced losses as farmers do not have to delay harvesting or store produce at home, where spoilage can be high. Some 45% of respondents reported no on-farm losses, and 78% reported reduced losses from thefts, bushfires, animal destruction, and physical damage. The tricycles are now assembled in Ghana, reducing their cost and making them available even in the remotest areas.[36] The tricycles also enable extension agents to reach hard-to-access areas.[37]

Source: SRID-MoFA 2014; Aikins and Akude 2015.

from technological changes to expand production.[47] Without larger markets to absorb the increased supplies made possible by technological advances, prices could fall, possibly leaving producers worse off than before. Moving farmers' operations from a low equilibrium (low inputs, low output) to a high equilibrium (high inputs, high output) thus requires markets to "thicken" so that they can support higher trade volumes without a price collapse. The key is integrating local markets with national and continental markets, to absorb the farmers' surpluses.

Some cross-border markets are more accessible to farmers than domestic markets are. For some farmers in the Tanzanian highlands, for example, markets in Malawi and Zambia may be more accessible than domestic markets. Similarly, farmers in the Kilimanjaro region of Tanzania may find it easier to access markets in Kenya,[48] while for southern Ethiopian farmers, Kenya, across the border, is the best market for their beans.[49] More generally, policymakers ought to be sensitive to the idea of "natural" markets, treating regional trade differently from international trade. For this idea to work, a regional food security arrangement that incorporates regional trade (for inland zones) and imports (if need be for coastal zones) would be more efficient than each country having an independent food security strategy.

The bigger markets that come with integration have many benefits. For instance, they provide incentives for private traders to invest in the fixed costs of setting up large trading operations, which are critical to upgrading value chains. Transaction costs are likely to fall as more players allow market coordination mechanisms to work. Bigger markets make possible larger transaction volumes and more frequent transactions, further reducing costs and risks for exchange and coordination as the fixed costs of establishing these relationships are spread over larger and more frequent transactions. More frequent transactions also establish trust and create incentives for contracting parties to honor contracts.[50]

The impact of improved regional trade can be large. Simulations suggest that coupling the higher maize productivity resulting from the application of new technology with improved transport and regional trade generates

BOX 4.4

M-Farm

M-Farm, founded in Kenya in 2010, has the aim of connecting small farmers to buyers directly, bypassing traders, and giving farmers direct access to current market prices via an app or text message. M-Farm also introduced a group-selling tool that enables farmers to join together and bring their produce to group drop-off points. Group selling gives farmers greater visibility among buyers by increasing the overall volume of produce.[45] The company founder soon realized, however, that it sometimes still needed to work with traders, whose multiple relationships and deep understanding of the market were key to getting the volumes needed as M-Farm's business grew. M-Farm still sources directly from farmers, but for large orders it resorts to traders.[46] The more sustainable innovations are likely those that provide farmers with market information to help them plan and negotiate, that link them to traders, and that connect traders to markets to execute orders.

Source: Solon 2013; Kwamboka 2016.

25% higher farmer incomes, and lower consumer prices, than when the same new technology is introduced into an unchanged marketing system.[51] Yet the reality of regional trade has yet to match the rhetoric. Intermittent trade restrictions, coupled with frequent roadblocks and their associated delays and bribes, disrupt market signals, raise transaction costs, and limit market integration.[52]

Improving quality and enforcing standards

Standards have become more important to agricultural markets. Uncertainty about the quality of maize supplied by smallholders in Zambia, to take one example, forced farmers to accept a 10%–15% price discount several years ago.[53] Consumer health and environmental concerns are the drivers, especially in international markets that require demonstrating compliance with standards. Entrance of big buyers in local markets is also putting a premium on quality and encouraging local traders to upgrade their systems (box 4.5).

Many countries have enacted domestic standards that are largely not enforced. But urbanization and a rising middle class are creating greater awareness for food safety, and this is slowly changing the food retailing landscape. Supermarkets are leveraging this by offering superior product and communicating this through effective branding to capture this emerging middle class market. Standards authorities are also issuing quality marks to certify local products so that they can be sold in supermarkets.[54] However, as domestic standards evolve to meet new market expectations, care is needed. While lack of standards is not good for trade, poor standardization policies may be worse especially when inappropriate standards disconnect poor farmers from poor consumers in regional and even domestic markets.[55] Standards can lead to additional trade costs when other cheaper and less disruptive ways are available to avoid health and safety risks. Domestic standards should seek as much as possible to be consistent with local realities (box 4.6).

International standards that apply to farmers wanting to export have little room for flexibility. Compliance is a requirement, and this may require significant upgrading of skills and facilities. Support is needed especially for smallholder farmers, and indeed without support from governments, donors, and nongovernment organizations, many smallholders will be unable to participate in export markets.

Standard setting is also shifting from the public sector to the private sector, particularly to retailers such as supermarkets, whose ability to set standards reflects their power as a dominant player in agricultural value chains.[56] These private standards are often preventive standards such as hazard analysis and critical control points (HACCP), a management system for food safety through the analysis and control of biological, chemical, and physical hazards at all points from raw material production and handling to manufacturing, distribution, and consumption. This differs from the traditional method based on outcome standards enforced through random checks by industry and regulators. Retailers and manufacturers can use HACCP systems as competitive weapons[57]—strategic tools to differentiate products and to coordinate supply chains—especially since complying with emerging private standards requires substantial investment in upgrading skills and processes.

Although standards can be specific to a retailer, many international buyers now agree on common standards such as GlobalGAP, which some countries are adapting locally to help local farmers upgrade (box 4.7).

BOX 4.5

Local purchasing under the World Food Programme

Food relief organizations are starting to buy food locally rather than sourcing it exclusively from donor countries. The World Food Programme (WFP) has been particularly active in local markets through its Purchase for Progress program. This shift is having some impact on local food markets because of the quantity and quality requirements that come with these purchases, especially in a trading landscape dominated by small traders who initially find it hard to meet these conditions.

Participation provides opportunities for local traders to learn how to upgrade their logistics to meet the WFP's demands. The WFP has stepped up the quality culture in Ethiopia, Malawi, and Uganda, for instance. Traders in Uganda contracted by WFP are paying a 33%–60% price premium to farmers for their now higher-quality maize. Traders and processing companies have also invested in new machinery and new practices to satisfy WFP demands. In Ethiopia and Malawi, WFP operations have spurred local traders to enter the market, stimulating competition.

Source: Tschriley, Myers, and Zavale 2014.

BOX 4.6

The East African Community's grain standards—just too much?

The East African Community (EAC) has made more progress than most of the continent's regional economic communities in achieving its regional integration objectives. A notable milestone includes a customs union. But in its zeal to deepen integration and enhance trade, the EAC has developed standards for grain that are higher than existing standards for member countries and in some aspects higher than international standards.

For example, the EAC standard on maximum moisture content is far more demanding than the international standard in the Codex Alimentarius. EAC standards also include a specification for total defective grain that did not exist in Kenya and Uganda before harmonization and that is not part of the Codex. The new standards make it hard to import surplus maize from Zambia (a nonmember) to the EAC bloc, which has a deficit in the cereal, as happened in 2012.

While the effort is laudable, the EAC seems to have missed the larger point of standards. Contrary to the view that mandatory standards are needed to facilitate trade, this is not always the case. A vibrant grain trade exists in Southern Africa where buyers specify the quality attributes they require and leave it to the seller to match them, though public health and other sanitary and phytosanitary concerns are still addressed through phytosanitary regulations.

Source: Keyser 2012.

BOX 4.7

KenyaGAP

Benchmarked against the common international standards in GlobalGAP, KenyaGAP was introduced in 2007 as a standard certifying that fruit and vegetable farmers in Kenya met standards for exporting to Europe. But complying with KenyaGAP can be a daunting challenge, especially for smallholders—demanding, for instance, that farmers maintain records of pesticide application protocol, evidence of training in crop hygiene, testing of soil and water, and assessment of crop handling facilities. For organized smallholder farmers, a one-time certification costs about US$632, and audits cost US$154 a month (and much more for nonorganized smallholders). The market premium farmers get for compliance with KenyaGAP is 12%–25%.

Source: Kariuki, Loy, and Herzfeld 2012.

While putting greater emphasis on compliance with standards by farmers and value chain players, governments also need to help farmers do so. Extension officers should expand their advice to cover ways to deliver quality products. National standards organizations should make standards consistent with the country's level of agricultural development and simplify and reduce the cost of compliance.

Strengthening farmer organizations

Acting collectively, smallholders can improve their market access by reducing barriers such as high transaction costs and their poor credit status in financial markets (including a lack of collateral). By organizing in this way, farmers can also improve their access to information, meet standards for quality, and gain entry to new domestic or international markets.

There are successful models of farmer organization.[58] But many organizations are plagued by weak systems of accountability, permitting a raft of issues to gain hold, ranging from nepotism to outright fraud. In a fertilizer distribution program in two Nigerian states, farmers in one received the fertilizer indirectly, through their farmer organization, and farmers in the other each received it directly.[59] In the first set, relatives of the organization's president received more fertilizer bags than others in the organization. And among millet farmers in Kenya, many were wary of such potential problems, though farmers acknowledged the benefits of membership.[60]

Farmer organizations thus need to incorporate structures of accountability, to make more use of management information systems, and to integrate these systems with mobile phone applications, allowing farmers to monitor the organization's practices in real time.

Enhancing the role of traders

Traders link farmers to markets. Many are small and weakly capitalized, so they are hard pressed to upgrade value chains. That means that product distribution chains are long, with products handled many times and thereby increasing transaction costs and (often) lowering quality. Sometimes adulteration occurs as some in the long chain may be unscrupulous. Most traders deal in small volumes over short distances, storing their goods for less than a month.[61] This means that the market stabilizing function of traders through temporal and spatial arbitrage, seen in other markets, is severely limited in Africa.[62] Attempts by the WFP to use small traders in Mozambique ran into challenges because they lacked infrastructure (warehousing and transport), and they found it hard to meet quality standards.[63] And low access to working capital meant that they struggled to cope with the long delays in payment when dealing with huge and bureaucratic organizations.

FIGURE 4.2

How traders can upgrade value chains

Source: ACET 2015f.

Stronger, better capitalized traders can upgrade the value chain by improving transport, storage, grading, cleaning, and other logistical services. Bigger traders can also integrate forward, drawing on their expertise in supply chains to expand into processing. The development of many industries has taken this organic path in which traders or importers become manufacturers over time as they develop a better understanding of supply and markets, build relationships, and accumulate resources.[64] Traders can also become information brokers, for example, by disseminating new seeds and other inputs.

In the Sindh, India, interlocking contracts combine effective recovery of input loans with competitive prices for inputs and outputs,[65] benefiting both traders and farmers. In areas where there was competition for market share and information sharing on borrowers among traders, traders screened and shared information on potential defaulters, providing a mechanism for channeling capital—sourced from wider national markets—to farmers through the crop marketing chain. The traders, in essence, were acting as both credit bureaus and lending arms ("branches") for national financial markets.

Operating a warehouse receipt system is an attractive option for traders, enabling them to buy products, sell storage services, and provide lending services as bank agents. A trader-centric warehouse receipt system solves some of the problems such systems face, particularly low trade volumes and reluctance by banks to lend on the basis of warehouse receipts (since they are not sure of the quality of the stored commodity that serves as collateral).

Nongovernmental organizations and social entrepreneurs bent on developing lending platforms aimed at cutting out traders probably need to reorient their efforts to support trading platforms that integrate traders. Ways need to be devised to merge the effectiveness of traders as creditors with a more open system like commodity exchanges.[66] Warehouse receipt systems and electronic commodity exchanges should incorporate traders as key stakeholders (figure 4.2) while increasing the transparency of trades. (At the moment, the objective seems to be to replace traders rather than work with them).

Policies that increase competition among traders, improve information sharing among them, and link them to lenders can increase the flow of funds to both traders and farmers and improve the functioning of input and output markets. Governments can also use tax breaks, interest rate subsidies, or special funds to help successful traders expand. Formalizing traders' informal lending can also enable them to expand credit to farmers. Private

BOX 4.8

The rise of the large-scale trader

While the trading landscape continues to be dominated by small poorly capitalized traders, this could be changing. Large-scale traders (LSTs) are rapidly capturing market share away from the small-scale traders. Between 2012 and 2015, maize sales to LSTs increased from 3% to 12% in Zambia, and in Kenya from virtually no sales in 2004 to 21% in 2007 and to 37% in 2014.

This development is driven to some extent by the rise of medium-scale farmers. Districts with a large share of cultivated land under medium-scale farms have witnessed the entry by LSTs accompanied by significant new investments by these traders. LSTs want to buy larger volumes per transaction to reduce transaction costs. And once they set up, they also buy more from small farmers too.

LSTs are also using contracts with processors downstream and contracts with smallholder farmers upstream to coordinate supply chain activities. As a result of improved supply chain coordination and economies of scale in transport, they tend to offer roughly 5% higher farmgate prices than the small-scale traders do. In addition to offering higher prices, LSTs are increasingly providing smallholder farmers with services, including extension advice, price information, and input credit.

This transformation of the agricultural landscape offers new opportunities for commercializing agriculture while also increasing smallholder incentives for intensifying production. That this is being driven by the emergence of medium scale commercial farmers shows the critical role of this farming sector in transforming agriculture. LSTs and medium-scale farmers have a symbiotic relationship, each needing the other, and the relationship has spillovers that benefit smallholder farmers.

Source: Sitko, Burke, and Jayne 2017.

sector businesses can also support the emergence of stronger traders. In Kenya and Uganda, the success of sorghum as an input to the beer brewing industry came about thanks to the emergence of strong traders who, with the backing of the breweries, provided supports to farmers, including inputs, mechanization, grading, and storage.[67]

Improving contract farming

As discussed in the section on managing price risk, contract farming can be one of the means of reducing price risk for farmers. It is also a sound way to tackle problems of access to markets and finance. Contract farming enables an off-taker, usually a large commercial farmer or a purchaser of agricultural produce (such as a processor or trader), to acquire produce from small farmers by guaranteeing them markets (quantity off-take and price level) before planting or harvest. These guarantees also help attract financial providers.

Contract farming can also address farmers' food security concerns, especially among contract farmers who produce cotton or other nonfood cash crops. For instance, in Mali, Compagnie Malienne pour le Développement du Textile has achieved some success in boosting maize production by making seeds and fertilizers available to its contracted cotton producers through its credit scheme.[68] But contract farming also has challenges that must be addressed it order for its full potential to be realized (box 4.9).

To reduce payment delays, Dunavant, a cotton buyer that contracts farmers in Zambia to grow cotton, has an electronic payment platform to ensure that farmers get paid promptly, which reduces their incentive to side-sell. This online interface releases payment as soon as the crop voucher receipt is processed, usually within one day.[73] Most contractors pay farmers only after they have exported the products or sold them in the domestic market. Adopting this rapid payment system requires adequate working capital, underscoring the need for strong credit markets (see the section on access to agricultural finance).

Policies to increase contract farming include reforms to establish a supportive business environment. In addition, governments could route some support to farmers through their contractors, so that each can leverage the other's efforts. For instance, the government could provide extension officers, and contractors could provide transport for them to farms. Providing tax breaks to contracting firms and farms or setting up specialized funds to support activities going beyond contracting parties' main interest could also help farmers diversify incomes and address food security.

BOX 4.9

Contract farming—opportunities and challenges for commercializing agriculture

Contract farming lowers risks by guaranteeing a price to farmers while providing a stable market for output. Contract faming also provides inputs to farmers, thus addressing input and credit challenges.

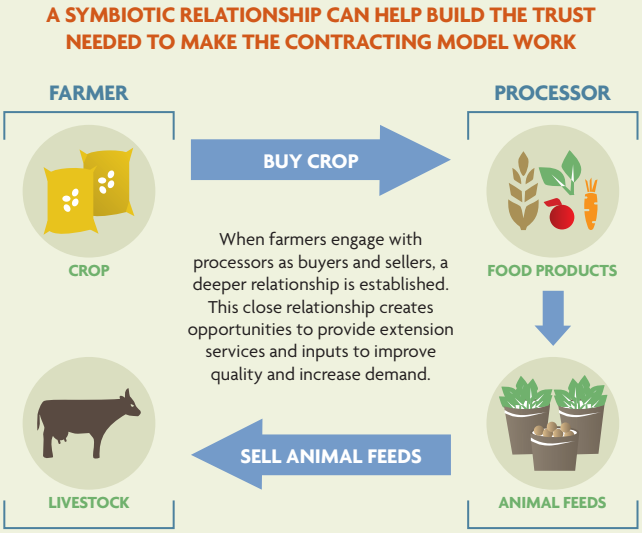
But a perennial lack of trust undermines the model. When farmers sign a contract, they agree to provide a certain quantity of products for a specified price and to pay back loans and other services advanced by the purchaser or off-taker (often a large commercial farmer, processor, or trader). However, some farmers "side-sell" when they have an emergency requiring liquid assets, since they lack access to credit and other sources of income. And when spot market prices at harvest are higher than the pre-agreed contract price, farmers have an incentive to renege on the deal by selling into the market at higher prices rather than meeting their commitments.[69]

In Uganda, for example, to help farmers take advantage of World Food Programme (WFP) local purchase contracts, farmers were organized into associations that could engage in collective marketing (to bulk fulfill an order). But when market prices subsequently rose (perhaps in part due to the WFP purchases), member farmers often sold in the market at a higher price rather than meet their bulking commitment, making it hard for the farmer associations to deliver on the WFP contract.[70]

On the other hand, farmers also complain of buyers rejecting products on flimsy grounds of low quality, as happened to poultry farmers in Kenya.[71] Often, the real issue is that the buyer does not want to honor the contract because of market challenges, including adverse market movements against the buyer.

Trust needs to be built before contract farming can work. Some contract models can help develop trust, while still enabling farmers to diversify incomes. In one model, the off-taker supports farmers in developing a second, more regular line of income. NUMA Foods in Uganda, for example, helps its millet outgrowers establish a livestock business for which NUMA Foods also sells feed, creating interdependency and helping farmers diversify their income sources. Similarly, Pwani Feeds in Kenya supplies inputs and sells feed to its contracted farmers and buys eggs in return. The interdependence and repeated transactions help create trust (see figure).[72]

Diversified and interdependent contract farming model



Source: ACET 2015f.

Improving agricultural input markets

Having well-functioning input markets is crucial in boosting productivity, but they are lacking in many parts of Africa, where high costs and fake inputs impede the use of modern inputs.

Inputs can be very costly to the extent that they may not be profitable to use. For instance, fertilizers have been estimated to account for 30%–50% of the costs of grain and oilseed producers in Southern Africa. Input costs are largely driven by high transport costs and also uncompetitive input markets. The oligopolistic structure of fertilizer markets in many African countries contributes to high costs. In Tanzania and Zambia, the top three suppliers control 60%–70% of the market. And in Malawi and Tanzania, fertilizer prices continued to rise between 2010 and 2012 even as international benchmark prices were falling (figure 4.3). Worse, the Competition and Consumer Commission of Zambia found that the two top suppliers were a cartel that had rigged government contracts for fertilizer supply between 2007 and 2011.[74]

As discussed earlier, transport and transaction costs for participating in output markets are high. The same

also applies for input markets. The unit cost of transport is just as high to move fertilizer from a distribution center in Ethiopia to farmers living about 10 kilometers away as it is to transport the fertilizer from the international port to the distribution center about 1,000 kilometers away.[75]

High transport costs are also attributable to official and unofficial market regulations and the structure of trucking industry, especially in West and Central Africa.[76] In the coastal countries of East Africa (such as Tanzania), powerful trucking lobbies seek to control the rules governing the trucking industry.[77]

Beyond high prices, some input markets (in Ghana and Kenya, for example) have to contend with adulterated products. Counterfeit inputs include seeds, drugs, animal feeds, and even services (quacks posing as veterinarians in Ghana).[78]

Several initiatives could make inputs more available and cheaper for farmers.

Improving regulation to increase competition

Improving regulation to create an environment that promotes competition and investment by the private sector maybe the low hanging fruit (and it does not require much in public spending). In Kenya, fertilizer use per hectare rose by 34% between 1990 and 2010 due to market reforms that made markets more efficient.[79] Prior to the reforms, the fertilizer market was controlled by state and quasi-state enterprises that set prices and controlled which firms could receive licenses. This structure encouraged rent seeking. Further, fixed prices meant that farmers needed to travel long distances to access fertilizers, as it was unprofitable for dealers to set up shops near farmers due to high transport costs. This impeded demand.

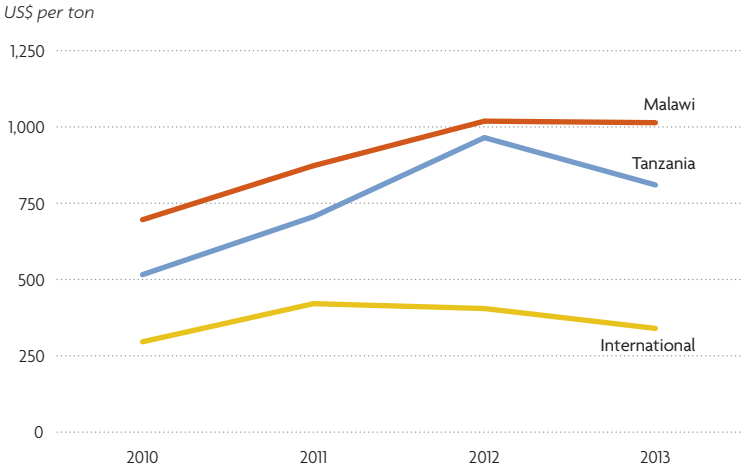
Full liberalization of the market saw a decline in fertilizer marketing margins and an expansion of rural fertilizer retailers. The reforms increased competition and attracted new investments in expanding the supply chains. This reduced costs for farmers and stimulated demand. Note that this increase in use was achieved without subsidies, which has been the dominant approach in several African countries in the last few years (see chapter 3).

Selling smaller input packs

Risk-averse subsistence farmers are cautious: they will invest a little at first, and if the new input works, they will invest a bit more. This suggests that selling fertilizer in smaller packs of 1, 2, 5, and 10 kilograms rather than the customary 50 kilogram pack might increase farmer uptake, as it has in Uganda.[80] It also makes commercial sense for small farmers with small plots, since a 50 kilogram bag may be more than they need.

FIGURE 4.3

Fertilizer prices in Malawi and Tanzania are well above international levels and continued to rise as international prices fell, 2010–2013



Source: Roberts and Vilakazi n.d.

Expanding the franchise model

In Kenya, the large number of small shops selling agricultural and veterinary inputs ("agrovet" shops) makes it hard to police bogus products.[81] Encouraging franchise shops that could develop strong brand recognition would reassure customers about quality and could contribute to higher use of inputs among farmers (box 4.10).

Delivering inputs as a service

There are several advantages to a having access to inputs as a service rather than as an outright purchase. That avoids having to pay the fixed costs of some capital equipment or bulk inputs (such as knapsack sprayers and chemicals) that small farmers may not be able to afford or that may not be cost-effective as a purchase for use on an individual small farm. But for input providers that can serve several farmers, the purchase could make financial sense. And because the service provider is likely to be properly trained, the inputs can be prepared and applied properly. In Nigeria, this model has been used to train youths to provide weed killing services.[82]

Using commercial farmers

Commercial farmers can improve the market for input services. As noted in chapter 3, in northern Ghana, 44% of large scale farmers who owned tractors also offered

BOX 4.10

Farm Shop: Franchising agricultural and veterinary input shops in Kenya

Farm Shop, a company in Kenya, is trying to tackle the problem of fake inputs by franchising agricultural and veterinary input shops (agrovets) and upgrading them to provide high-quality products, services, and information. This approach should translate into increased productivity for subsistence farmers. The cornerstone in a franchise is the assurance of a certain standard. Farm Shop aims to position itself as a chain of clean, modern, and professionally managed shops.

Farm Shop spends 12 weeks screening each potential franchisee. Existing agrovets are selected based on criteria such as purchasing power, willingness to work, interest in the concept, and financial discipline. And to become a popular hub for everything innovative, franchise shops must have social standing in the community. Once selected, a franchisee takes out a US$4,000 loan for working capital and inventory at a competitive interest rate through Farm Shop, with a repayment period of 24 months. In 2011, Farm Shop offered its franchisees loans at the interest rate of 15%, compared with the 18–28% commercial rates that prevailed at the time.

To build the capacity to provide farmers with the right products and services, franchisees receive training (sales and business skills), tablet computers with Internet access, price lists, and shop branding. Franchisees are also equipped to deliver soil testing and chemical spraying. Farm Shop facilitates networking among franchisees and holds demonstration days, training sessions, and farm visits. A comprehensive community education program helps farmers understand the products, services, and methods on offer, which in turn stimulate demand.

Source: http://www.cbs.dk/files/cbs.dk/panum_and_hansen_2014_3.pdf.

mechanization services to other farmers. On average, tractor owners plowed 34 hectares on their own farms and about 200 hectares for other farmers as a paid service.

Increasing access to agricultural finance

Farmers need access to investment capital to buy capital inputs and to make other farm improvements, and they need access to working capital to produce and market their output. As in all businesses, access to credit is crucial to farming, but smallholders face particular credit constraints for several reasons. Agriculture is subject to high weather and market risks. Financial services providers find lending to farmers too costly, since in addition to these risks it entails many small loans, and farmers are widely dispersed, lack collateral, generate irregular cash flows, and have low financial literacy. And many financial services providers know little about agriculture. In short, banks find lending to agriculture to be too risky and so rarely develop financial products that meet smallholders' needs and expectations (with some exceptions, as seen in the next subsection).[83]

The share of commercial bank lending to agriculture in Africa is very low: 3% in Sierra Leone, 4% in Ghana and Kenya, 6% in Uganda, 8% in Mozambique, and 12% in Tanzania.[84] Credit access is tight not only for farmers, but also for aggregators, traders, and processors in agricultural value chains. For female smallholder farmers, access to credit is even more difficult.[85] Women's unequal access to finance is linked to social and cultural barriers, limited education and mobility, and misconceptions about the role of women in agriculture (chapter 8).[86]

Lacking access to formal lending, smallholders have traditionally relied on savings and borrowing from families and informal lenders, though often at extremely high rates.[87] Some lending is based on trust and personal relationships. Informal lenders often report very low administrative costs, typically under 3%, against banks' reported administrative costs of about 12%–19%. They also report very low default rates: more than 80% of moneylenders surveyed in Ghana and Nigeria reported no delinquent accounts.[88]

Membership in farmer-based organizations is another traditional way of accessing credit. Membership is closely linked to access to agricultural credit among farmers in Benue State, Nigeria, and in Ethiopia.[89] But less than 10% of Africa's smallholders are members of such organizations.

Emerging financial instruments

A combination of electronic platforms with new business models is lowering costs and increasing the accessibility of financial services, deepening financial inclusion. Some innovations now target smallholders; the most dynamic ones have been introduced by social enterprises.

Innovations driven by social enterprises and microfinance institutions. One Acre Fund is providing value

chain financing to smallholder farmers in Kenya and Rwanda through a package that includes inputs, insurance, and storage (so that farmers can sell when prices are higher). The fund also has a flexible repayment model that allows farmers to pay according to the farming cycle.

Opportunity International—one of the world's largest microfinance institutions—is providing direct lending to small farmers in Ghana, Malawi, Mozambique, Rwanda, and Uganda. Its "informed lending" production finance model is anchored on an exact mapping of the borrower's farm plot (including plot size, altitude, and access to water); a diagnostic of the borrower's household profile (demographics of the family; breakdown of all farm enterprises such as crops, land used, other sources of income; mobile phone use; and access to roads and banks); and the crop profile, including costs of inputs and labor and returns based on yield and price data.[90]

New banking models for farmers. Some traditional banks are giving agricultural lending a fresh look, developing new models and working closely with development partners (box 4.11).

Government lending initiatives. Governments have traditionally tried to stimulate lending to agriculture through specialized agriculture banks, but some have proven unworkable, undone by inefficiencies associated with patronage and rent seeking. Governments in Brazil (box 4.12) and in Africa are exploring new ways to support lending to farmers.

In Ghana, the Export Development and Agriculture Investment Fund (EDAIF), now re-named the Ghana Import-Export Bank, has provided financial resources for developing and promoting agro-processing (among other services).[92] Funded by a 1.5% levy on all imports, it has provided loans through designated financial institutions —many of them banks—to ensure high standards of lending. But the approach has not worked as well as intended. Banks were expected to on-lend the money at 12% interest and collect a fee of 2%. However, banks have been reluctant to direct borrowers to these funds, preferring to lend their own funds to good projects (at interest rates of up to 28%). And loans using EDAIF funds bore the risk of default, which many banks were unwilling to assume.[93] As the problem of lending to agriculture is really one of risk, not one of poor bank liquidity, EDAIF seems to be have been addressing the wrong challenge.

In Nigeria, the government seems to have identified the issue correctly. The Incentive-Based Risk Management System for Agricultural Lending (NIRSAL), set up by the Central Bank of Nigeria, seeks to lower risk in agriculture so that banks can lend with confidence. The government has spent some US$350 million to leverage US$3.5 billion from banks, mainly to support agricultural value chains. As pointed out in chapter 3, high

BOX 4.11

Equity Bank and agricultural financing in Kenya

Equity Bank's approach to agricultural financing is based on direct lending to small farmers that is integrated into a larger supply chain partnership and supported by a first-loss guarantee provided by donors. The bank signed a partnership with the Alliance for a Green Revolution in Africa (AGRA), the International Fund for Agricultural Development (IFAD), and the Government of Kenya in May 2008.

The deal includes a project fund of US$50 million for agricultural small and medium-size enterprise loans for farmers with little or no collateral. AGRA and IFAD provide a 10% first-loss guarantee. Under this partnership, Equity Bank developed the smallholder financing product Kilimo Biashara to make financing available for 2.5 million small farmers and 15,000 agricultural input retail businesses in rural areas.

Equity Bank enhances security by capping loan exposure at US$17,000 per farmer, applying group lending terms through which six farmers are grouped and act as co-guarantors, and reducing the cash amounts in farmers' hands (farmers can pay agro dealers out of their credit line through direct deduction). The loans carry a 12% interest rate—well below Equity Bank's standard lending rate of 18%.

The project has changed the position of smallholder borrowers from food insecure to semi-commercial producers. One success factor is the technical assistance on financial literacy and farm management provided by the government extension service bureau to the farmers. The repayment risk of the individual farmers is mitigated by their integration into supply chains, including the World Food Programame's Purchase for Progress program.[91]

Source: International Finance Corporation 2012.

BOX 4.12

Brazil's "I-Owe-You" notes

Brazil's Rural Product Notes (commonly known as I-Owe-You notes) are instructive as a potential innovation adaptable for Africa. These notes, issued by farmers, are collateralized by farmers' future crop or livestock production and give farmers access to credit.

Brazil has notched up a success with these notes, but only when certain preconditions were met: farmers are linked into value chains (market-oriented farmers); the legal and regulatory frameworks are supportive (providing, among other things, for out-of-court settlements of commercial conflicts); insurance covers weather risks; monitoring agencies (to monitor farmers) are in place; and electronic registries are set up to record the notes.

This model can be applied to medium-scale commercial farmers, who are more likely than smaller farmers to meet the precondition related to value chains. Something like this type of transaction is already happening in Northern Ghana, where many farmers are pre-financed by traders (70% of rice farmers in Northern Ghana get their financing this way). These arrangements, usually based on verbal agreements, can be formalized by traders issuing rural product notes on behalf of their farmers to give them access to financing. Similarly, the sharecropping schemes, as practiced in Ghana, have provisions for investors to put in money in return for a share of the output. The mainly urban middle class who do the financing get an "I-Owe-You" note.

Source: http://www.fin4ag.org/en/session/s4-development-and-regulatory-issues-of-capital-market-instruments-for-agriculture-what-can-we-learn-from-brazil-and-other-countries.html

monitoring costs are likely to remain a constraint because of NIRSAL's exposure to both bank and borrower moral hazard.[94]

Value chain financing. To commercialize their activities, farmers need to work through upgraded value chains, so financing should target the value chain as well as farmers. Agricultural value chain finance requires a comprehensive assessment and understanding of the entire chain and the use of (and in some cases development of) specially tailored financial products that meet the needs of the chain. Such finance also requires an assessment of the broader risks of the value chain. By focusing on agricultural value chain finance, banks can develop a long-term strategy for growth.[95] Root Capital, using this method, has financed farmers through traders, who are better placed than financial institutions to interact with farmers and understand their circumstances.[96]

Contract farming. As seen earlier, contract farming is another way of financing agriculture since the contracting party usually provides inputs and sometimes mechanization services. The costs are deducted from output sales, and the farmer gets the balance. This model of providing inputs can be extended to insurance.

Insurance. Insurance can help lenders manage their agricultural lending risks (also see the next section). Loans are insured so that the payout in case of default is to the lender, with two beneficial impacts: it spurs lenders to lend to agriculture, and it helps lenders build expertise in the sector—so they can see opportunities rather than just risks. Lenders that initially had very high collateral requirements and interest rates have gradually lowered them as they became more familiar with the agricultural sector.[97] One bank in Zambia lowered its interest rate from 26% to 21% and then to 14% as it gained experience in the sector. In Burkina Faso, collateral requirements fell dramatically, from a 25% to a 1.5% cash deposit.

New insurance instruments

Agricultural insurance has traditionally been offered for crops, usually as indemnity policies that cover a farmer against multiple perils and pay out on the basis of yield losses assessed at harvest time. But these policies are expensive, and the cost of assessing yield losses for each farmer is considerable for small farmers. The policies are also prone to moral hazard—having insurance that pays when yields are low reduces the incentive for a farmer to exert full effort to achieve the highest yield possible.[98]

Moral hazard. Moral hazard problems can be handled, as in a pilot in Zambia.[99] The pilot used a group savings and loan approach in which groups are formed based on mutual trust. Since members know each other and can vouch for each other, moral hazard is reduced. Agricultural inspectors also monitor and provide mandatory farming recommendations.[100] Scale is the issue though, and indemnity-based

schemes will become viable only where there are strong, representative farmer organizations or a sizable number of commercial farms, both still rare in Africa.

Index-linked insurance. Index-linked insurance products eliminate the need to verify individual claims, reduce transaction costs, and make it easier to offer products and services in rural communities and frontier areas. With weather-indexed insurance, farmers are indemnified when poor weather reduces their crop output (the costs of their inputs are refunded).[101] But this approach requires reliable data and a correlation between the index and the loss suffered, which cannot always be established, so some farmers might experience a loss and not receive a payout. And the concept of an index is hard to market because smallholders need to know the characteristics of the financial product they are purchasing and indexed products are complex to explain.[102] Another drawback is the high premium cost: the amount farmers are willing to pay is far less than the actuarially fair premium rate.[103] For these reasons, indexed insurance, though around for some time, has seen low uptake, most of it encouraged by donor activity.[104]

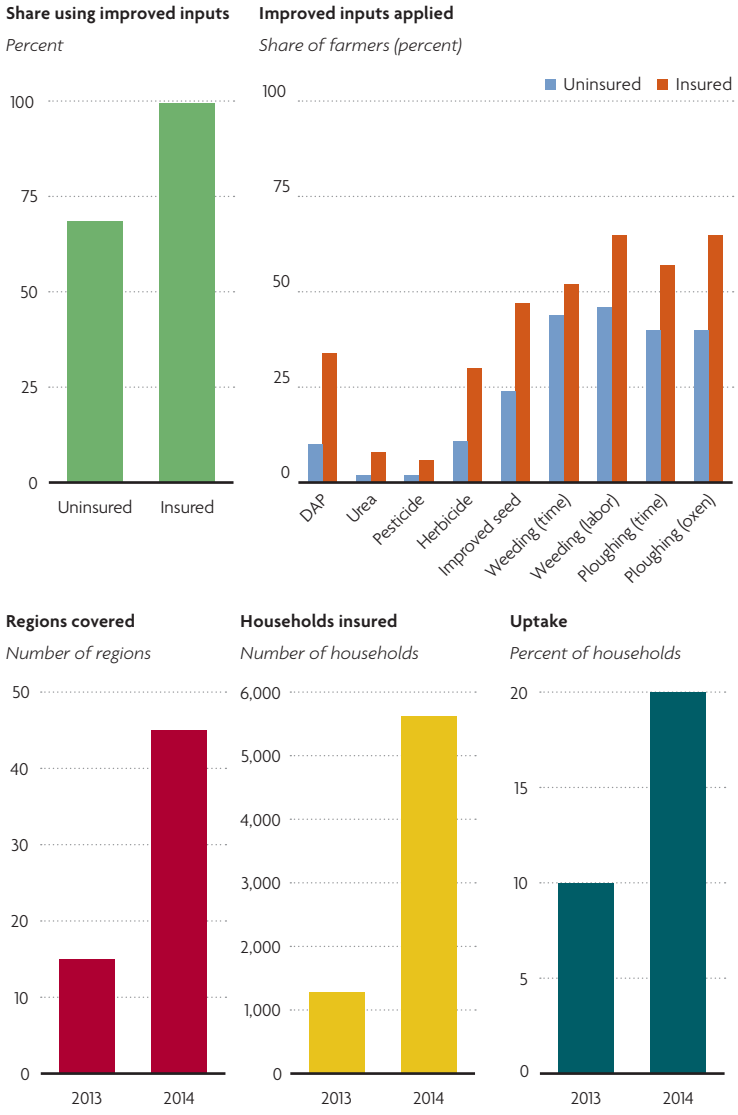
Still, some studies on the impact of weather-indexed insurance find that insured farmers make riskier, but potentially more profitable choices. They shifted their production toward cash crops and invested in inputs such as fertilizer.[105] This is best demonstrated by JICA's intervention in Ethiopia, where farmers who got insurance used higher levels of improved inputs (figure 4.4).

Research points to some pathways to increase the uptake of index-linked insurance:

- Subsidy vouchers, even for very small cash amounts, are very effective with weather-indexed insurance, but they are likely to be taken up mainly by farmers who are already using inputs at high levels. Subsidy vouchers are thus unlikely to bring about a transformative increase in input use among those who have not previously used weather-indexed insurance.[106]
- Uptake of weather-indexed insurance depends on how its goals are expressed. When described to farmers as a means of mitigating risk, many of them say that they have always managed risk. When explained as a means of savings (leaving one's other savings intact in case of a disaster), many farmers see insurance as a buffer. The insurance product framed as means of saving had a higher uptake.[107]
- Bundling insurance products as part of the package of inputs offered in contract farming[108] increased uptake of insurance to 72% of farmers in a contract scheme, compared with 5% under a standard insurance contract.[109] Bundling insurance has also increased the willingness of lenders to lend.[110]

FIGURE 4.4

Input usage of insured and uninsured farmers in Ethiopia, 2014



Source: JICA 2014.

Conclusion and policy considerations

Commercializing African agriculture will require farmers to increase productivity and market participation. That, in turn, will require reducing production risks and improving input and output markets. Commercialization will also require increasing access to finance for farmers

and value chain actors. In a virtuous cycle, access to finance will be advanced by reducing production risks and improving market functioning. And the further development of agricultural insurance will help to better manage the residual risks.

Improving the functioning of markets will require attention to transport, storage, and market integration to thicken markets. Many innovations have also demonstrated their effectiveness in improving markets, including franchising to strengthen input markets, indexed insurance products to reduce production risks, warehouse receipt systems to reduce price risks, and traders serving as lending arms of financial institutions. The actual mix of innovations will depend on the crop and the country context. Policies to catalyze and scale innovations are needed, including special funds that promising innovators can tap to develop and scale ideas.

Reorganizing farming systems will also be crucial. Stronger farmer based organizations are needed to help farmers take collective actions and better engage the markets. The emergence of medium-scale commercial farmers has the promise of transforming the agricultural landscape. Medium-scale commercial farmers are providing mechanization services to smallholder farmers and also catalyzing the emergence of large-scale traders who are in turn investing and upgrading the value chains and more crucially also contracting smallholder farmers. Potential policy actions include routing support (subsidized credit or inputs) through commercial farmers and through traders who have contracted with smallholder farmers. Contract farming deserves special attention by policymakers. With improvements in contracts and contract enforcement, contract farming can be leveraged to address many of the challenges impeding commercialization of African agriculture.

Because responsibility for agricultural input and output markets, finance, and insurance are spread across different government ministries and agencies, coordination will be required. A specialized agricultural transformation agency, as in Ethiopia and Nigeria, shows promise if supported at the highest levels of government. In addition, policymakers and stakeholders spanning the various domains important to agricultural development need a way to meet regularly to exchange ideas and craft common positions. Although the ministry of agriculture would be the natural convener of such gatherings, the cross-cutting nature of the issues and the budgetary implications mean that the ministry of finance is needed as a co-convener.

Notes

1. Farmers' concerns go beyond cold calculation of returns as farming may provide other benefits that are not monetary, such as the cultural value of having a cow may outweigh the benefit of more profitable crop production for a *Maasai.*
2. Nwilene et al. 2013. It is estimated that each year insects destroy between 10% and 30% of all food produced in Africa (citing Oerke 2006; Pimentel 2007; Dhaliwal, Jindal, and Dhawan 2010).
3. For instance, Carter, Laajaj, and Yang (2013) find that Among Mozambican farmers who received a voucher to buy subsidized inputs in their study, but did not redeem it, 36% reported the nonavailability or late arrival of the agro-inputs at the agro-dealer or the distance to the closest agro-dealer as reasons for nonparticipation.
4. ACET 2015f.
5. Jayne et al. 2002.
6. ACET 2015f. Product adulteration is common in some countries. For instance, in Uganda millet traders have been accused of adding sand to increase weight, and in Tanzania farmers have been suspected of adding water to cotton.
7. Miranda and Mulangu 2016.
8. Verschoor, D'Exelle, and Perez-Viana 2015.
9. AGRA is promoting this approach in Nigeria and a number of other countries (see chapter 3 on productivity).
10. Antonaci, Demeke, and Vezzani 2014.
11. Mghenyi, Myers, and Jayne (2011) find that higher maize prices (due to price support policies by the board) lead to increased poverty and lower household income in every region except for the high potential zones, mainly because most smallholder farmers are net food buyers.
12. Antonaci et al. 2014.
13. Abbott 2012, cited in Antonaci et al. 2014.
14. Antonaci et al. 2014. Minimum quantity requirements hinder access by smallholders and small traders unless they are organized as producer groups.
15. Warehouse receipt systems can also be unregulated. Receipts issued under an unregulated system are, however, nontransferable and nonnegotiable and therefore of very limited use in promoting trade (Aning 2016).
16. Aning 2016.
17. Aning 2016.
18. Katengeza 2009.
19. Aning 2016.
20. The development of a warehouse receipt system and electronic commodity exchanges are the precursors to the full development of a workable futures market.
21. Jayne et al. 2014.

22. Aning 2016.
23. Poulton, Kydd, and Dorwar 2006.
24. Poulton, Kydd, and Dorwar 2006.
25. ACET 2015f.
26. UNDP 2012.
27. Britwum 2013.
28. Reardon and Timmer 2005.
29. Gollin and Rogerson (2010) point out that the paved road network in Uganda is equivalent to Britain's paved road network under the Roman empire!
30. Barrett and Mutambatsere 2008.
31. Carruthers, Krishnamani, and Murray 2008.
32. ACET 2015f.
33. World Bank 2009.
34. SRID-MoFA 2014.
35. Aikins and Akude 2015.
36. Though they are now also being used to carry passengers and pose serious dangers as they are designed for carrying goods: http://www.graphic.com.gh/features/features/motor-king-tricycle-a-blessing-or-curse.html.
37. http://www.ghananewsagency.org/features/tamale-made-motor-tricycle-video-technology--62670.
38. ACET 2015c, 2015d, 2015e, 2015f.
39. Abdulsamad, Brun, and Gereffi 2013.
40. Sitko and Jayne 2014.
41. Sitko and Jayne 2014.
42. ACET 2015b, 2015c, 2015e.
43. ACET 2015f.
44. For more details see. https://esoko.com/about-us/our-story.
45. Solon 2013.
46. Personal interview with one of the founders of M-Farm, Linda Kwamboka, 2016. See also http://www.wired.co.uk/article/mfarm.
47. Barrett 2008.
48. For Tanzania highlands, Zambia and Malawi are the natural markets, for productive regions around Kilimanjaro Kenya is the natural market. For farmers on the western part, Democratic Republic of Congo is the natural market (ACET 2015d).
49. Tschriley, Myers, and Zavale 2014.
50. Williamson 1985, 1991, cited in Poulton et al. 2006.
51. Diao, Headey, and Johnson 2008.
52. Haggblade et al. 2015.
53. Onumha 2010, cited in Antonaci et al. 2014.
54. ACET 2015e.
55. Keyser 2014.
56. Ponte 2002.
57. Consumers now demand healthier products, more differentiated products, and "unique shopping experiences." Traceability and adhering to given quality standards have become key.
58. ACET 2015f.
59. Liverpool-Tasie 2014.
60. ACET 2015c.
61. Onumah 2010, cited in Aning 2016.
62. Onumah 2007.
63. Tschirley, Mayers, and Zavale 2014.
64. In Kenya, Pwani Feeds grew from an egg trader who became successful and invested in making feeds that she supplied to her poultry farmers (ACET 2015c).
65. Smith et al. 1999, cited in Quartey et al. 2012.
66. Molony 2008.
67. ACET 2015e.
68. Poulton et al. 2007.
69. Diwan, Gaddah, and Osire 2013.
70. Tschriley, Myers, and Zavale 2014.
71. ACET 2015c.
72. ACET 2015f.
73. IFC 2012, p. 98.
74. Roberts and Vilakazi n.d.
75. Minten, Koru, and Stifel 2013.
76. Raballand and Macchi 2008, cited in Roberts and Vilakazi n.d.
77. Argent and Milanovic 2014, cited in Roberts and Vilakazi n.d.
78. ACET 2015b, 2015c, 2015e.
79. Sheahan et al. 2016.
80. Verschoor, D'Exelle, and Perez-Viana 2015.
81. ACET 2015c.
82. https://blog.gfar.net/2016/03/07/yap-proposal-198-mechanical-weeder-service-hassan-halimot-omotoke-nigeria/.
83. Abdulsamad, Brun, and Gereffi 2014; Dzadze et al. 2012.
84. https://www.liverpool.ac.uk/risk-and-uncertainty/postgraduate/cdt-research-projects-available/farming-east-africa/.
85. FAO 2011.
86. Staritz and Reis 2013.
87. Money lenders include professionals like building contractors, teachers, carpenters, masons, and managers.
88. Quartey 2012.
89. Asogwa, Abu, and Ochoche 2014.
90. IFC 2012.
91. IFC 2012, p. 61.
92. EDIAF was initially established to support firms engaged in exports, especially those from the agro-processing sector. But after review, its mandate was expanded to support all actors in agricultural value chains that support agro-processing and exports, including farmers. The EDAIF was joined with the Export Finance Company Limited and the Eximguaranty Company Limited to become the new Export-Import Bank in late 2016.
93. ACET 2015d.
94. Moral hazard is the incentive for individuals insured against risk to engage in riskier behavior than they would if they were fully exposed to risk.
95. Cuevas and Pagura 2016.
96. ACET 2015f.
97. Asseldonk et al. 2015.

98. Miranda and Mulangu 2016.
99. Asseldonk et al. 2015.
100. The agricultural inspector gives recommendations on improving farming practices. In case of a claim, the inspector checks whether the recommendations were implemented. If they were not, the claim is ineligible.
101. This is a model already in use in Kenya and Rwanda by the One Acre Fund.
102. Miranda and Mulangu 2016.
103. Miranda and Mulangu 2016.
104. Cole et al. 2012, cited in McIntosh, Sarris, and Papadopoulos 2013.
105. Schickele 2016.
106. Ayenew et al. 2014.
107. Verschoor et al. 2016.
108. The premium is paid by the buyer and later deducted from the farmer's revenue.
109. Casaburi and Willis 2014.
110. Asseldonk et al. 2015.

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CHAPTER 5

Feeding Africa

Africa is importing more of its major food staples, despite having the potential to produce them competitively, for five reasons:

- Rising urbanization means that more people are buying rather than producing their food.
- Rising incomes are creating diet shifts, increasing demand for processed and convenience foods and for dairy and meat products.
- Productivity growth is slower in African agriculture than in other global regions.
- The approach to farm production and post-farm value chains for food crops are traditional and informal in Africa (unlike the case for export cash crops).
- Underdeveloped agricultural value chains cannot meet the demand for processed and convenience foods.

As a consequence, the gap between domestic supply and demand is widening, putting upward pressure on prices, threatening to increase food insecurity, and boosting food imports.

But current patterns of rising food imports are unsustainable because of their increasing pressure on the trade balance (figure 5.1). A basic question is why should Africa import food items that it could produce competitively itself? By failing to realize its natural comparative advantage in land and labor to increase food production, and relying instead on imports, Africa exposes itself to greater risks of food supply shocks. In addition, this failure means that Africa is forgoing potential increases in employment and incomes in the food industry. And the foreign exchange drain from food imports could be better used to import goods and services that cannot be competitively produced at home—particularly capital equipment and technology.

Abundant and reliable production of high-quality food products by Africa's farms could form the basis for economically viable modern food processing industries, providing jobs and raising incomes. And increased domestic food production would moderate rises in the cost of living and help keep wages competitive, enabling Africa to leverage its comparative advantage in labor to become globally competitive in labor-intensive manufacturing.

For all these reasons, Africa's economic transformation requires a concerted effort to increase outputs of the main food products in which it has a natural comparative advantage and to strengthen post-farm value chains and logistics to bring them to market more efficiently.

This chapter discusses how to do that, drawing on the general discussions on land, farm productivity, and commercialization in chapters 2, 3, and 4 to focus on the specific problems of increasing the production and quality of selected food staples. The discussion also covers how to reduce on-field and postharvest losses during storage and transport to market in order to increase availability in urban areas. The food products discussed here were selected for their importance in consumption (caloric intake), their ranking in value among food imports, and Africa's comparative advantage in producing them.

Africa's key staples and major food imports

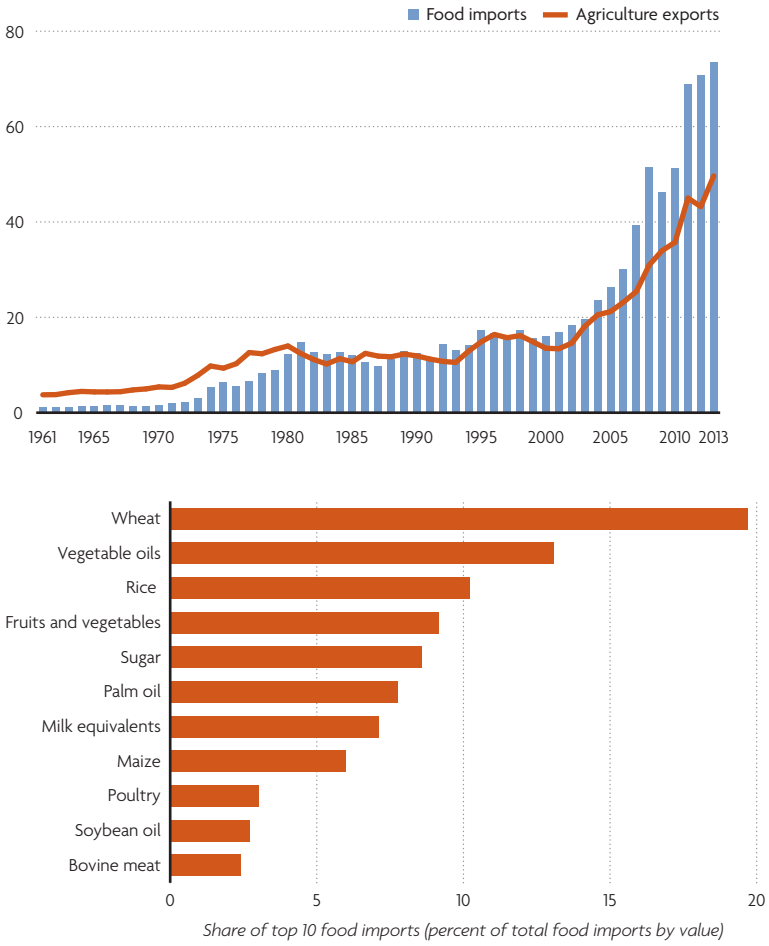
Africa's rising food needs are increasingly being met by nontraditional staples, in particular rice and wheat, which have experienced tremendous growth in consumption (figures 5A.1–5A.5 in the appendix). But maize, a traditional staple, continues to dominate diets in East and Southern Africa and shows strong growth in the other subregions. Cassava is still an important traditional staple in West and Middle Africa, while the traditional grains of millet and sorghum have been losing ground rapidly. And though not key staples, sugars and oils have seen consumption increase dramatically, evidence of sharp dietary shifts toward more processed foods as Africans eschew traditional staples in favor of Western-style diets.[1] These shifts have drawn in imports both of new staples, mainly rice and wheat, and of traditional staples like maize. The rise in food imports (figure 5.1, bottom panel) has created a growing deficit in agricultural trade since agricultural exports cannot cover the food import bill (figure 5.1, top panel).

Rising imports reflect Africa's low competitiveness in production, poor logistics for transporting output from farm to market, and shifts in diet preferences, especially in expanding urban markets that demand foods that are cheap and convenient. The growing urban middle class is creating demand for diversity in foods and for high-quality, well-packaged foods, which domestic

FIGURE 5.1

Trends in Africa's food imports, 1961–2013

US$ thousands



Source: FAOSTAT online.

underdeveloped value chains struggle to deliver. Bennett's law predicts increasing consumption of meat, dairy products, and fats as incomes rise.[2] This pattern is playing out in Africa, with most of this new demand met by imports, as the livestock sector, especially the dairy and poultry sectors, remains underdeveloped.

A review of consumption patterns on the continent paints the following picture:

- Although differing across subregions, diets are uniformly narrow, with the top five food staples providing at least half the calorie intake in each subregion (table 5.1).
- Food imports are concentrated among very few products, leaving Africa vulnerable to global price volatility of even one key import. The top 10 imports account for 87% of the food import bill, and the top 5 for 60%.
- The shift in diets over the last 50 years has accelerated since the 1980s. Traditional grains of millet and sorghum have been largely replaced by rice and wheat. Maize is a more dominant staple, and cassava, though losing some ground, is still very important. The shift to rice and wheat has fueled surging growth of imports of these cereals.
- Consumption of oils, sugars, and dairy and meat products has also climbed quickly as incomes have risen, fueling these products' rapid import growth.

Increasing the production of key staples

For Africa to take full advantage of dynamic urban markets and the spending power of its rising middle class, it must increase production of key staples while nurturing a vibrant and competitive food processing sector that requires an assured supply of high-quality, competitively priced produce. Increasing supply requires higher yields, better postharvest practices, and more efficient logistics to convey the produce to processors and urban markets.

What, then, is the easiest path to increasing the availability of key food staples and products? Africa's relative abundance of land might suggest simply increasing land under cultivation. However, that misses some key points.[3]

First, the uncultivated land is unevenly distributed, and much of it is in politically unstable countries. Nearly half of it is in one country (Democratic Republic of Congo), and 90% is in just nine countries (table 1.1 in chapter 1).[4] Second, expanding the land under cultivation would not necessarily lower food prices, as scarce resources would need to be devoted to opening new lands, some of them of marginal fertility. Third, infrastructure is already poor, and new farmland is likely to be in remote areas with the worst infrastructure.

Thus, while land expansion is one way of increasing food production (and has been the main trend), care is needed in continuing with this strategy. More important is to sharpen the focus on increasing productivity and improving logistics to keep food prices low, especially of traditional staple crops like maize and cassava, and on raising production of new staples, primarily rice and wheat.[5] Livestock, notably dairy and poultry, need particular attention to meet the rising protein demand of the expanding middle class without heavy reliance on imports.

The question then is this: What is Africa's comparative advantage in producing the main staple foods? Chapter 3

TABLE 5.1

The top five foods and the top five food imports in Africa, by subregion, 2013

Top five foods	North Africa	West Africa	Middle Africa	East Africa	Southern Africa
Consumption Top five foods (by caloric intake)	1. Wheat 2. Sugar 3. Maize 4. Vegetable oils 5. Rice	1. Rice 2. Cassava 3. Vegetable oils 4. Maize 5. Yams	1. Cassava 2. Maize 3. Vegetable oils 4. Wheat 5. Rice	1. Maize 2. Wheat 3. Rice 4. Cassava 5. Pulses	1. Maize 2. Wheat 3. Vegetable oils 4. Sugar 5. Rice
Percent of calories supplied by top five foods (kilocalories per capita per year)	58	52	50	53	71
Imports Top five food imports (percent of total imports by value)	1. Wheat products 2. Maize 3. Vegetable oils 4. Fruits and vegetables 5. Dairy products	1. Rice 2. Wheat products 3. Vegetable oils 4. Palm oil 5. Sugar	1. Wheat products 2. Poultry meat 3. Rice 4. Vegetable oils 5. Sugar	1. Wheat products 2. Vegetable oils 3. Sugar 4. Rice 5. Fruits and vegetables	1. Vegetable oils 2. Fruits and vegetables 3. Rice 4. Wheat products 5. Sugar
Top five food imports (percent of total food imports by value)	67	78	56	74	54
Food imports (percent of total imports by value)	15	14	12	13	4

Source: FAOSTAT online.

Note: FAO classifies the subregions as follows: *North Africa:* Algeria, Egypt, Libya, Morocco, Sudan (former), Tunisia. *West Africa:* Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo. *East Africa:* Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, Uganda, United Republic of Tanzania. Zambia, Zimbabwe. *Middle Africa:* Angola, Cameroon, Central African Republic, Chad, Republic of Congo, Democratic Republic of Congo, Equatorial Guinea, Gabon, São Tomé and Príncipe. *Southern Africa:* Botswana, Lesotho, Namibia, South Africa, Swaziland.

discussed ways to boost productivity and increase farm output. The discussion focused on addressing the key constraints without reference to particular crops or livestock. This chapter focuses on the major food products: rice, maize, cassava, wheat, fruits and vegetables, poultry, and dairy. It also briefly considers the benefits of moving toward mixed livestock and crop systems; reviews how to reduce on-farm, postharvest, storage, and transport and handling losses; and discusses whether it is practical to use trade policy to reduce food imports. The chapter offers some options for increasing output and improving quality.

Rice

Over the past 50 years, rice has experienced the greatest increase in consumption (in kilocalories per capita per year), rising from a position outside the top 10 to rank in the top 5 in all subregions. This diet transition has been most pronounced in West Africa, where rice is now the key staple. Southern Africa has shown the most rapid percentage growth rate, though from a low base. In Tanzania in East Africa, too, the rise in incomes has been accompanied by a shift from maize to rice.[6] The rice diet transition is attributable to income growth and urbanization, with urban consumers preferring a product that can be easily cooked over other cereals and tuber crops that require more preparation.[7]

Increased demand for rice has been met mainly by imports, which now satisfy about 40% of Africa's rice consumption and account for about 30% of global rice imports.[8] But domestic rice production has also been increasing rapidly, due mainly to expansion in the area under cultivation, as average yields have not risen much (figure 5.2).

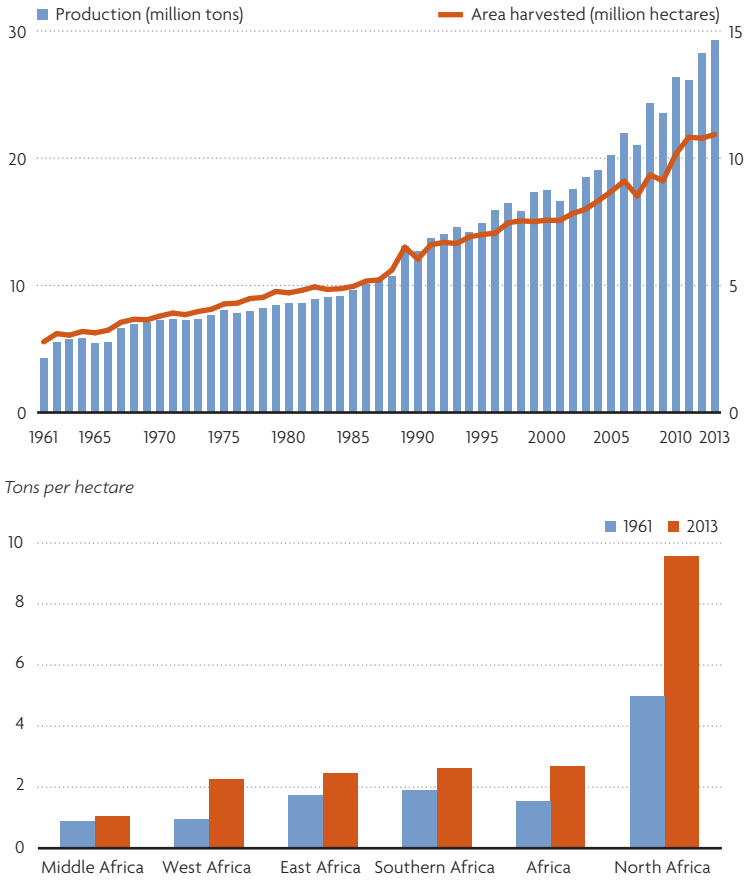
Rice production has significant room for growth from both yield increase and area expansion. But each faces hurdles.

Improving yields. Average rice yields in Africa are very low, apart from those in North Africa (see figure 5.2, bottom panel). Even if most subregions have made large gains, they come from a very low base. North Africa has seen a green revolution in rice that doubled its yield from an already very high level to yields even higher than the 6.7 tons per hectare average for Southeast Asia, the world's dominant rice growing area.[9]

Most countries show wide variations in yield; in Senegal, for instance, yields range from 1.1 tons per hectare to 6 tons per hectare.[10] Though most of the variation is attributable to differences in agroecological conditions

FIGURE 5.2

Trends in rice production and yields, Africa and subregions, 1961–2013

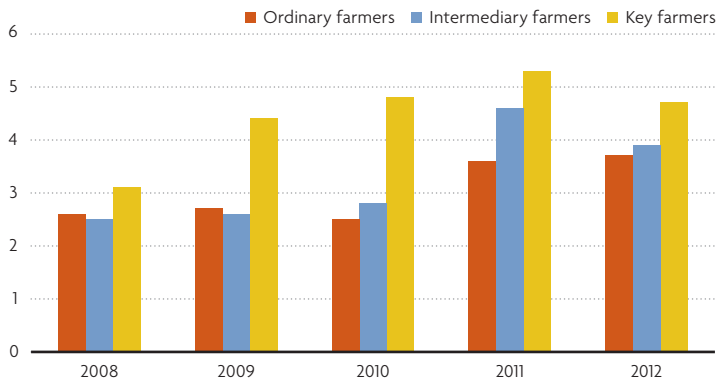


Source: FAOSTAT online.

FIGURE 5.3

Trends in rice yield in Tanzania after a rice production management training intervention, 2008–2012

Tons per hectare



Source: Nakano et al. 2016 (cited in Otsuka 2016).

and access to irrigation, these disparities point to opportunities for learning within countries.

Rice has great potential for a green revolution in Sub-Saharan Africa, where profitability and yield per hectare are positively correlated under both irrigated and rainfed conditions.[11] Average paddy yields per hectare are reasonably high in Tanzania, at 3.7 tons, and Senegal, 4.5 tons. These yields are similar to the 4 tons per hectare in tropical Asia, whose agroecological conditions are close to those in much of Sub-Saharan Africa. Yet high fertilizer prices impede agricultural transformation in Africa, by limiting farmers' use.

Training farmers is vital for any agricultural transformation, as an intervention in 2008–2012 in Tanzania shows.[12] In the study sites, all in irrigated areas, "key farmers"—those considered to be the more competent producers—were trained intensively in the adoption of modern varieties, seed selection, bunding (for containing potential pollutants), leveling, transplant timing, fertilizer application, and postharvest operations. Each key farmer chose five farmers ("intermediary farmers") to whom to teach the newly acquired knowledge on rice production technology and management. The remaining farmers—"ordinary farmers"—were then expected to learn from the key and intermediary farmers through interactions with them and demonstration effects.

The average rice yield of the key farmers rose from 3.1 tons per hectare in 2008 before training to 4.4 tons in 2009 and 5.3 tons in 2011 after training, before declining slightly to 4.7 tons in 2012 (figure 5.3). The yields of intermediary farmers also increased, though slightly less quickly, as did the yields of ordinary farmers, but more slowly still. In general, average yields increased 60% or so as farmers learned rice production management directly (through training) or indirectly (through farmer-to-farmer networks).

Even under rainfed conditions, training can have a big impact. For instance, in two villages in Uganda, paddy yields rose from 0.8 tons per hectare to about 3.7 tons per hectare after improved varieties and management practices were introduced (in 2008/2009).[13] But with no training, there was no significant difference in yield between farmers adopting and those not adopting the improved varieties.

The farming system, too, affects productivity. There are sharp variations in rice yields across farmer types in Ghana, for example, from 2.5–3.5 tons per hectare among commercial rice farmers to 1.4–1.8 tons per hectare among other farmers.[14] Yield differences stem from a mix of factors, but particularly from the ability and

willingness of farmers to adopt improved technologies and production methods.[15]

Increasing the area under rice production. The area planted to rice in Africa expanded almost 300% between 1961 and 2013, but that is still less than a third of the area under maize.

Two factors argue for putting more land into rice production in Sub-Saharan Africa: rising demand for rice as a staple food and the existence of vast unused marshy land that can be converted to lowland paddy fields.[16] Of the 7.2 million hectares planted to rice in Sub-Saharan Africa over 1995–2004, 38% was irrigated upland, 34% was rainfed lowland, 20% was irrigated lowland, and 8% was in deepwater and mangrove areas. The potential for area expansion is greatest in the lowlands.[17] But expansion will demand heavy resource use: in Zambia, it costs US$10,000 per hectare to turn bush into farmland.[18]

Expanding irrigation. The green revolution in Asia can be partly explained by expansion in the use of irrigation.[19] In Africa, yields on irrigated fields can be twice those on rainfed fields (figure 5.4). Yet a decade ago, less than 20% of lowland paddy fields in Sub-Saharan Africa were irrigated.[20]

Ghana and Tanzania's national rice development strategies include ambitious plans to expand irrigated lands.[21] A key question is whether returns are high enough to justify the much higher cost of irrigation. In both Ghana and Tanzania, it has been found that the profitability of irrigated rice is higher than for nonirrigated rice despite the higher cost associated with irrigation.[22]

Maize

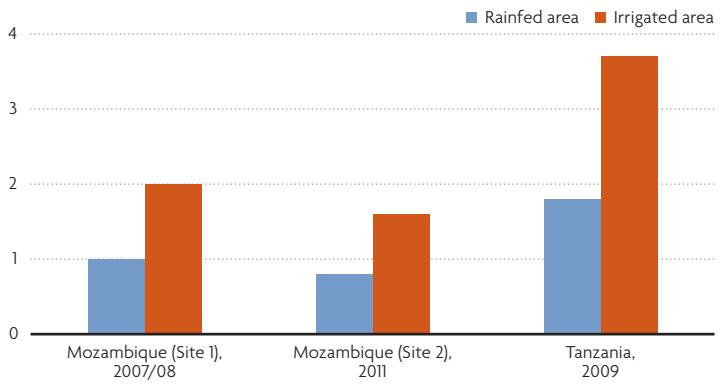
Maize, grown in all subregions, is the most important staple in Africa. Consumption is high and still rising. Many countries are self-sufficient, but some regularly import maize, while almost all occasionally import it when hit by drought (most maize is grown under rainfed conditions). Production has grown steadily, mainly due to growth in area harvested, but yields have also risen (figure 5.5).

Adoption of improved varieties of maize is fairly widespread in Africa (50%), and the impact on yields is high (a 50% increase).[23] Nonetheless, wide yield disparities between subregions suggest room for further gains. North Africa's yields are more than three times those of East Africa, where maize is the main supplier of calories, and more than 50% higher than those of Southern Africa, the other subregion that depends heavily on maize (see table 5.1). Yields in North Africa grew almost 300%

FIGURE 5.4

Rice yields are considerably higher in irrigated than in rainfed fields in major Sub-Saharan African rice producing countries

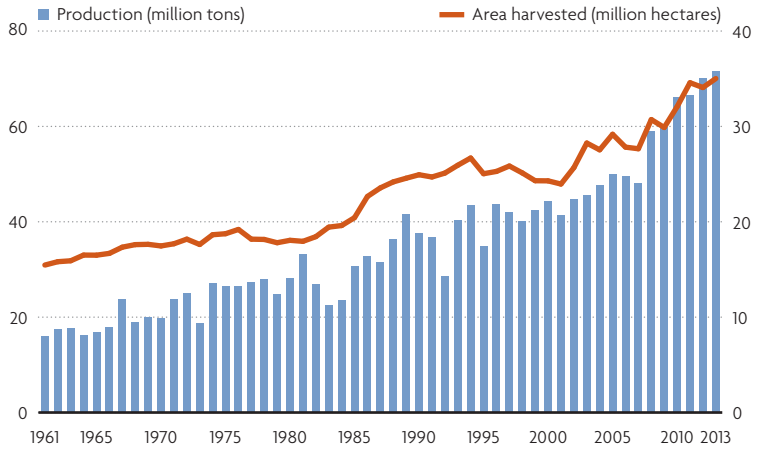
Tons per hectare



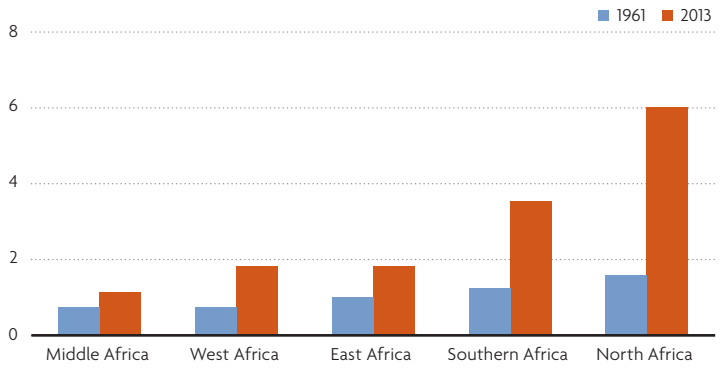
Source: Otsuka and Larson 2016 (cited in Otsuka 2016); ACET 2015b.

FIGURE 5.5

Trends in maize production and yields, Africa and subregions, 1961–2013



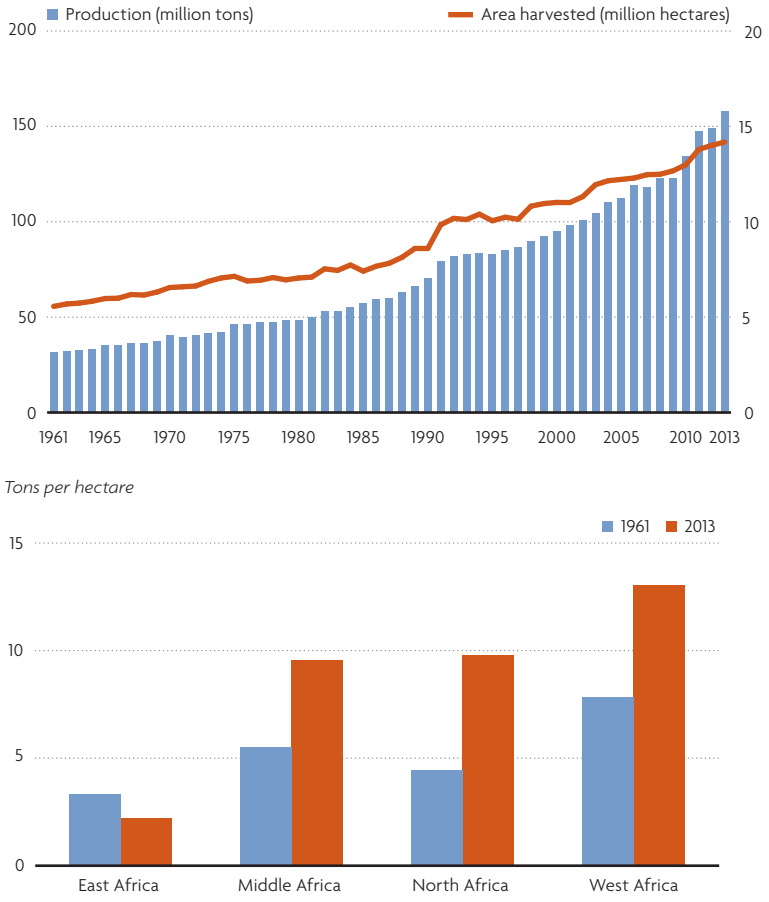
Tons per hectare



Source: FAOSTAT online.

FIGURE 5.6

Trends in cassava production and yields, Africa and subregions, 1961–2013



Source: FAOSTAT online.

between 1961 and 2013, a clear indication of the impact of the green revolution there.

Sub-Saharan Africa overall has good prospects for its own green revolution in maize, and some countries are already going through it: maize yields in South Africa at 4.2 tons per hectare, for instance, are almost four times those in the rest of Sub-Saharan Africa, which range from 1.1 to 1.8 tons per hectare. Beyond adopting improved varieties, improving yields entails adopting better farming practices. Maize, in particular, requires rotation with other crops, including leguminous crops with the capacity to fix nitrogen in the soil, application of manure, compost, and crop residues, together with the use of improved seed varieties and inorganic fertilizers.[24]

There is also evidence from Kenya on the benefits of an integrated farming system that relies on planting high-yielding hybrid maize, applying inorganic fertilizer, intercropping with legumes, and keeping dairy cows to supply manure.[25] But more research is needed to better understand the optimal proportion and timing of each element.

Cassava

Cassava remains a staple in Middle Africa and West Africa but shows up little in the diets of Southern Africa and North Africa. It has lost some ground in East Africa and Middle Africa but gained ground in West Africa, where it is increasingly becoming an important food and commercial crop, gaining share in urban food markets. One survey in Ghana indicates that cassava farmers sell about 84% of their produce.[26] Much of it is processed into ready-to-eat foods, especially gari (roasted granulated cassava flour), showing that this crop can respond to market demand for convenience foods.

Africa is largely self-sufficient in cassava, with production rising strongly (figure 5.6, top panel) and keeping pace with demand. Output has been driven mainly by land expansion, although much progress has been made in developing high-yielding varieties, particularly the Tropical Manioc Selection variety developed by the International Institute of Tropical Agriculture (IITA). Still, at 9–13 tons per hectare in the key producing subregions (figure 5.6, bottom panel), yields remain below those of benchmark countries, notably Thailand, which achieves yields of about 30 tons per hectare.[27]

A project to disseminate improved technologies in the Wenchi district in Ghana shows how simple innovations, introduced incrementally, can dramatically raise yields (box 5.1).

Access to processing equipment is also vital to boosting cassava production. Farmers in Uganda without easy access to markets but with easy access to processing equipment planted more cassava than farmers with easy access to markets but no easy access to equipment.[28] The resilience of cassava in West Africa, particularly in Ghana and Nigeria, is due in part to ready access to affordable equipment, thanks to a vibrant roadside fabrication sector. These fabricators adapt or copy imported equipment using local materials and innovative business models, such as selling grating services rather than trying to sell the equipment to poor farmers.[29] In fact, the uptake of the Trans Manioc Selection variety really took off only after roadside artisans developed cheap grating technologies and provided a grating service to farmers.[30]

Cassava yields differ sharply by type of farming system. While most yields remain below those of benchmark countries, some commercial farmers achieve yields of 30 tons per hectare, as in Thailand (figure 5.7).[31]

BOX 5.1

Incremental interventions but dramatic outcomes

Cassava yields in Ghana generally range from 15 tons per hectare without following best practices to 25 tons per hectare following best practices, including ridging and fertilizer application—a gain of about two-thirds. Yields rose even more—from 12–15 tons per hectare to 30–35—through a project initiated in 2011 by the Dissemination of New Agricultural Technology for Adoption in Africa (DONATA) in the Wenchi district in Ghana to disseminate improved technologies and indigenous knowledge to participants along the cassava value chain.

Interventions included sowing high-yielding varieties, planting in rows, and applying better weed management practices. The project provided information to farmers to solve specific problems, rather than teaching farmers everything about the new practices, as in the farmer field schools approach. Farmers developed better links to transporters and markets. Another innovation, which increased uptake among female farmers, was to distribute already sprouted planting materials, which require less labor for planting, and packaging the materials in small bags, which are easier to handle. Reducing labor demand is particularly important for women, whose labor is also in high demand in the household.

Because cassava has to be processed within 48 hours of harvest, having the right processing machines in place is crucial. Farmers are unwilling to increase production without access to labor-saving processing technologies, especially graters and presses. Most processing machines are designed to be used by men, requiring great strength to operate (as with heavy double screw presses). Unless machines are adapted for use by women as well (for example, hydraulic presses), female farmers are unlikely to adopt high yielding varieties. So, the project also worked with equipment fabricators to modify machines for use by female cassava processors. Cassava processors, whose knowledge of market preferences is trusted by farmers, were also used to disseminate information on improved varieties.

DONATA used an incremental approach in its interventions. A farmer was initially asked to plant only a small portion of land using the DONATA approach. Observed differences in yields between that plot and the rest of the farm became the motivation for wider adoption.

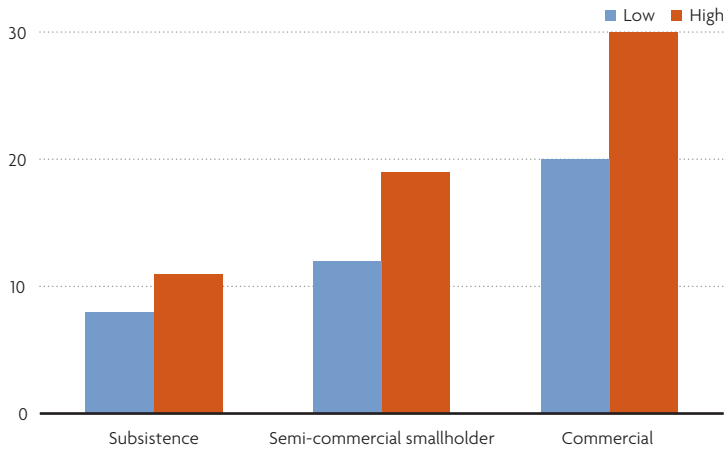
Source: ACET 2015b.

Finally, farm-level mechanization is required to make commercial cassava farming profitable. Cassava production is labor intensive, especially during harvesting. In Ghana, many small farmers sell their cassava crop to traders while it is still in the ground to avoid the huge costs of harvesting. Because commercial farmers in Ghana use much more labor than do smallholder farmers, profits per hectare are lower for commercial farmers, despite their higher yields, when prices are low. Simulation studies found that access to mechanical harvesting and planting reduce the use of labor and can greatly increase the profits of commercial cassava farming in Ghana.[32] But before a farm can mechanize, it must absorb the huge costs of removing tree stumps to make it possible to use tractors and other machinery. This one-time cost has discouraged farmers in Ghana from establishing cassava farms.[33] This may be a case where a one-time subsidy could pay off.

FIGURE 5.7

Cassava yields vary across farming systems in Uganda, c. 2014

Tons per hectare



Source: ACET 2015e.

Wheat

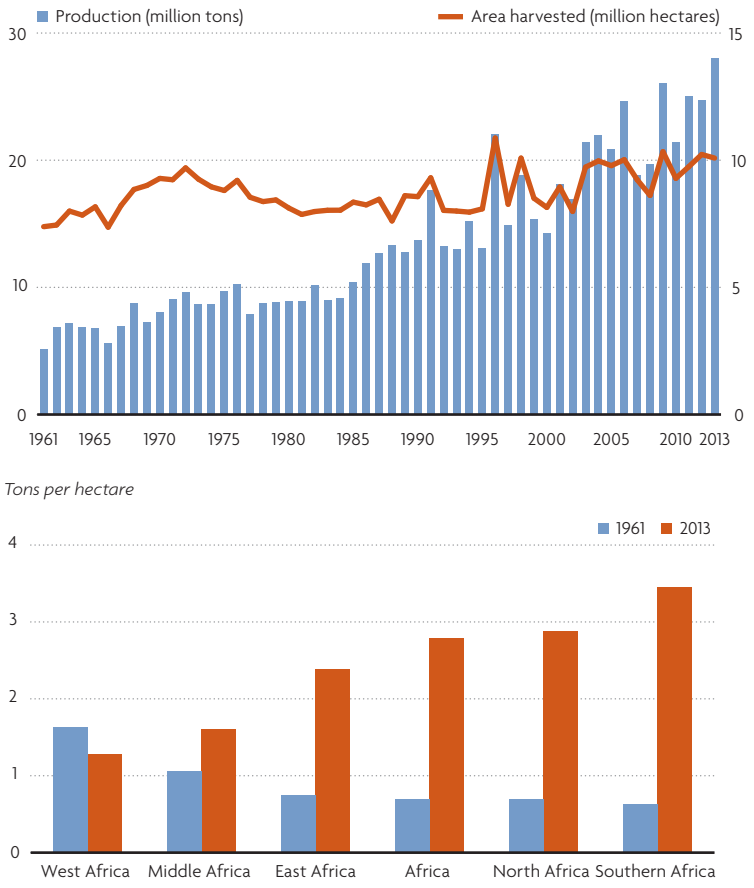
Wheat consumption has shown tremendous growth across Africa and now ranks in the top five key staples in all subregions except West Africa. Demographic and

economic changes tied to urbanization have boosted wheat demand. For example, a study using data for 1980–2009 for Sub-Sahara Africa found that, a 1 percentage point increase in the ratio of women's to men's labor force participation raises wheat consumption by roughly 5,000–6,200 tons.[34] Government policies that subsidize wheat consumption, especially to keep restive urban populations content, have also driven demand in some countries.[35]

Strong growth in wheat production have been driven largely by yield increases, with little expansion of harvested area, unlike the case for most staples (figure 5.8, top panel). The green revolution in wheat is spreading in Africa, as evidenced by the adoption of semi-dwarf varieties and high use of fertilizers and irrigation.[36] Yields in most parts of Africa have already caught up with those in India, which has similar agroecological regions, showing gains in all subregions except West Africa (figure 5.8, bottom panel).

FIGURE 5.8

Trends in wheat production and yields, Africa and subregions, 1961–2013



Source: FAOSTAT online.

However, as a temperate climate crop, wheat cannot be grown in many parts of Africa. A sizable part of consumption is therefore met through imports. Wheat is now the top food import by value (see figure 5.1).

Wheat is grown mainly in the highlands, which are endowed with cool climates, and in the temperate zones in North and Southern Africa. These lands are not abundant, however, so the scope for increasing production is limited. Self-sufficiency in wheat is an unlikely prospect, and attempts to achieve it have been costly. For instance, a simulation study suggests that if Morocco were to achieve self-sufficiency in wheat, the outcomes would be temporary and the cost over 11 years would be a staggering US$16 billion.[37] A better strategy would be to finance wheat imports by using the limited land suitable to grow high-value fruits and vegetables for export, a strategy already followed by Tunisia.[38]

East Africa, endowed with highlands but achieving low wheat yields, has room to improve its productivity. An intervention in Ethiopia supported by the World Bank has seen wheat yields rise from 1.8 tons per hectare to 5 tons, as small fragmented subsistence farms consolidated to create contiguous, mechanized farms.[39] If Ethiopia can replicate these successes on a large scale, it could significantly reduce its imports of wheat, which now meet about 30% of its consumption needs.[40]

High production costs need to be lowered, particularly as wheat is one of the world's most traded commodities, and imports are always a threat to local production. For the 2016 harvest, Kenyan wheat farmers, who produce 30%–40% of the country's needs, struggled to sell their wheat as millers preferred imports, which remained cheaper even with a 10% import duty.[41]

Africa's dependency on wheat imports could also be reduced by shifting diets toward traditional grains—millet and sorghum—that can substitute for wheat (up to 30% of wheat flour can be replaced by sorghum without a discernible change in product taste or quality; box 5.2). With research and development and proper marketing, millet and sorghum products can compete with wheat products, though processors need more knowledge to develop them and the proper equipment.[42]

Fruits and vegetables

As incomes rise, diets in Africa and worldwide are moving toward more fruits and vegetables.[43] Fruits and vegetables are now among the top five imports in three subregions of Africa and are becoming important exports of some African countries. Tapping into growing export markets can be particularly useful to offset wheat imports, which are unlikely to fall dramatically even if wheat yields improve.

BOX 5.2

The case for returning to traditional grains?

Traditional grains are well suited to Africa's agroecological conditions. Millet can survive with as little as 300 millimeters of rainfall per year (compared, for example, with twice that for maize) and is better adapted than most other crops to high temperatures, short growing seasons, and acidic, low-fertility soils with poor water-holding capacity. Millet can also be stored for more than 10 years with little deterioration in quality. Sorghum does equally well in drought and heat and can mature in as little as 75 days, providing three harvests a year. It is good not only as food, but also as fodder and biofuels. These properties make both crops very important for a changing climate.

Millet and sorghum are nutritionally equivalent or superior to most cereals, with high levels of micronutrients like iron, phosphorus, and calcium, and vital amino acids, which are lacking in the diets of hundreds of millions of poor people who subsist on starchy foods such as cassava and plantain. These traditional grains also have high energy and protein content.

The primary reasons for loss of market by these traditional grains are low productivity, damage by birds, a poor image, and lack of product development to meet new demands. Traditional grains have been neglected by agricultural research systems, which have favored maize and other "modern" crops. The result has been low yields, making them uncompetitive. The quelea bird is another challenge. These birds can eat as much as 50%–100% of the crop. In the past, children would guard the crop, but as more children now go to school it is hard to get the labor to guard against the birds. Maize quickly replaced these grains as it is covered by a sheath that protects it from birds. Also, millet and sorghum tend to be grown and consumed by poor people in marginal areas, so they have acquired the image of a poor person's food, which has dented demand in urban areas. Also, as demand for quick to prepare meals has risen in urban areas, traditional grain value chains have not been able to provide ready-to-eat products that meet this demand.

Despite these drawbacks, the reputation of millet and sorghum is bouncing back. The two grains are beginning to be seen as nutrient-packed "superfoods," and demand is rising worldwide. Surveys in East Africa find a growing preference for traditional grains, with the rate of increase highest among high-income groups due to perceived nutritional value, suggesting unmet demand, especially among urban middle class consumers.

Source: ACET 2015f; Time Magazine 2014; Schipmann-Schwarz et al. 2013.

Increasing production of these high-value crops should be a key piece of Africa's food production strategy. But beyond the need for improved varieties, modern inputs, and better management practices, high-value food production requires the capacity to communicate information on quality and safety.[44] Unlike grains, which have small quality variations and are easy to grade, fruits and vegetables have wide quality variations. Establishing quality assurance systems that reduce information asymmetry by guaranteeing quality and safety is therefore very important. In 2007, Kenya introduced KenyaGAP, a standards system benchmarked against the common international standards of GlobalGAP (see box 4.6 in chapter 4), which has helped Kenya expand its market share in European markets. Kenyan farmers who comply with KenyaGAP get a 12%–25% premium on price.[45]

It has been pointed out that unlike cereal farmers, who basically sell commodities where quality differentiation is not a major consideration, farmers of high-value products are "entrepreneurs," who must compete on quality for the highest possible prices.[46] This is a challenge particularly for smallholder farmers. One solution is for the contractor in a contract-farming arrangement to set the quality standards and provide assistance to farmers in meeting them. Another is innovative training for smallholders on market orientation, management, and marketing as provided under the SHEPs project in Kenya (box 5.3).

Increasing the production of livestock products

Though animal products are not key suppliers of calories in Africa, they rank among the top imports, with poultry and dairy products the most important. Poultry is the second biggest import in Middle Africa, while dairy imports rank fifth in North Africa and sixth in West Africa.

Poultry and dairy production require little land. But increasing productivity is more complex for livestock than for crops and requires greater knowledge and proper management practices.

Poultry

Poultry production has shown strong growth in absolute terms, but yields have grown slowly (figure 5.9).

BOX 5.3

From producers to entrepreneurs—JICA Smallholder Horticulture Empowerment Project

In Kenya, horticultural crops (vegetables, fruits, and so on) is a promising subsector that has shown rapid growth over the last few decades and it is now the second largest export after tea. However, horticultural smallholder farmers, who produce over 60% of the horticultural crops, face significant marketing challenges. and their incomes remain low. JICA's Smallholder Horticulture Empowerment Project (SHEP) carried by from 2006 to 2009 in Kenya aimed to address this challenge. It sought to help farmers to adopt a more commercialized outlook under the theme "Grow crops with potential customers in mind," instead of the traditional approach of looking for customers only after growing crops.

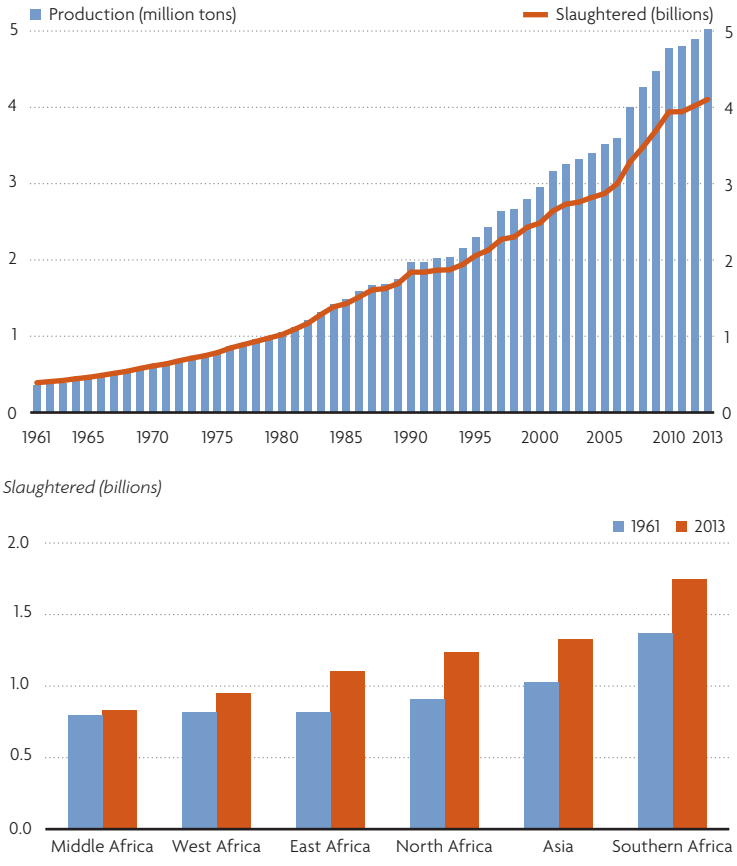
SHEP targeted farmer groups to build farmers' capacity to participate in markets. It helped farmers' groups to understand how to do market research and collect market information on their own and also develop networks that are key to effective participation in markets. Capacity to develop action plans based on market research was also developed. SHEP also supported strengthening of farmer groups to enable them to hold joint sales and take large orders on a contract basis, and to jointly purchase pesticide, fertilizers, and so on, and thus reduce input costs.

The impact of SHEP was huge. The average income of a farmer under the program increased by about 106%. As a result of this success, the Kenyan government established the Smallholder Horticulture Empowerment and Promotion Unit Project (SHEP UP) in 2010 for a wider roll out of the program.

Source: JICA 2014.

FIGURE 5.9

Trends in poultry production and yields, Africa and subregions, 1961–2013



Source: FAOSTAT online.

Productivity of poultry is generally low (exemplified by Ghana in figure 5.10) relative to Brazil, a significant exporter of poultry to African countries.

Ghana faces challenges in the two most important determinants of poultry productivity: the quality and costs of feed and of day-old chicks.[47] Feed is expensive and of low quality, and mortality rates of day-old chicks produced by local hatcheries are high, so farmers prefer to import them. Imported chicks cost more upfront, but lower mortality rates make them cheaper in the long run. In Kenya, too, feed is expensive and of low quality, hatchery rates are very low due to the poor quality of eggs, and a proliferation of fake drugs exacerbate matters.[48]

To become competitive, the poultry sector needs to increase the quality of inputs and to lower its costs. This is not an easy task as the biggest cost is feed, which can range from 70–80% of the cost of production. So, it is hard to compete with imports, especially from countries where the cost of feed is low, as in Brazil. One potential avenue that is immune to competition from imports is the market for indigenous chicken. These are free range chickens with low levels of productivity (take a long time to mature) and thus are more expensive (than imported chicken), but are preferred due to their better taste.

Burkina Faso is famous for its traditionally processed chicken called "poulet bicyclette," highly demanded by both locals and visitors. The preference for local chicken explains the low penetration of imported frozen chicken meats compared with countries like Ghana. Burkina Faso

also exports this chicken to Côte d'Ivoire despite the fact that this country is at the coast and able to easily import poultry. There are basically two chicken markets, the poultry broiler market and the indigenous chicken market. Burkina Faso has done a good job of developing and branding the indigenous chicken.[49]

Dairy (milk)

Milk production has been rising rapidly, driven mainly by the growth in total herd size (figure 5.11).

African countries have some of the biggest cattle herds in the world. These herds are usually indigenous breeds, which are resistant to disease and hot and dry conditions, but whose milk yields are low (figure 5.12). Yields have barely risen except in Southern Africa, where growth is driven mainly by South Africa's highly developed and commercialized dairy sector. Its average herd size of 427 cows in 2016 (up from 195 in 2010) is the third largest in the world.[50] Herds are improved, high-yielding breeds, mainly Holstein, Jersey, Guernsey, and Ayrshire, from imported stock from Europe, which do well in South Africa's temperate climate.[51]

Dairy is probably Africa's least developed agricultural sector. A large share of the growing demand, which is driven by rising urban incomes, is increasingly met by imports. Yet with yields in South Africa surpassing the global average—and Asia's—other African countries may be able to learn from their continental counterpart.

Milk productivity in African dairy systems varies widely, partly reflecting the many systems in operation. Kenya, for instance, has three. The intensive (zero grazing) system requires higher investment in infrastructure and closer management of cattle and normally produces 30–40 liters per cow per day, semi-intensive practices yield 5–20 liters, and the traditional pastoralist system often produces only 1–2 liters.[52]

But improving production is more complicated than moving from a traditional to a more intensive system. Kenya's well-developed modern dairy sector has huge disparities among dairy breeds and even within a breed (figure 5.13). Most farmers see yields well below the potential of the improved breeds (high-yielding breeds imported from Europe or cross-breeds between imported and local cattle).

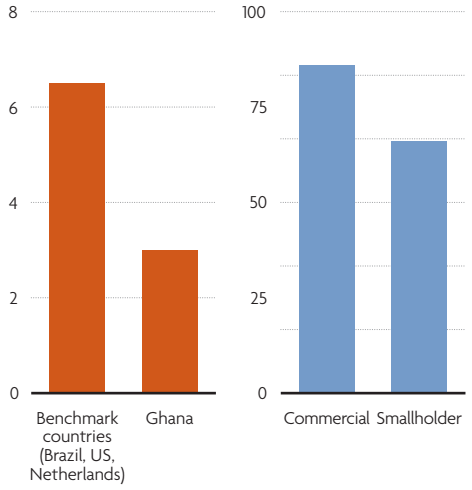
These yield variations point to the importance of feed, management practices, and know-how for boosting productivity. More efficient cows can produce 98% more milk while consuming only 21% more feed than less efficient cows of the same breed.[53] The Kenya Dairy Board estimates that 450 million–500 million liters of milk are lost annually due to the lack of know-how, as evidenced by prolonged calving intervals of 450–500 days.[54] This problem is related to inadequate feeding and heat detection, herd health, and lack of herd record-keeping.

One way to improve management is through a farming system that diffuses know-how and lets farmers specialize, as in some peri-urban areas of Kenya. There, farmers of all sizes are creating a farming ecosystem in which each has a specialized role and supports the others. The large farmers focus on breeding, while the medium-scale farmers raise heifers to sell to smallholders, who focus on milk production.[55]

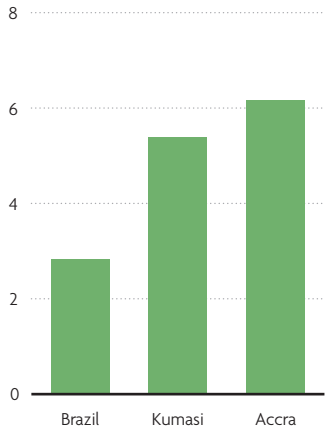
FIGURE 5.10

Poultry sector performance in Ghana, circa 2011

Ghana's poultry productivity is low, resulting in a high-cost production system



Slaughtered (billions)

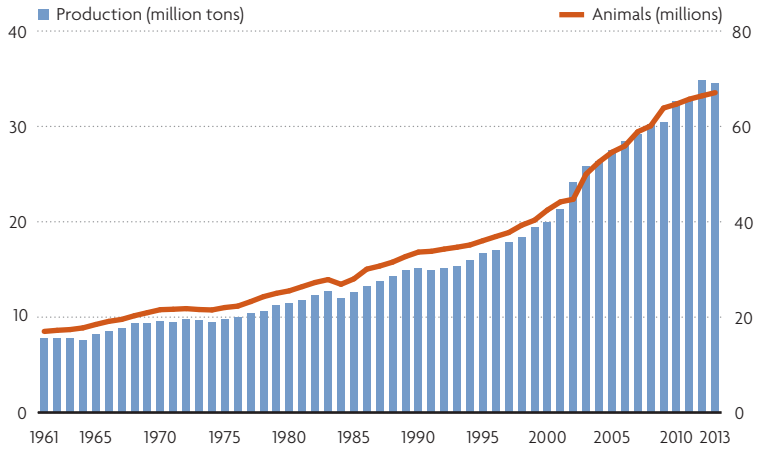


- Low productivity means that production cost in Ghana is almost twice that of benchmark countries.
- Poor feeds mean low conversion ratios.
- Veterinary officers are highly under-resourced, which has made room for quacks and fake drugs.
- Feed and utility costs are also very high in Ghana compared with benchmark countries.

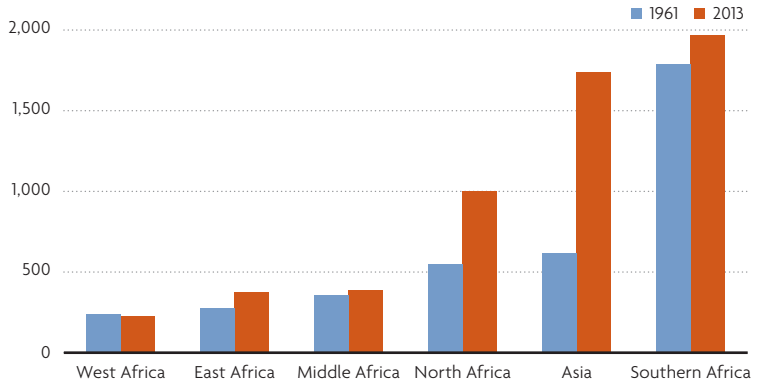
Note: Smallholder is where poultry is free range and supplemented by some commercial feed. Commercial farmers keep chickens in housing and use commercial feed.
Source: ACET 2015b.

FIGURE 5.11

Trends in whole fresh cow milk production and yields, Africa and subregions, 1961–2013



Kilograms per cow per year

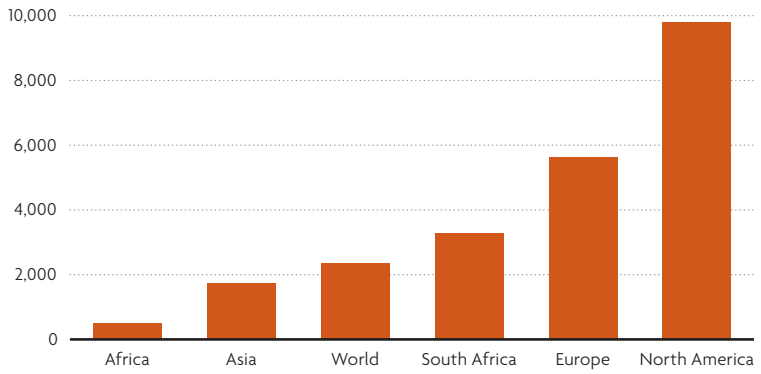


Source: FAOSTAT online.

FIGURE 5.12

African milk yields are low, 2013

Kilograms per cow per year



Source: FAOSTAT online.

Mixed livestock and crop systems

Livestock rearing and crop production can be highly complementary. Farmers can meet the yield challenge more easily by focusing on systems that combine livestock rearing and crop production. Such mixed systems also improve resilience, as recommended by climate-smart agriculture.

Part of the reason for the low uptake of fertilizer in Africa is the relatively low return on its use, given fertilizer's much higher prices in Africa than in other regions such as Asia.[56] For instance, in Uganda, sorghum production improved when chemical fertilizers were used, but returns fell; when fertilizer and manure were combined, however, both yields and returns rose.[57]

So, one strategy for increasing food production is to support and strengthen the development of mixed livestock–crop farming systems. As already noted, a new maize-based farming system combined with stall-fed dairy cows that provide manure for organic fertilization has emerged in the highlands of Kenya.[58] And most farmers are planting high-yielding hybrid maize seeds intercropped with leguminous crops that fix nitrogen in the soil. This evolving system is promising but extremely complicated, requiring more research.[59]

Reducing losses

Beyond growing more food, an important aspect of increasing food availability in Sub-Saharan Africa is to lose less of it—in the field and after harvest during storage, transport, and handling. Both quantity and quality losses are common. Losses in quantity occur, for example, from spillage during transportation and handling. Losses in quality occur, for example, when poor storage leads to pest and mold damage, lowering the price the product can fetch. Note that the two types of loss can occur together.

On-field

On-field losses in quality and quantity are substantial, but have not been well studied. On-field losses of both types stem mainly from poor practices. For example, Tanzanian farmers tend to grow many varieties of rice together, and these varieties mature at different times. At harvest, there is huge variation in readiness. Apart from leading to uneven taste, the rice also tends to have significant breakage when processed.[60]

Losses also result from failing to harvest crops on time, which leaves them exposed to rodents, water logging, and other damage. A lack of labor is the key reason for late harvesting.[61] Lack of mechanization also leads

to losses. Manual harvesting, threshing, and winnowing result in heavy losses for rice. Fairly simple interventions may be effective in reducing qualitative losses, as for cassava crops in Uganda (figure 5.14).

After the harvest

Postharvest crop losses in Sub-Saharan Africa are large. Table 5.2 shows postharvest loses for three common staples for a sample of nine Sub-Saharan African countries. Most postharvest losses stem from poor storage and deficiencies in transport and handling.

Storage. In Sub-Saharan Africa, insects, mold, and rodents cause quantitative grain storage losses estimated at 10%–20% of production.[62] Insects cause particularly heavy storage losses for grain and legume producers, reducing both quantity and quality.[63] For producers without access to good storage facilities, these damage discounts also force premature sales, as market penalties can quickly erode gains from seasonal price increases.

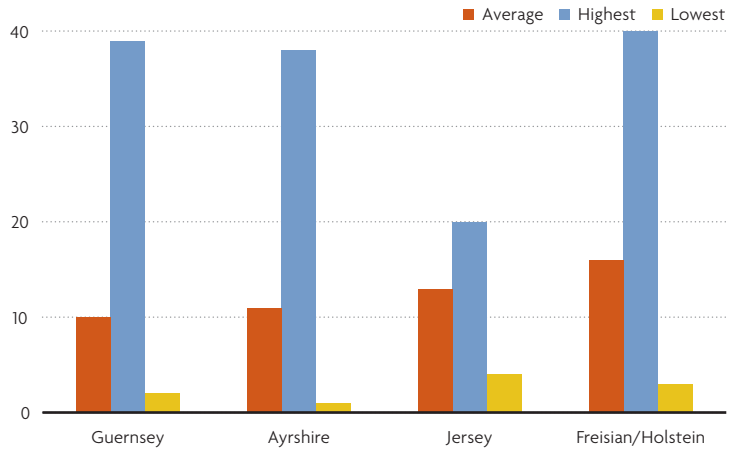
Yet good storage can be very expensive. For instance, in Kenya, metal silos that can store 1.8 tons of grain can cost US$270, which is often out of reach of the average smallholder.[64] More affordable options are available, however, and include the following:

- Silos built of mud and local grasses are traditional in some parts of Ghana. They can store up to 1.5 tons of grain. They can reduce losses to almost zero if the grains are well dried and treated before storage to prevent rotting or infestation. Well maintained, they can last up to 50 years, yet cost only US$25 to build.[65]
- In Mozambique, silos made of local materials, including mud and clay, have the advantage of being more affordable and based on locally developed technology. Known as "gorongosa silos," they can last up to 20 years with good maintenance. The silos can preserve the quality of the grain for up to 10 months (http://www.fao.org/in-action/improved-post-harvest-handling-raises-incomes-for-mozambique-farmers/en/)
- Hermetic bags are cheap and effective for small quantities. In Togo, postharvest losses were less than 0.5% for maize infected with the maize weevil (S. zeamais) and 6.0% for maize infected with the large grain borer (P. truncates) when stored in hermetic bags, compared with losses of 19.2% and 27.1% using regular propylene bags. Hermetic bags can also be very cost-effective. In Kenya, the economic benefit–cost ratio for hermetic bags has been estimated at 4.8.[66]

FIGURE 5.13

Milk yields in Kenya vary considerably across and within cattle breeds, 2013

Kilograms per day



Source: MoLD 2010 (cited in ACET 2015c).

FIGURE 5.14

Simple quality intervention for cassava chips in Uganda

Simple quality improvements can have substantial impacts

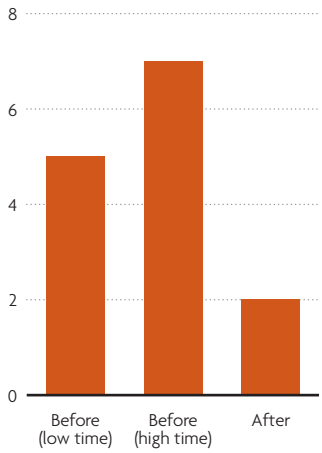
Intervention

Cutting
- Motorized chipper

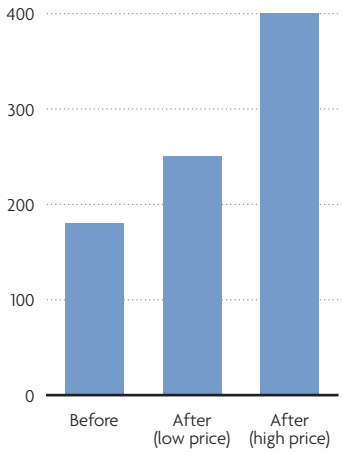
Drying
- Raised racks
- Biomass dryers
- Polythene sheets
- Improved local oven

Impacts
- Aflo-toxin reduced to safe levels
- Drying time more than halved
- Price went up by between 40% and 120%

Drying time (days)



Price of cassava chips (Ugandan shillings per kilogram)



Source: ACET 2015f.

TABLE 5.2

Postharvest losses in cassava, maize, and rice in nine Sub-Saharan African countries, around 2013

Percent

Country	Cassava	Maize	Rice
Burkina Faso	na	na	6–24
Ethiopia	na	na	13
Ghana	18	9–18	11–27
Kenya	na	19	16
Malawi	10–30	17	11
Nigeria	28	20	na
Tanzania	19–63	19	20
Uganda	20–25	18	18
Zambia	5	16	25

na is not available.

Source: World Food Programme 2014 (cited in Aning 2016).

Transport and handling. Transport and handling–related damage result primarily in qualitative losses. High transport costs encourage overloading, which accelerates deterioration. In Rwanda, 50 kilogram bags are sometimes stuffed to almost double the recommended weight, causing the bags to pull apart along the seams. Grain that falls out attracts rodents and provides a breeding ground for insects, further increasing losses. Another side effect is more broken grains, particularly for paddy rice, which becomes brittle when dried to a suitable storage moisture level (under 13.5%).

Two factors encourage overstuffing. One, as mentioned, is the high cost of transport. Overstuffing reduces the unit cost (per bag not weight) of transport to the farmer. Another is that some traders try to cheat farmers by overstuffing bags. While farmers sell to traders per bag, which has an assumed standard weight, traders sell to processors by weight. Although using scales would seem to be a simple solution, many farmers distrust them, believing tampering to be widespread.

Trade policy as a tool for reducing food imports

Some African governments use trade policy to manage surging imports and stimulate local production to substitute for imports, using very high import duties or outright bans to reduce imports and encourage import substitution. There are four main arguments against this use of trade policy, however.

First, because borders are porous, any sharp increase in import duties boosts informal imports from neighboring countries. For example, in 2012 informal cross-border trade in rice rose dramatically after Nigeria raised tariffs. Rice shipments from third countries to Benin and Cameroon, which have porous borders with Nigeria, shot up, further increasing smuggling into Nigeria. Benin's imports rose from 200,000 tons of white or polished rice in 2012 to an additional 2 million tons of parboiled rice, which generated a surge in revenue from import duties. The amount of rice legally passing through Nigeria's ports in 2013 dropped to 100,000 tons, down from over 2.5 million tons in 2012, causing a huge drop in government revenue.[67]

Second, weak overland supply chains mean that imports land at coastal ports at a lower price than domestic products from inland locations when they reach the same destinations. Dar es Salaam, Tanzania, is more easily served by imports than by the country's own southern rice-growing regions because of high internal transport costs. It is easier for these regions to export to neighboring countries.[68] Without improved infrastructure, lower transaction costs, and increased linkages between rural producers and urban suppliers, import substitution policy is likely to raise prices rather than spur domestic production.[69]

Third, local products may not be substitutes for imported products. In Ghana, Nigeria, and Senegal, consumers do not view local rice as equivalent in quality to the imported product.[70] The disparity is so great that consumers view them as different products. Import tariffs or bans have not stimulated demand for local rice.[71]

Fourth, exchange rate policy is far simpler to deploy and more effective in providing a general stimulus for reducing imports and expanding exports.

Mainly for these reasons, trade policy tends to have little impact on domestic supply, increasing food prices and poverty instead. Abandoning restrictive trade policies would, in fact, result in substantial consumer benefits. In Nigeria, for example, tax revenues would be much higher without such policies.[72] The substantial resources used to enforce bans would be better applied to improving border procedures for all traded goods (imports and exports).[73]

All the same, there is some room for this policy tool, especially where international markets are not very active and buyers are concentrated. For instance, Nigeria was able to effectively ban barley imports and force domestic brewers to use sorghum as a substitute.[74] Though breweries resisted this move as it entailed developing new supply chains, they did not have much choice.

Breweries, which are formal, regulated companies, cannot use informal means to source supplies, and since buyers for barley are formal food processing companies, smugglers have no market.

Tariffs, as long as they are not high enough to stimulate smuggling, could be used to create a fund to help the domestic sector become more competitive. The fund could be used to develop incentives for investors and producers. Some potential approaches include:

- Providing incentives to big importers to develop local suppliers, as Olam is doing in Nigeria.
- Developing products that can partially replace imports. For instance, cassava or sorghum flour can substitute for part of the wheat in bread. Nigeria has a requirement that bread contain 10% cassava flour (which will rise to 40% as capacity is built). To make this work, Nigeria has established a Cassava Bread Development Fund to support farmers and millers. The fund draws on import duties levied on wheat products, which are 20% on grain and 100% on flour.
- Processed foods, such as vegetable oil, account for a large share of imported foods, so developing processing capacity can reduce imports. Improving processing requires upgrading local capacity and attracting the right foreign direct investment (see chapter 6) with incentives, partly funded by trade taxes. Having different taxes on raw and processed products—such as having higher tariffs for milled rice than for paddy rice—is likely to encourage investors to establish processing capacity.
- Improving quality and branding local products are crucial. Senegal's experience indicates that raising the quality of local rice combined with a sustained branding campaign can create a product that could compete against imports and fetch a 38% premium in local markets.[75]

To tackle the issue of food imports agricultural policy needs, in addition to farm productivity, to focus on product quality and the logistics of moving products from farms to urban markets (as discussed in chapters 3 and 4). Also of crucial consideration is developing a strong food processing sector that can deliver diverse range of well packaged foods that urban markets are demanding (see chapter 6).

Conclusion and policy considerations

Africa is becoming increasingly dependent on food imports. That need not be the case, however, given the continent's potential comparative advantage in producing many of the foods that it imports. Many steps need to be taken to boost productivity at the farm level, reduce postharvest losses, and improve quality in Africa's important food products, particularly rice, maize, cassava, wheat, fruits and vegetables, poultry and dairy (milk).

The policy context

This is an ambitious but achievable agenda. Africa will not be able to realize these goals simply by replicating the Asian green revolution, which focused on using improved seeds and inorganic fertilizers (coupled with irrigation) to raise yields, particularly for rice and wheat. Beyond needing to focus on more than two staples, Africa also needs to expand mechanization, increase the supply of manure (to supplement inorganic fertilizers), and introduce more complex farming systems involving intercropping, mixed crop-livestock systems, and food–cash crop complexes. All the changes will need to occur in the midst of major diet shifts powered by urbanization and a growing middle class that require agricultural systems to deliver diverse, high quality, and more processed food products. Being competitive in urban markets will be a key success factor in Africa's green revolution.

An African green revolution will require upgrading the agricultural value chain. This is a complex undertaking. Priority should be assigned to reducing postharvest losses. Quick wins are possible here, as the food has already been produced and low-cost solutions are available and easy to implement. For example, inexpensive hermetic bags for grain storage can be bundled as part of fertilizer subsidy programs. Improving the quality of food from farm to fork should also be a high priority as low quality prevents locally produced foods from finding adequate markets. Efforts to improve quality must be accompanied by aggressive marketing campaigns to change the perception that locally produced food means low-quality food.

The reality of shifting diets and food preferences means that food imports, especially of temperate-climate crops like wheat, will continue as there is not enough suitable land in Africa to satisfy domestic demand. However, wheat imports can be reduced by requiring the inclusion of cassava or sorghum flour in wheat flour. As much as 30% of such flours can be added without affecting the quality of wheat products such as bread. Domestic products can also substitute for imports as a result of savvy marketing, enabling innovative ready-to-eat products that use the traditional grains of sorghum and millet to reduce demand for wheat imports. This will require considerable attention to food science, food processing technologies, and food marketing.

An Africa green revolution will encompass a number of revolutions: a revolution in crop production, a revolution in livestock production, a revolution in food logistics, a revolution in food processing, and a revolution in food marketing. So policies will need to pay greater attention to issues beyond farm production, through support programs that target the whole value chain while also addressing critical bottlenecks for key staples.

Product-level policy options

Several product-level measures could be taken to increase production and quality, summarized in table 5.3, by food product.

Pursuing a more integrated approach to farming. While commercial export crops will remain important as a source of foreign exchange for imports, especially of capital goods, their well-developed infrastructure and inputs system can be leveraged to also support food production. As the domestic and export crop production systems are complementary, treating them separately, as many ministries of agriculture do, needs to be reconsidered.

Agricultural support policies should encourage better integration of livestock and crops because integrated farming systems have the potential to increase the productivity of both systems. A more flexible system of support could target farming systems and packages rather than a single component of the system, such as fertilizer.

Exploiting synergies in commercial farming. Harnessing the potential synergies in a mix of small, medium-scale, and large commercial farmers would enable specialization, thereby lowering costs and increasing output. The medium-scale commercial sector is the "glue" in this symbiotic system, interacting with the large farmers and adapting the technologies that these larger farmers bring to agriculture. Medium-scale farmers can also work closely with small farmers, especially through contracting, and in that way, can transfer know-how and create linkages to markets, which will require some policy support.

Targeting interventions for managing postharvest losses. Government policy can do much to reduce postharvest losses. In Rwanda, for example, targeted government investments in the postharvest value chain over 2010–2015 reduced maize losses from 30% to 19%.[76] Public investments in rural transport systems and storage infrastructure are vital, as are incentives to attract private investment, particularly in attracting large scale traders who can invest in storage and transport logistics.

Sharpening the quality focus. The critical role of quality underscores the need for independent institutions that can certify quality. Strategies for lowering the costs of compliance are needed, however, as farmers and processors complain about the high cost of becoming certified.[77] In addition, imparting know-how for increasing quality should be part of regular extension packages. Similarly, mechanical inputs that can improve quality should be considered for subsidies, not just inputs to increase productivity.

Mechanizing faster. Despite the large demonstrated benefits of mechanizing, many poor farmers cannot afford to do so. There are several options for making technology more affordable.

TABLE 5.3

Priority actions for increasing the supply and quality of the main food products

Food product	Priority action
Rice	Upgrade on-farm machinery and processing equipment to improve quality Develop strong local brands
Maize	Improve yields though intercropping Move toward mixed livestock and crop systems to increase access to manure
Cassava	Increase access to machinery to save on labor at farm level and to process the crop faster
Fruits and vegetables	Develop local standards Build capacity to deliver quality assurance
Poultry	Develop improved local chicken varieties that are more suited to local conditions Build low-cost hatcheries (such as from old refrigerators as in Kenya) Improve feed quality and lower its cost through increased know-how on manufacturing feeds
Dairy	Encourage the emergence of commercial farmers, especially medium-scale farmers Develop market links

BOX 5.4

Locally developed technology—Thailand's "iron buffalo"

Thailand's experience with the two-wheeled walk-behind tractor—the "iron buffalo"—is testimony to the impact of continuous development of local technology. Developed in the 1950s by the engineering division of the rice department of Thailand's Ministry of Agriculture, the technology spread to local artisans and, as competition intensified, the tractor became very inexpensive.

Technology shifted from kerosene- to diesel-powered engines; gearbox and steering clutches were added; and attachments were developed including moldboards, disc plows, and harrow trailers, making the tractors a versatile, all-round piece of machinery. A later addition was a power takeoff that enabled farmers to use the tractor to drive water pumps. By 2007, there were an estimated 2.2 million two-wheeled tractors in Thailand.

Source: FAO 2008.

Develop a strong local fabrication sector. The growth in cassava production and consumption in West Africa is attributable largely to a strong local fabricator sector. Similarly, in Kenya, expansion of poultry production is being helped by local fabricators who are making incubators from broken-down refrigerators.[78] These African fabricators are following the local-technology tradition of the "iron buffalo" in Thailand, a two-wheeled walk-behind tractor (box 5.4). Longer term, a strong innovation system is key. It should include links between research institutions to design the machines and roadside artisans who can adapt and commercialize them.

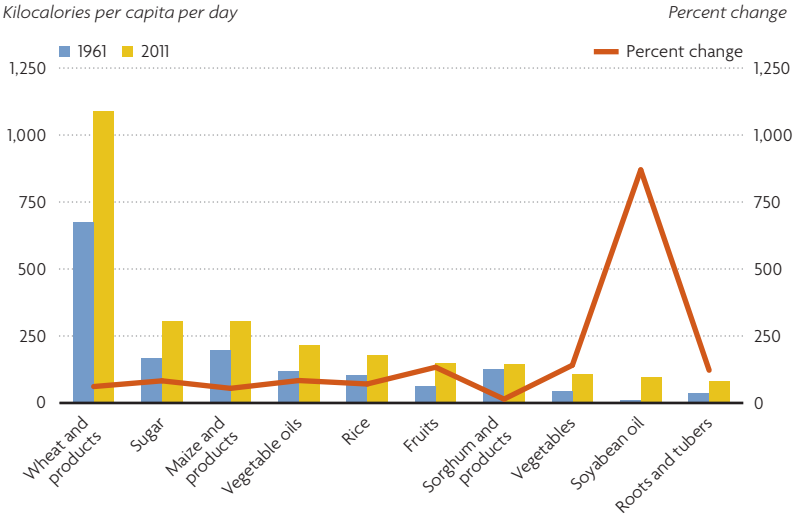
These three options are not mutually exclusive, and a mix of solutions tailored to local conditions may be most effective. Support for instance, should help local fabricators work with research institutes to design or adapt imported machines, and public–private partnerships should be developed (perhaps using subsidies to buy equipment) to establish mechanization centers in parts of the country where local fabrication and innovation are weak.

Using import taxes rather than trade bans to nudge agricultural development. Trade bans are unlikely to reduce imports, largely because of Africa's often porous borders. Governments could instead consider import tariffs, charging higher rates on processed foods than on raw foods to encourage domestic processing. The tariffs could incentivize investors (in particular, large importers) to establish local processing capacity or to develop local supply chains, especially to improve quality. While use of this policy tool depends on the tariff bounds individual countries have committed to at the World Trade Organization, most countries have not exhausted the policy space in this area. An analysis by the Food and Agriculture Organization of the United Nations finds a 15.1% average applied tariff among least developed countries, while the average committed tariff is 74.5%, thus creating an unused policy space of 59.3% (the equivalent figures for developing countries are 14.8% applied, 52.9% committed, and 38.1% policy space).[79]

Developing substitute products. As Nigeria is doing with cassava bread, products are needed that can partly substitute for wheat. Millet and sorghum flour can also partly substitute for wheat. Bakers would require training, and millers would need support to upgrade equipment to make high-quality flours and to blend them. Product development needs to be matched by promotional and image-building campaigns to position the local products as high-quality and healthy alternatives.

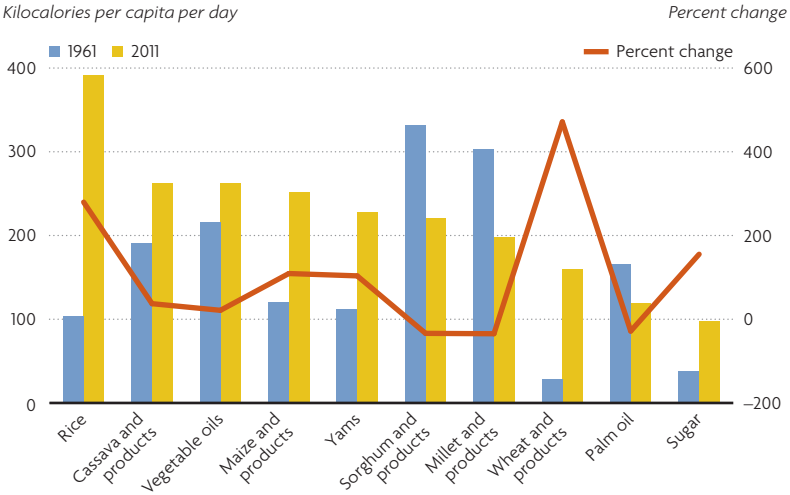
Appendix 5.1 Additional statistics

FIGURE 5A.1 Top 10 calorie providers, North Africa, 1961–2011



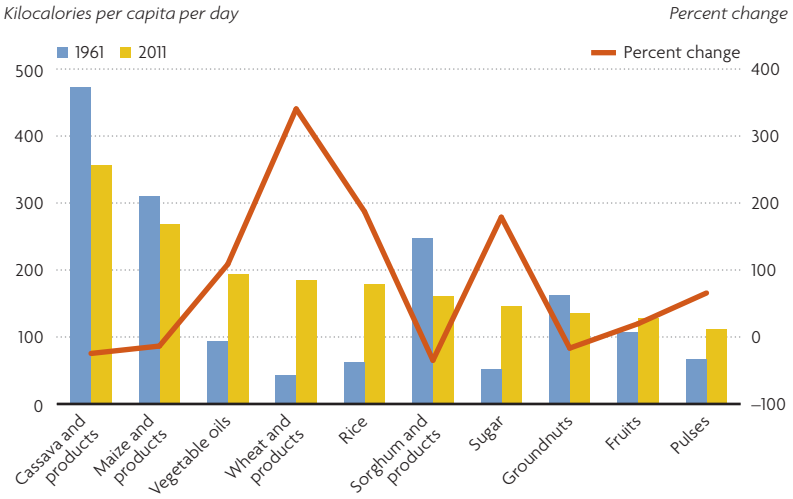
Source: FAOSTAT online.

FIGURE 5A.2 Top 10 calorie providers, West Africa, 1961–2011



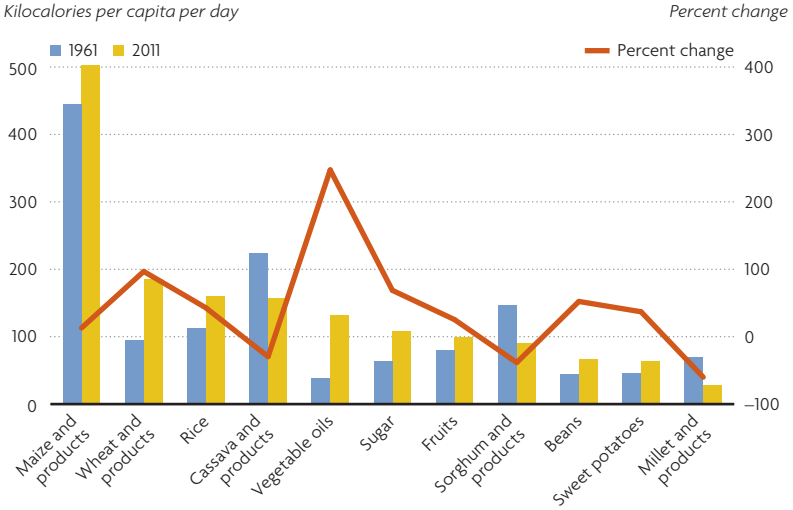
Source: FAOSTAT online.

FIGURE 5A.3 Top 10 calorie providers, Middle Africa, 1961–2011



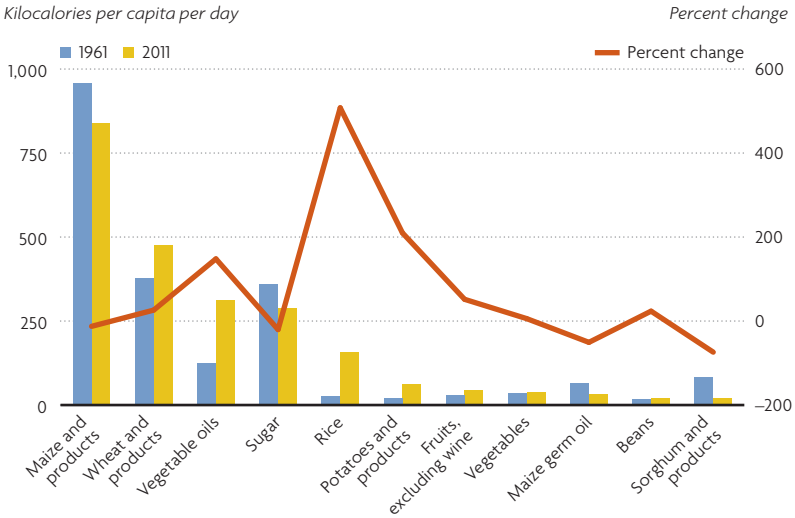
Source: FAOSTAT online.

FIGURE 5A.4 Top 10 calorie providers, East Africa, 1961–2011



Source: FAOSTAT online.

FIGURE 5A.5 Top 10 calorie providers, Southern Africa, 1961–2011



Source: FAOSTAT online.

Notes

1. The food processing sector is a key consumer of sugar and fats, which are used in preparing many foods. In the European Union, for example, only 30% of sugar is consumed directly, the rest being used as inputs to the food processing sector and other industries.
2. Reardon and Timmer 2005.
3. Roxburgh et al. 2010.
4. Jayne et al. 2014. Democratic Republic of Congo, Angola, Republic of Congo, Zambia, Cameroon, Mozambique, Central African Republic, Gabon, and Sudan, in descending order.
5. Wheat is not a new crop in North Africa, however, where it has long been a staple.
6. ACET 2015d.
7. Lançon and Benz 2007.
8. USDA 2017.
9. Asian yields range from a high of 6.7 tons per hectare in Southeast Asia to a low of 3.7 tons per hectare in South Asia.
10. Otsuka 2016.
11. Otsuka 2016.
12. Otsuka 2016.
13. Otsuka and Larson 2016, cited in Otsuka 2016.
14. ACET 2015c.
15. Commercial rice growers in Ghana constitute of 20% rice farmers. The Ghana National Rice Development Strategy describes them as growing rice as a cash crop, being market oriented, using hybrid seeds and fertilizers, hiring labor, and some also owning tractors. This is in contrast to small farmers who have assets that are used inefficiently because of lack of access to technologies and markets, are served by poor infrastructure, and are exposed to weather-related risks.
16. Balasubramanian et al. 2007, cited in Otsuka 2016.
17. Balasubramanian et al. 2007, cited in Otsuka 2016.
18. Balasubramanian et al. 2007, cited in Otsuka 2016.
19. Otsuka 2016.
20. Balasubramanian et al. 2007.
21. ACET 2015a, 2015b.
22. Otsuka 2016; ACET 2015d. Also important are whether farmers use organic and inorganic fertilizers, pesticides, and hired labor; the soil type; and whether they intercrop paddy with other crops.
23. Otsuka 2016.
24. ACET 2015b.
25. Otsuka 2016.
26. ACET 2015e.
27. ACET 2015b, 2015f.
28. Mbwika 2001, cited in ACET 2015e.
29. Gatune 2016, ACET 2015b, 2015f.
30. Nweke 2004.
31. ACET 2015d.
32. ACET 2015b.
33. ACET 2015b.
34. Mason, Jayne, and Shiferaw 2012.
35. For instance, Mozambique, a fairly poor country, subsidizes bread made from imported wheat and suffered serious urban riots when it tried to end the subsidies. http://blogs.worldbank.org/africacan/on-the-riots-in-mozambique-are-subsidies-the-solution.
36. Otsuka 2016.
37. World Bank 2009.
38. Lebdi 2016.
39. World Bank 2014.
40. Demeke and Marcantonio 2013.
41. Mureithi 2016. The government in 2016 forced the millers to buy all the local crop before they were allowed to import. The local crop cost 3,000 Kenyan Shillings (KShs) per bag, and the import price was KShs2,650.
42. ACET 2015a.
43. Reardon and Timmer 2005.
44. Otsuka 2016.
45. Kariuki, Loy, and Herzfeld 2012.
46. Otsuka 2016.
47. ACET 2015b.
48. ACET 2015c. The preponderance of fake drugs has other repercussions, as some dealers keep the drug prices high to avoid the perception that they are selling fake drugs.
49. ACET 2015a.
50. Coetzee 2016.
51. Meissner 2015.
52. Higher yield does not necessarily translate into higher profitability. In general, the non-zero-grazing farmers seem to be doing better than the zero-grazing farmers. The higher profitability of non-zero-grazers is probably due to lower feed costs, which seem to more than compensate for the increased likelihood of disease among grazers. However, zero-grazers in peri-urban areas, and thus with easy access to market, are most profitable (ACET 2015c).
53. Meissner 2015.
54. KDB 2010, cited in ACET 2015c.
55. ACET 2015c.
56. Otsuka 2016.
57. Kaizzi et al. 2012, cited in ACET 2015d.
58. Otsuka and Muraoka 2015; see "Identifying scalable solutions" in chapter 9. Reminiscent of the agricultural revolution in the United Kingdom, in which grazing was replaced by stall-feeding to increase manure application.
59. Otsuka 2016.
60. ACET 2015e.
61. ACET 2015a, 2015b. For livestock, late "harvesting" is due to weak commercial orientation. For instance, a beef study in Uganda found that cows were sold at a very late age because beef cows

were also used to supply milk to the family, and thus tended to be sold much later. A beef cow is sold at five years in Uganda against two years in the European Union (ACET 2015d).

62. World Bank 2011.
63. Jones, Alexander, and Lowenberg-DeBoer 2014, cited in Jones et al. 2014.
64. Gitonga et al. (2013) point out that though they found metal silos to be very effective in reducing grain losses due to maize-storage insects and having a huge impact of farmer's welfare, the initial cost of metal silos is high and therefore call for policies to increase access to credit, to reduce the cost of sheet metal.
65. The Guardian 2014.
66. Ndegwa et al. 2015.
67. Vorley and Lançon 2016; Benjamin, Golub, and Mbaye 2015.
68. ACET 2015e.
69. Reardon et al. (2015, cited in Vorley and Lançon 2016) points to how linkage to growing urban and regional markets has provided incentives for farmers to invest in soil conservation and fertility and in productivity-enhancing inputs, including seeds, breeds, fertilizer, and irrigation in Ethiopia, Kenya, Mali, Rwanda, and Senegal.
70. Demont and Rizzotto 2012; Johnson et al. 2013.
71. del Villar and Lançon 2015.
72. Johnson et al. (2013) suggest that much of the estimated annual US$800 million potential import tariff revenue from rice from mid-2009 through 2012 might have been captured as rents by traders or regulatory officials.
73. Johnston et al. 2013.
74. Chete et al. n.d.
75. Demont and Rizzotto 2012.
76. Kibaara 2015.
77. ACET 2015f. In export markets where quality standards are prerequisites for export, quality compliance can cost as much as 30% of the value of the product. Many organic and fair-trade exporters in Ghana rely on nongovernmental and other support organizations to pay this cost to stay profitable.
78. ACET 2015c.
79. Mathews 2015.

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CHAPTER 6

Adding Value and Spurring Agro-industry

Attempts to transform Africa's agriculture—beyond increasing agricultural productivity and output, and making agriculture profitable (chapters 3, 4 and 5)—must be linked to modern and well-performing agribusiness. Upstream from farms, the demands of modernized agriculture will support the manufacture of inputs such as fertilizers and other chemicals, farm implements, and packaging. Downstream, increased and reliable agricultural outputs can support a vibrant and competitive agro-processing sector as part of agribusiness.[1] Expansion of agro-industry will bolster Africa's moves to industrialize, increasing employment and incomes, and reciprocally stimulating agricultural growth by creating new output markets and increasing farmers' incomes, which they can invest in land or new inputs to improve productivity.

Agribusiness links input suppliers, farmers, agro-processors, traders, exporters, and retailers, in four main groups:

- Agro-processing,[2] covers the postharvest activities involved in transforming, preserving, and preparing agricultural production for intermediary or final consumption.[3] It includes transforming outputs into food and beverages; tobacco products, leather, and leather products; textiles, footwear, and apparel; wood and wood products; and rubber products.
- Equipment for processing agricultural raw materials, including machinery, tools, storage facilities, cooling technology, and spare parts.
- The agricultural inputs industry, such as fabricators and manufacturers of agricultural machinery, equipment, and tools, including their maintenance and repairs; fertilizers, pesticides, and insecticides; and irrigation systems and related equipment.
- Services, including, storage, packaging, transport, distribution, marketing, packaging; finance; information and communications technology; and marketing design.

This chapter focuses on opportunities in agro-processing and value addition and, less so, on the manufacture of selected inputs necessary for agricultural transformation. The discussion starts with an overview of the agro-processing industry in Africa with a focused discussion on three value chains that have high potential in Africa—cotton, oil palm, and cassava followed by a limited look at other products in the agrifood and leather sectors, presenting processing and value-adding opportunities. These crops and products are just used to illustrate opportunities, challenges, and actions for promoting agricultural processing. For input manufacturing, the discussion considers fertilizers, equipment and machinery, and packaging materials.

Agro-processing and value addition

The postharvest activities required to transform, preserve, and prepare agricultural output for intermediary or final consumption, and the value added by these processes, are a vital part of transforming agriculture in Africa.

Opportunities

Agro-processing, and more especially the agrifood sector, presents valuable opportunities for African countries to kick-start their industrialization as many countries elsewhere in the world have done. Sub-Saharan Africa has become attractive as a fast-growing consumer food market, reflecting its rapid urbanization and population growth. Because of population growth, increased urbanization and changing food habits toward ready-made foods, urban food markets are expected to quadruple by 2040 from their levels in 2012 and to exceed US$400 billion annually, requiring cumulative agribusiness investments in processing, logistics, market infrastructure, and retail networks in the food and beverage markets of US$1 trillion over the period.[4]

Sub-Saharan Africa's average gross domestic product (GDP) per capita is projected to increase by around 30% between 2010 and 2030 and by another 80% between 2030 and 2050.[5] As in other parts of the world, rising incomes will increase per capita food consumption and swell the ranks of a growing middle class demanding greater diversity and higher quality in their diets, along with increased demand for processed foods. These shifting demographics will provide many opportunities for Africa's agro-processing sector. The region's biofuel market is also growing. In this context, some African countries—Burkina Faso, Ghana, Mali, Malawi,

Mozambique, Nigeria, Senegal, South Africa, and Tanzania have started to introduce programs and initiatives for the development of bioethanol production and the plantation of jatropha oil seeds for biodiesel production.

State of agro-processing in Africa

A typology of African agro-processing shows four categories of enterprises: artisanal (generally micro), semi-artisanal (normally small), semi-industrial (medium), and industrial (large and often modern) (table 6.1). The artisanal and semi-artisanal categories include the smallest firms that use the simplest technology and that frequently conduct their activities in the informal sector. In Sub-Saharan Africa (except perhaps South Africa; box 6.1), the bulk of agro-processing enterprises (about 75% in West Africa in the mid-2000s) fall into the artisanal and semi-artisanal categories.[6]

The artisanal and semi-artisanal categories face severe constraints to growth and income generation: very low productivity of labor and other resources and very limited market access (their market focus being primarily low-income consumers in the village or neighborhood). For most Sub-Saharan African countries, the industrial structure is weak in both the number of firms and average size. While there are differences across countries, a large majority of industrial firms are small or medium-size enterprises, with only a few large (often foreign or state-owned) firms. Their small size hampers their ability to export.

BOX 6.1

Importance of linkages in South Africa's agro-industry

South Africa has more than 7,000 agro-processing firms with their own commodity value chains. The sector is dominated by a few large diversified firms. A key characteristic of the agro-processing sector is its strong upstream and downstream linkages. Upstream, the sector links to primary agriculture across a variety of farming models and products. Downstream, agro-processing outputs are intermediate products (to which further value is added) and final goods (which are marketed through wholesale and retail chains as well as a diverse array of restaurants, pubs, bars, and fast-food franchise outlets).

Source: SA Department of Agriculture, Forestry and Fisheries and Department of Trade and Industry.

In most of Africa, value added in the agro-processing sector is small relative to that in agriculture, typically less than 50%. Except in Mauritius and South Africa, the ratio of agro-processing manufacturing value added to

TABLE 6.1 Characteristics of agro-processing enterprises in West Africa, by type during the mid-2000s

Characteristics	Artisanal	Semi-artisanal	Semi-industrial	Industrial
Scale	Microenterprise	Small enterprise	Medium-size enterprise	Large and specialized
Labor	Family or social	Family	Large and moderately specialized	Large and specialized
Products	Traditional products, often with a short shelf life	More or less standardized products, stable shelf life	Diversified products with stable shelf life	Products meeting grades and standards; branded products
Organization	Informal enterprise. Little or no organization (embryonic)	Beginning to be organized	Formal with separated functions of employees; accounting systems	Very modern (administrative units; divisions and departments)
Investments	Small to none. Operations are essentially manual	Some machines	Important mechanization	Important and modern
Production	Low level of production	Regular and larger level of production	More mechanized processes	High capacities for production
Types of Markets	Local and very targeted	Local distribution	National distribution and sometimes regional	All markets (local, regional, overseas)
Distribution	Short distribution channels; direct sales to consumers	Direct sales and/or sales by intermediaries	Long distribution channels	Long and professional channels
Estimated share of total processing firms in West Africa	75%		20%	5%

TABLE 6.2 Characteristics of agro-industry in selected African and other countries

Percent

1	2	3	4	5	6	7
Country	Agricultural value added as share of GDP (2014)	Manufacturing value added (MVA) as share of GDP (2014)	Agroprocessing MVA as share of total MVA	Agroprocessing MVA as share of GDP (3 × 4)	Agroprocessing MVA as share of agricultural value added (5 ÷ 2)	Food MVA as share of agroprocessing MVA
Africa						
Algeria	11.1	6	53.4[a]	3.2	28.8	69.5
Ethiopia	41.9	5	55.5[b]	2.8	6.6	74.2
Ghana	22.4	7	54.6[c]	3.8	17.0	59.5
Kenya	30.2	10	40.5[d]	4.1	13.4	76.8
Mauritius	3.7	15	77.7[d]	11.7	314.0	58.6
Morocco	13.0	12	42.7[d]	5.1	39.3	49.6
Senegal	15.4	12	38.5[d]	4.7	30.2	86.1
South Africa	2.4	15	28.9[a]	4.3	180.4	75.8
Tanzania	31.1	9	62.0[a]	5.6	17.9	78.2
Other countries						
Brazil	5.2	13	33.3[d]	4.3	83.2	64.0
Chile	3.7	10	46.5[f]	4.7	125.6	79.0
China	9.1	33	22.9[a]	7.6	82.9	51.5
India	17.4	14	18.7[a]	2.6	15.0	47.6
Malaysia	8.9	25	17.6[d]	4.4	49.4	70.5
Mexico	3.5	16	30.3[a]	4.9	138.5	73.6
Thailand	27.2	28	29.8[e]	8.3	30.6	64.2
United States	1.3	12	17.0[e]	2.0	156.9	79.4
Vietnam	17.7	24	40.4[d]	9.7	54.8	53.2

a. 2007. b. 2008. c. 2009. d. 2010. e. 2011. f. 2012.

Source: ACET calculations based on latest data available from UNIDO Database (Industrial Statistics) and World Bank (agricultural GDP data).

agricultural value added in Africa is below 40% (table 6.2, column 6). Similarly, the share of agro-processing in GDP is very low (column 5), even if it often constitutes more than half of manufacturing value added (column 4). Sector output is heavily concentrated in low-technology artisanal processing, with low and uncertain supply of agricultural raw materials.

ACET's 2014 *African Transformation Report* identifies agro-processing as typically offering a big step up for agriculture in generating employment, income, and foreign exchange.[7] The sector can often be unlocked through a push from well-designed policies to overcome barriers that prevent domestic players from emerging, reaching scale, and becoming globally competitive. A robust agriculture to agro-processing value chain can create a potent combination of comparative advantage, scalability, and substantial spillovers for African countries.

But according to an ACET study of 20 value chains in five African countries, processing is probably one of the most challenging stages in Africa's agricultural value chains.[8] Many African agro-processors are below 50% capacity utilization due mainly to the lack of a consistent supply of high-quality raw materials at low prices. Beyond these supply issues, constraints include regulatory bottlenecks that discourage the transition from informal to formal industries; other missing or inappropriate policy and institutional measures for attracting private investment; weak infrastructure (including energy, roads, and water sources); and difficulties for smallholders and small firms to access technology, information, skills, and finance. Chapters 3, 4, and 5 address many of these issues. Here, we use selected value chains (mainly cotton, oil palm, and cassava) to illustrate the opportunities and challenges of agro-processing and value addition, and what could be done.

Processing and adding value to a traditional export: Cotton

Cotton, one of the world's most traded commodities, is produced in at least 30 African countries.[9] The top 10 producers for 2016 (in descending order) were Burkina Faso, Mali, Benin, Côte d'Ivoire, Cameroon, Chad, Nigeria, Ethiopia, Tanzania, and Zambia.[10] Cotton can be processed in different ways for products with numerous uses, but by far the most common is the manufacture of textiles and apparel.[11] The export of textile and apparel products[12] has been used by some countries, including a few in South and East Asia and Mauritius in Africa, as a pathway to economic growth and industrialization. How can other African countries also add value to their cotton and leverage it into manufacturing? [13]

Cotton value chain

The rungs in the cotton value chain are as follows:[14]

- *Seed cotton production.* About 8% of globally traded cotton is harvested in Sub-Saharan Africa, where it is grown almost exclusively by smallholder farmers, who rotate it with crops such as soy, maize, and groundnuts (box 6.2). Ginning companies purchase seed cotton from farmers in most African countries and convert it into cotton lint or fiber and cottonseed. Total lint production in Africa averaged about 1.43 million tons between 2010 and 2014.[15]
- *Yarn.* Spinners mix lint (or fiber) from several bales and blend them to create a uniform blend of fiber properties. They transform the cotton lint into yarn, the fundamental unit of production for creating fabrics. The spinning of cotton yarn represents the first stage of the industrial transformation of raw cotton into an intermediate textile product (yarn) and adds significant value.
- *Textiles or fabrics (often used interchangeably).* Cotton yarn is converted into fabric or textiles by weaving, knitting, or braiding—different weaving methods produce different finishes on the final cotton fabric.
- *Apparel or garment production.* This is essentially the design, cutting, assembly, and finishing of textiles to make clothing and "made-ups" (bed sheets, kitchen towels, and other home furnishings). Apparel or garment production is typically a labor-intensive process, but the ability to provide rapid delivery and to respond quickly to frequent shifts in consumer preferences and changes in retail practices are the most important areas of comparative advantage. In 2014, world exports of textiles and clothing totaled US$842 billion, of which Sub-Saharan Africa accounted for US$6.1 billion.[16]

Africa has a low share of global production of cotton and negligible participation in cotton value-added products. Between 2010 and 2014, Africa cotton lint production as a share of world output ranged between a low of 4.7% (2011) and a high of 6.3% (2014).[17] The African Cotton & Textile Industries Federation estimates a value addition to the cotton fiber produced of about 23% of average production between 2010 and 2014 (0.33 million metric tons of the lint Africa produces).[18] This means that while there is a substantial increase in the market size of subsequent steps in the value chain, Africa essentially fails to capture it. Low cotton yield in Africa remains a key issue, and exchange rate volatility also reduces cotton exports. Africa's raw cotton suffers from an international market perception of being of low quality (mainly due to contamination), which combined with Africa's small world market share, reduces its price bargaining power.

Yarn. Sub-Saharan Africa has a very small spinning industry (only 0.01% of global spinning capacity). Cotton yarn (including cotton/synthetic-fiber blends) is produced for export to the United States and the European Union, as well as for use in downstream production of apparel for export to these markets.

Textiles and apparel. Africa is a net cotton exporter, but a net textile and clothing importer. Textile and apparel industries in most Sub-Saharan countries have shrunk, starting around 2004, particularly in the largest textile-producing countries of Mauritius and South Africa. Facing increased competition once the Multi-fibre Agreement was phased out at the end of 2004, Africa has struggled to be competitive on cost in producing yarn, textiles, and apparel against Bangladesh, China, and India.

Several African countries are eligible for duty-free preferences for their textile and apparel exports to the United States under the African Growth and Opportunity Act (AGOA),[19] and without them few African apparel exports to the United States would be cost competitive. U.S. trade data show that apparel exports under AGOA peaked in 2004,[20] having risen sharply since AGOA's inception late in 2000.[21] Since 2013, however, Africa's textile and apparel exports to the United States have been increasing. Leading African exporters using the AGOA trade preferences include Kenya, Lesotho, and Mauritius.

Looking at the apparel industry in six African countries—Mauritius, Madagascar, Lesotho, Kenya, Ghana, and Senegal—the 2014 *African Transformation Report* concluded that, given the labor intensity of apparel production, Africa has an opportunity to leverage

its labor cost advantage for higher apparel exports and employment if it can overcome its domestic supply constraints and three challenges in the global apparel market:[22]

- Taking advantage of international trade regimes, such as AGOA and the EU's Everything but Arms initiative (EBA), which now shape global competition and market access.
- Competing with China (with its huge labor force, scale economies, deep domestic supply chains, and good logistics), whose emergence on the world textile and apparel market has made competition based on low wages harder.
- Competing with or entering the global value chains that now dominate global exports of apparel and have a huge impact on the viability of apparel manufacturing in low-wage countries.

Value-capture opportunities

The discussion of opportunities in cotton needs to be presented in the context of the challenges for Sub-Saharan Africa along the cotton value chain (table 6.3).

Africa's comparative advantage lies in its easy access to cotton lint, low-cost abundant labor, and some preferential trade agreements (AGOA and EBA), suggesting that cotton fabric and apparel production (rather than complex textiles) should be the focus. There are four main areas where countries could capture additional value.

- *Increasing the volume of seed cotton production.* The main possibilities for countries producing seed cotton would be to increase yields through better agronomics, move to appropriate and better adapted genetically modified (gm) cotton (box 6.2), and improve farmer incentives for production.[23] Tanzania, a large producer of seed cotton and organic cotton, exemplifies these and other needs (box 6.3).
- *Improving seed cotton quality.* Required here are more stringent quality controls for handpicked cotton, expansion of best practices (as with Senegal's program to eliminate polypropylene contamination), and more efficient processing of cottonseed oil (a by-product). Box 6.4 shows the steps open to Burkina Faso to move up the cotton value chain.
- *Addressing high-value niche markets.* A few countries also have the potential to look at additional value capture opportunities in niche markets—organically produced cotton and fabrics, "Made in Africa" and "Buy Africa, Build Africa" branding, and ethnic textiles like kikoi from some of the East African countries. Specific niches include fair trade cotton; "origin cotton" (cotton made in Africa that is marketed as non-gm, handpicked, grown under sustainable rainfed conditions and with responsible use of pesticides and fertilizers); and indigenous African prints and woven fabrics (such as kanga from the Great Lakes region and kente from Ghana) for regional and diaspora markets.
- *Nurturing or strengthening the domestic apparel industry.* Based on existing processing capabilities and areas of comparative advantage, several countries can capture additional value by strengthening their domestic apparel industry. These include Botswana, Ethiopia, Kenya, Lesotho, Madagascar, Mauritius, Nigeria, South Africa, Tanzania, and Zambia. The main actions would entail developing industry clusters (parks or export zones), addressing infrastructure challenges, and exploiting AGOA and EBA.

TABLE 6.3 Challenges for value capture along the African cotton value chain

Lint	Yarn	Textiles	Apparel	Branding, marketing, and retail
• Paucity of agronomic expertise (in integrated pest management, post-harvest handling, and other) • Outdated ginning machinery • Decreased efficiency/yields through low mechanization and irrigation • High cost of organic cotton certification	• Outdated machinery • Scarcity of skilled labor • Problems with cotton lint quality • Poor infrastructure, including power, water, and transport	• Outdated machinery • High costs of production • (utilities, labor, • taxation) • Scarcity of skilled labor • Lack of access to capital at competitive rates • Difficulties in changing operations and reeducating the workforce • Poor logistics in servicing export markets • Insufficient supply of clean water and wastewater treatment	• Imports of second- hand clothes • High costs of production (utilities, labor, taxation) • Lack of high-quality fabrics of local manufacture to enter global markets • Poor infrastructure hitting delivery times	• Low quality • Weak design expertise • Inadequate marketing capabilities • Lack of knowledge of regional and international markets

Source: ACET 2014a.

BOX 6.2

Burkina Faso's reversal from genetically modified cotton

Burkina Faso is the only country in Africa to have used genetically modified (gm) cotton. In an attempt to expand production, the cotton industry in Burkina Faso began gm cotton trials in partnership with Monsanto in 2003. These gm cultivars were patented and released to farmers in 2008. Adoption of gm cotton nationally skyrocketed and by 2013 almost 70% of total cotton area was planted to gm cultivars. The rate of adoption remained high until 2015. The only published studies on the performance of gm cultivars in Burkina Faso during this period reported an average on-farm yield gain of 22% over conventional cultivars and a profit gain of 51% for a gm cotton-producing household with just over 3 hectares.[24] The profit gains stemmed from the significant reduction in pesticide applications coupled with increased yield, which outweighed the higher seed cost.

Despite these economic advantages, the introduction of gm cotton had several downsides. It affected important traits that distinguish West African cotton from its international competitors. Conventional Burkinabe cotton has a high ginning ratio and long staple length. Starting in the early years of commercial release, Burkinabe officials noticed declines in ginning ratios and staple length. While Monsanto officials have been skeptical, these declines have persisted and have apparently affected the marketability of Burkinabe cotton. Results from classification by the regional cotton ginning companies in Burkina Faso (SOFITEX, SOCOMA, and FASO COTON) showed that the gm cultivars produced fibers that were 1/32 of an inch shorter than those from conventional varieties. In the 2013/14 season, for example, more than two-thirds of the nation's total crop was classified as lower-quality medium, with only a third retaining the previous classification as medium to high staple length.

This decline in staple length has undermined the reputation of Burkinabe cotton and cut into its value on the international market. When coupled with the decline in lint due to the lower ginning ratio, the apparent inferior quality characteristics of the gm cultivars have compromised the economic position of Burkinabe cotton ginning companies.[25] Monsanto scientists are at a loss to explain the precise mechanism that has created these problems and are trying to correct this fault. Burkinabe cotton companies, hurt by declines in quality, ginning yields, and profits, have set a timetable to move out of gm cotton unless the quality issues are resolved (they control seed supply and distribution). From the peak adoption rate of 73% of cultivated area in 2014/15, they moved to 53% in 2015/16, a planned 30% in 2016/17, with the goal of a complete return to conventional cotton in time for the 2017/18 season.

Before the emergence of the quality concerns, Burkina Faso's gm adoption experience had started to play a pioneering role in the promotion of gm crops in Africa. Nearly two dozen countries sent delegations to learn about the experience with gm cotton. The quality issues, however, will need to be quickly resolved if Burkina Faso's yield gains are to be replicated—without the loss of reputation.

Source: Dowd-Uribe and Schnurr 2016.

Policy agenda for value capture in the cotton sector

A policy agenda to support a cotton sector value-adding strategy must be based on the opportunities for value capture and the associated policy bottlenecks of each country, though some general themes are common. Beyond measures to improve the environment for agro-processing in general—notably energy, roads, ports, and investment incentives—a few broad measures should be considered for the cotton industry.

- *Improving productivity in the field.* Intensifying production (pest control integrated with soil fertility management, input access, equipment, water management, and pesticide management); upgrading research and development; building capacity of farmers and their organizations; and reducing production costs. Support for well-regulated contract farming, including organic farming, would also help in promoting production.
- *Improving the intrinsic quality of each country's lint with upstream and downstream measures.* Strengthening farmers' associations to improve price bargaining power would be crucial to ensuring that farmers' interests and rights are respected; obtaining the support of farmers to improve the classification system of seed cotton; reducing cotton contamination by improving transport, storage, and handling at all stages of the value chain; and developing and modernizing a fleet of machines for automatic electronic ranking of the fiber in the factory and training technicians in operating and maintaining them.
- *Promoting additional processed products such as apparel.* Helpful measures include Improving the

BOX 6.3

Why let others capture the value? How Tanzania can move up the value chain

Tanzania ranks among the top five African producers of seed cotton and is the world's fourth-largest producer of organic cotton (after India, Turkey, and Syria). Cotton is Tanzania's second export crop after coffee. It is cultivated on about 300,000–500,000 rainfed hectares of land (about 9% of total cultivated land in Tanzania) by smallholder farmers, and it provides direct income and employment to about half a million households. Yet the country is failing to capture most of the value in the cotton value chain.

Most of the cotton is exported in raw form as lint, mainly to China, India, Indonesia, Kenya, Malaysia, Thailand, and Vietnam. Tanzanian firms engage in only minimal processing into yarn, textiles, and apparel.

Less than 30% of the cotton lint or fiber produced in Tanzania is marketed to local textile mills for use in dying, spinning, weaving, and printing. The textile industry consists of 23 privately owned mills, operating at about 40–50% of capacity.

Tanzania's main value-added opportunities are the following:

Aside from increasing productivity through appropriate farm management practices, Tanzania can increase cotton processing to produce edible oil. Tanzania's demand for edible oil is around 170,000 tons a year, but estimated national production is far lower, at around 60,000 tons. The consumption gap is filled through imports of semi-refined palm oil. Demand is expected to grow alongside projected population growth of nearly 3% a year. This wide domestic demand–supply gap is an investment opportunity for cottonseed production and cottonseed oil processing.

Using cottonseed cake for livestock. Cottonseed cake produced in Tanzania as animal feed competes with other feeds, including sunflower cake, sardine, and fishmeal feeds. Demand for feeds has been growing as the country's livestock subsector modernizes. Feed, especially for intensively raised animals such as dairy cattle, poultry, and pigs, accounts for 60% of their overall production cost. Increased demand for industrial feed has helped raise the price of cottonseed cake. In addition to local demand, cottonseed cake is reportedly exported, unofficially, to neighboring Kenya and Uganda. So there is value to be captured in expanded production of cottonseed cake.

Improving the competitiveness of textiles by ensuring uninterrupted power. A modern mill in Tanzania can be as competitive as any in the world, so long as the power supply is uninterrupted, allowing it to operate at its annual potential of 8,400 hours. Knitted fabric conversion costs in Tanzania are some of the lowest in the world, after India, Egypt, and China; capital costs are high, but offset by inexpensive labor and electrical power. A vertical operation—including spinning, weaving, and knitting with modern machinery; a consistent supply of power; and an internationally competitive rate of finance—has the potential to be highly competitive in foreign markets.

Tapping into AGOA by promoting a local apparel industry. Most cotton is exported as fiber. Value could be captured by processing the fiber into textiles and apparel before export, including to the United States, which has extended to 2025 the AGOA legislation that gives preferential access to the U.S. market for apparel from Africa.

Source: Salm et al. 2011; Kadigi 2014; ACET 2014a.

processing ability of the industry through efficient equipment and skilled labor; introducing or strengthening subregional textile policies, including controlling inflows of second-hand clothing and opening up regional markets to domestic textile industries; improving artisanal value capture by promoting small and medium-size export firms engaged in weaving, manufacturing fabrics for furniture making, and décor production; building the capacity of artisans through training in crafts such as weaving, dyeing, and printing; developing local expertise in craft material; and expanding marketing activities to raise the visibility and popularity of African fashion items.

Processing promising crops for export and import substitution: Oil palm and cassava

A broad range of potentially very high-value, but underexploited, crops and their products, alongside growing international demand, provide a scale opportunity for several African countries in processing and import substitution. These crops include fruits and vegetables, flowers, yams, meats, and some cereals such as sorghum, millet, and maize. Two important examples are oil palm (Côte d'Ivoire, Ghana, Guinea, Liberia, and Nigeria) and cassava (Democratic Republic of Congo, Ghana, Mozambique, Nigeria, and Tanzania).

BOX 6.4

Why let others capture the value? How Burkina Faso can move up the value chain

Burkina Faso is the largest seed cotton producer in Africa (more than 700,000 tons in 2015), but it has very little downstream activity beyond production (its spinning capacity is about 7,000 tons). And despite its large cotton resources, its textile and apparel sector is small.

The Société Nouvelle Huilerie et Savonnerie Citec (SN–CITEC) is Burkina Faso's only large cottonseed processing firm, coexisting with many much smaller, less technologically advanced, companies. The company uses husks from the decorticated cotton to meet as much as 95% of its energy requirements, and it achieves more than a 16% oil extraction rate, equivalent to rates achieved in the United States.

The weakest link in the cotton value chain is processing, as only about 4% of the cotton lint produced is transformed domestically, mainly into yarn, because the country has failed to develop a strong, modern textile or apparel industry and to take advantage of opportunities like the U.S. African Growth and Opportunity Act (AGOA). Burkina Faso has only one industrial spinner (spinning perhaps 1% of nationally produced lint and not working at full capacity). The only industrial-scale textile printing operation is FASOTEX.

The opportunities for Burkina Faso to add value are similar to those for Tanzania (see box 6.3) and include.

Improving the quantity of seed cotton production and lint quality. Seed cotton production remains low despite seed potential, and production efficiency could be increased by lowering postharvest quality losses.

Processing. A good opportunity would be for the country's two textile companies to produce fabric for school uniforms (mandatory in public schools in quite a few African countries). Burkina Faso has more than 5,000 primary schools requiring uniforms. To make this a reality, however, the business environment must be improved, especially access to credit and dependable energy.

Marketing and trade. A more aggressive marketing strategy for branding "Made in Burkina Faso" cotton should add a premium to the cotton lint price, drawing on the traditional traits of local cotton, but this requires increased domestic processing of cotton lint.

Oil palm

Production. Indigenous to Western Africa, the oil palm tree is important for industrial, retail, and consumer markets. The tree grows extensively in Africa's tropical region, but largely as low-yield multicrop stands in and around villages, where oil palm trees have traditionally been grown as a subsistence crop in small-scale farming systems. The economic importance of oil palm to Africa is huge, particularly for women who handle most of the production, from the harvesting and processing of palm oil to the sale of the oil and other oil palm products in the local markets.

In West Africa, the main producers, in descending order, are Nigeria, Ghana, Côte d'Ivoire, and in recent years, Liberia. In 2013, palm oil output in West Africa was about 2.2 million tons, but as demand exceeds supply, West Africa is a net importer of 850,000–900,000 tons of palm oil a year, mainly from Indonesia and Malaysia. Côte d'Ivoire is the only net exporter in West Africa, exporting an estimated 275,000 tons, with about 75% of its exports going to other subregional countries.

Nigeria is Africa's largest producer, at more than 970,000 tons, followed by Ghana (520,000 tons) and Côte d'Ivoire (415,000 tons). Guinea, Benin, Liberia, and Sierra Leone produce 35,000–50,000 tons each.

In Middle Africa, a large part of the dense humid forests is ecologically suitable for oil palm cultivation. In Democratic Republic of Congo, national production is estimated at around 215,000 tons a year. In Cameroon, the French Bolloré group is one of the main players in the oil palm sector, its 40,000 hectares of plantations accounting for 80% of national production. The company has industrial plants and recently declared an interest in producing biodiesel. Cameroon produces an estimated 270,000 tons of oil palm annually[26] and is the world's 13th largest producer. Gabon has less than 35,000 hectares of industrial oil palm plantations, owned by Olam International Limited (a global integrated supply chain manager, processor, and trader of soft commodities) and the SIAT Group (an agro-industrial group of companies that specializes in establishing and managing industrial and smallholder plantations and allied processing and downstream industries).

While Africa remains a net importer of palm oil, African governments see its development as a potential source of tax and export revenue. Smallholders account for 70–90% of African oil palm growers, but Africa, in particular, West Africa, has become a new frontier for large-scale palm oil production. Many companies with

plantations, and other investors, are now looking to expand their operations to meet growing international demand for palm oil.

Egypt is Africa's largest importer of palm oil, importing an estimated 1,600,000 tons in 2016.[27] Egypt's Misr Gulf Oil Company processes several forms of palm oil products, including vegetable ghee, palm oil, palm olein, palm stearin, shortening, palm kernel oil, and fatty acids. Some of these are used in domestic cooking and frying or in shortening for manufacturing biscuits and other foods. Oil and other products processed by Misr Gulf Oil are exported to other countries, including Jordan, Kuwait, Libya, Saudi Arabia, Sudan, and Syria

Processing. Both the kernel and the fruit of oil palms are used to produce oil, but generally in separate processes. Extraction of oil from palm kernels is often carried out in mills that process other oilseeds (such as groundnuts, rapeseed, cottonseed, shea nuts or copra). Processing the fruit to produce oil entails sterilizing and threshing fresh bunches of oil palm to free the palm fruit, mashing the fruit, and pressing out the crude palm oil. The crude oil is then purified and dried for storage and export. The palm products generated include crude palm oil, which can be further processed or refined into a range of derivative products including olein and stearin; palm kernel oil processed from the seed of the palm nut for the industrial market; and other products, including palm kernel cake and sludge, which are important by-products used by the animal feed industry.

Alongside the emergence of large-scale fully mechanized oil palm mills, small-scale village and artisanal processing have continued in Africa. Throughput ranges from a few hundred kilograms up to 8 tons of fresh fruit bunches per day that supply crude palm oil to the domestic market. Small motorized digesters have been developed in most African countries that cultivate oil palm, offering opportunities for small millers to invest in improved machinery: a US$12,500–US$13,500 investment in efficient oil extraction machines could increase extraction by 15–46%.[28] Small millers supply more than half the crude oil in West Africa, implying that such investments could have large follow-on effects.

Value-capture opportunities. Palm oil is the world's most widely consumed vegetable oil. About half of all packaged products sold in supermarkets contain palm oil.[29] Palm oil and its derivatives are contained in numerous food, cleaning, and personal care products. Palm oil, palm kernel oil, and derived chemicals are common in processed snacks, cosmetics, shampoos, laundry detergent, and much more. Palm oil can also be refined to produce biodiesel.

The palm oil sector has multiple untapped value-added opportunities that can be captured. Based on Africa's capabilities and areas of comparative advantage, there are several key opportunities for capturing value for oil palm producing countries, starting with closing the yield gap between smallholders in Africa and plantations in East Asia. Another is to improve the oil extraction rate and crude palm oil quality of small millers by investing in efficient machinery. To ensure an adequate supply of fresh fruit bunches for the oil mills, Africa needs to promote strong outgrower schemes, provide adequate services to farmers, and link smallholders with processing units (chapters 3, 4, and 5). Finally, there are opportunities in producing energy to supplement the power grid and producing biodiesel for export and to support specific sectors. Capturing downstream value addition opportunities (specialty fat, oleochemicals, and biodiesel) will require strong private sector participation because of the high financial commitment entailed, something that most African governments have failed to prioritize in their support of oil palm development. Facilitating the participation of private investors in this industry requires making more land available for large-scale plantations in transparent transactions that respect the rights of local communities (chapter 2).

Cassava

Production. Africa produces about half the world's cassava: about 145 million tons of the 273 million tons produced globally in 2014.[30] Cassava is cultivated in about 40 African countries, stretching across a wide belt from Madagascar in the southeast to Senegal and Cabo Verde in the northwest. Five countries account for some two-thirds of the cassava harvested in Africa: Nigeria (38%), Ghana (11.4%), Democratic Republic of Congo (10%), Mozambique (3.7%), and Tanzania (3.4%). Throughout the forest and transition zones of Africa, cassava is either a primary or a secondary food staple. Traditionally, it is produced on small, family-run farms. The roots are processed and prepared for home consumption and for sale in village markets and shipment to urban centers. Over the past 30–50 years, smallholders, especially in Ghana and Nigeria, have increased their production of cassava as a cash crop, primarily for urban markets and, in more recent years, for export.

Processing. Artisanal and traditional processing, mainly by women organized in processing groups, is by far

the most vibrant sector of the cassava industry and is responsible for highly successful cassava enterprises. Artisanal processors employ rudimentary equipment, and their premises tend to be of low standards. Gari (a granulated cassava product that is ready to eat with just the addition of water—warm or cold) [31] is the most widespread manufactured product: 88% of processors surveyed in Ghana processed cassava into gari, with the next most common product being high-quality cassava flour, processed by 25% of processors in Ghana.[32] Other products include sun-dried chips or flour and cassava dough. About 14% of processed cassava products are exported, mainly by small and medium-scale food manufacturers, usually to diaspora markets in the Netherlands, the United Kingdom, and the United States.

The industrial cassava processing sector produces mainly cassava chips, starch, and high-quality cassava flour for use as industrial inputs to beer, plywood, mosquito coils, and other manufactured products. There are also potentially bigger export markets for cassava as an industrial input—including cassava chips for the animal feed industry, cassava starch, and cassava ethanol[33]—but they are yet to be tapped. In Nigeria, the government has mandated the inclusion of 20% high-quality cassava flour in bread, and 30–40% in other baked goods such as pastries, croissants, and cakes. As part of the agricultural transformation policy in the agribusiness sector, the Nigerian government established a Cassava Bread Development Fund in 2013 to support farmers and millers. The fund draws on import duties levied on wheat. Cassava flour is also gaining momentum as a grain-free alternative. Nigeria spends about US$2 billion a year on wheat imports, and the government estimates that increasing the use of cassava in baking to the mandated levels could save the country up to US$420 million a year. In recent years, breweries in Ghana and Nigeria have launched cassava-based beers.

Cassava chips are produced mainly for the animal feeds industry domestically and for export by most cassava-producing countries. For example, a 2015 ACET report on Ghana indicates that an estimated 2.7 million tons of cassava were used in making animal feed in 2009.[34] Cassava starch is produced in large commercial quantities by only one company in Ghana, the Ayensu Starch Company (ASCo), which supplies cassava starch to Guinness Ghana for making cassava beer. ASCo, set up in 2003 to process and export cassava starch, has had problems enforcing its contracts with cassava farmers. ASCo closed in 2006, opened again briefly in 2011 before closing again, and then reopened in 2016; it still produces at only about 25% of installed capacity.

High-quality cassava flour is used in bakeries as a substitute for wheat flour and to make cassava-based food products and in the plywood industry as a binding material. Ghana, Nigeria, Tanzania, and Uganda are attempting to develop a high-quality cassava flour industry. Demand is especially strong for packaged and branded cassava flour, which customers see as healthy and convenient. Demand is also growing in the baking industry.[35] And high-quality cassava flour can also be used as raw material in the production of glucose syrups, industrial alcohol, and adhesives.

Most high-quality cassava flour is produced by small producers, but they cannot meet demand. Their main impediment seems to be drying, the most expensive part of the process. A flash dryer costs US$100,000–US$200,000, which is far more than most small and medium-scale processors can afford. Artisanal processors rank low labor availability and the high costs of labor, transport, and processing equipment as the key bottlenecks to their operations.[36] Among 12 potential impediments, they rank market availability the least challenging, followed by lack of raw materials. In Democratic Republic of Congo, Tanzania, and Uganda, basic processing involves peeling, chipping, then drying the chips; the chips are sold or milled into flour.

African production and processing contrasts with processes in Thailand, where cassava is grown not only as a subsistence crop but as an agro-industrial crop with a well-developed industry and market. Annual output is about 30 million tons. In Thailand, the starch-rich roots of cassava are used as a raw material for producing high value added products such as starch and starch derivatives, including tapioca pearls, modified starch, sweeteners, organic acid, sugar alcohols, and alcohols for local and export markets. Cassava is used in food and in non-food applications, including bioethanol (Thailand is a net energy importer).

Value-capture opportunities. As exemplified by experience in Ghana, there are two cassava-based food processing sectors with differing fortunes in Africa. The artisanal processing sector is doing well, with a good supply of raw materials and good margins on products. However, the artisanal sector has difficulty meeting food regulation standards and accessing modern markets. The modern small and medium-scale processors, on the other hand, are able to meet the food standards fairly well, but they have difficulty getting raw materials. So the cassava-based food sector could benefit from stronger linkages between the rural artisanal and urban-based small and medium-scale processing sectors.

As food imports in Africa continue to rise with urbanization and the growing middle class, people are looking for easy-to-prepare foods, a trend that favors processed foods including those from cassava. In some West African countries, cassava-based products are being developed as substitutes for imports (an example is attiéké in Côte d'Ivoire, a dish made with grated and fermented cassava).

The main farm-level value-capture opportunities are increasing yields (yields are far below potential);[37] improving planting and harvesting efficiency through better tools, mechanization, and support for the fabrication sector; rethinking cassava food manufacturing; and developing industrial feedstock. The main food manufacturing opportunities would come from linking rural-based artisanal processing to modern, urban-based food manufacturers (chapter 5) and from developing new cassava-based food products and adapting them for a wider market, domestically and abroad.

Remaining largely untouched is the opportunity for cassava as an industrial feedstock, notably in producing high-quality cassava flour for starch, sweeteners, and ethanol (as ingredients for foods, pharmaceuticals, and other industries), and cassava chips (for animal feeds). Most African countries still import these products. Among industrial cassava products, the following are some of the opportunities:

- *Starch.* Import substitution should probably be the focus initially, and once industrial capacity is developed, export markets may hold promise. Competition from maize is going to limit export opportunities at the start: maize is still supplying as much as 75% of the global starch market, and cassava starch about 12%.
- *Sweeteners and sweets.* These have been made in Europe and elsewhere from cassava in the past, and Nigeria and some other countries have plans for using cassava to produce fructose. As Africa imports huge quantities of sugar, cassava fructose presents a substantial opportunity. The industrial feedstock sector could also use products made with such sweeteners. This would require planting cassava varieties that are best for industry (high-starch) rather than for food, so incentives, including taxes on sugar imports, would be needed to spur a nascent commercial sector to plant these varieties.
- *Ethanol.* Because ethanol can be blended with gasoline at 5–10% and diesel at 3% (by volume), vehicle engines require no modification to use ethanol. Global demand for ethanol is growing, mainly due to concerns about greenhouse gas emissions. The EU and the United States, for example, have mandated the use of ethanol in fuels.
- *Animal feeds.* These present the biggest opportunity in the long run, given the high rate of growth of Africa's livestock (3.3% a year) and poultry populations (2.2%).[38] For Ghana alone, the Cassava—Adding Value for Africa project estimates the potential long-term market for dried cassava in animal feeds at 80,000 tons annually (75,000 tons for egg layers, 2,000 ton for broilers, and 3,000 tons for pigs), and demand from other African countries would undoubtedly be several times higher. Outside the continent, export market opportunities for cassava chips abound. This would include the EU, where cassava is allowable in feeds. China is now the biggest market for cassava chips, though Africa faces extremely stiff competition from Brazil and Thailand.

Other processing and value-adding opportunities and operations

In Kenya and Uganda, active government support through the removal of excise duties has allowed sorghum to substitute for barley in modern commercial brewing. Côte d'Ivoire and Ghana have also been promoting more domestic processing of cocoa beans before export. Rwanda produces about 6.5 million pounds (3 million kilograms) per year of high-quality green, black, and white teas for local and international markets. Premium Foods, a leading grain-product supplier and processor has operated in Ghana since 1994. Working with farmers in Ghana's Northern, Upper West, and Upper East regions, it processes maize for Ghanaian breweries and for export.

Zambeef is one of the largest integrated agribusinesses in Zambia. Founded in 1994, it is involved in the production, processing, distribution, and retailing of beef, chicken, pork, milk, dairy products, eggs, edible oils, stock feed, and flour. The Group also has large row cropping operations (principally maize, soya beans and wheat), with approximately 8,120 hectares of row crops under irrigation and 8,480 hectares of rainfed/dryland crops available for planting each year. The Group is also rolling out its West Africa expansion in Nigeria and Ghana, as well as developing a palm project in Zambia.

RCL Foods Limited, formerly Rainbow Chicken Ltd, is a leading African food producer operating across South Africa, Swaziland, Namibia, Botswana, Uganda, and Zambia. It manufactures a range of branded and private label food products, which it then distributes through its own route-to-market supply chain specialist, Vector. It is the holding company of four principal operating subsidiaries:

Foodcorp Proprietary Limited, Rainbow Farms Proprietary Limited, TSB Sugar RSA Proprietary Limited, and Vector Logistics Proprietary Limited. They are involved in sugar milling, logistics, chicken processing, grocery supplies, and milling and baking.

Flamingo Horticulture Ltd is a vertically integrated agribusiness, offering a diversified product range across roses, other flowers, vegetables, and herbs. The group consists of the Flamingo Flowers, Flamingo Produce, Flamingo Horticulture Kenya, Flamingo Horticulture South Africa, Omniflora, Dudutech, Flamingo Flowers BV and a joint venture with Best Fresh Group in Holland, FV Seleqt. Flamingo is a core supplier to most of the leading UK multiple retailers, as well as to customers in Europe, South Africa, the Middle East, Japan, and Australia.

Leather industry and processing opportunities

Africa has a large population of cows, sheep, and goats, an abundant and renewable resource base for the leather sector. The African leather industry is therefore an important strategic sector for the economic and industrial development of many African countries. Labor-intensive, it has the potential to be a major source of employment all along its supply chain.

Despite owning a fifth of the global livestock population, African countries account for only about 4% of world leather production and 3.3% of value addition in leather.[39] Most Sub-Saharan African nations are essentially exporters of raw hides and skins and wet blue leather and maintain a low production capacity for finished leather. Ethiopia is one country that is emerging as an exception to this trend. Exports of hides and skins from Africa have fallen below 4% in recent years, yet leather is ranked very high as an export commodity in several African countries. Tanning capacity has fallen from 9.2% to 6.8%.[40] At the same time, the livestock population has jumped about 25% over the last decade, faster than the world trend.[41] So the gap between livestock resources and leather production is wide, but this points to the industry's potential. Because of the backward and forward linkages in the supply chain, Africa can be both a source of raw materials and an exporter of finished goods.

Leather processing can be small scale or large scale, with tanning an essential activity in the process. The processing of raw hides and skins to either semi-finished or finished leather is determined by several factors including the ability of the tanneries to convert raw materials to good quality leather. Downstream industries—such as footwear, leather garments, and leather goods—depend on the tanning industry for supply of quality leather. Established tanneries in Africa range in size from artisanal, small- to medium-scale, and in some cases large highly mechanized tanneries.

With major government efforts in the late 1990s and early 2000s to privatize parastatal or government-owned tanneries and to encourage the private sector to invest in tanneries since then, especially in East and Southern Africa, tanning performance has improved. Across Africa, however, the main constraints facing the tanning and leather industry continue to include:

- Poor quality of hides and skins.
- Trade barriers on imports and exports, which interfere with the volume and direction of trade.
- Pollution and environmental control requirements that have become increasingly stringent throughout the world, and the challenges faced by African countries in dealing with such issues.
- Difficulties facing suppliers in Africa in following basic market requirements such as on-time delivery and agreed selection and grades—often due to poor and deteriorating roads, power supplies, and telecommunications that affect all of the supply chain.
- Lack of capital, limited technology investments, poor management, low labor productivity, and outdated training services.

The African leather industry generally lacks strong backward linkages partly due to the absence of organized marketing systems for livestock and livestock products. In addition, lack of centralized slaughter facilities and widespread home slaughter that yields poor quality raw hides and skins do not provide sufficient incentives to develop the industry.

The industry's development can be considered at three levels:[42] developed, as in Egypt, Morocco, Tunisia, and South Africa; fairly developed, as in East and Southern African countries including Ethiopia and Kenya; and relatively underdeveloped, as in most West African countries. The leather industry in North Africa has a longer history than other regions in Sub-Saharan Africa. Egypt in particular has a long tradition of leather tanning, with virtually all raw hides and skins tanned by the mid-1980s. Other North African countries like Morocco and Tunisia have enjoyed close ties with the European leather industry, especially with the developed industry of Italy. As a result, these countries have moved substantially further downstream to produce finished leather products, mostly footwear.

Ethiopia and Kenya are among the largest producers of raw leather in Africa. For Ethiopia, livestock and livestock products are major foreign exchange earners, second only to coffee, with hides and skins contributing the most. With the largest livestock herd in Africa, Ethiopia

has huge potential for the leather industry. While leather exports stood at US$123 million in 2012, the government targeted growing the leather industry's annual exports to US$500 million from the end of 2015.[43] Ethiopia's leather and leather products sector already produces a range of products from semi-processed leather in various forms to processed leathers including shoe uppers, leather garments, stitched upholstery, backpacks, purses, industrial gloves and finished leather. Ethiopian leather products are exported to markets in Europe (especially Italy and the UK), America, Canada, China, Japan, and other Far Eastern countries, and the Middle East.

In recent years, the country's leather industry has attracted several foreign companies, that have set up factories to create value-added products. These include the Chinese footwear manufacturer Huajian Group, which opened a factory in 2012 in the industrial zone outside Addis Ababa to manufacture shoes, as well as the UK firm Pittards, which has installed factories to produce high quality leather items for export. Earnings from leather exports in 2013. Of this figure, around US$30 million came from shoe exports. While Ethiopia has long exported its leather to Europe and Asia, where it was transformed into fashionable items, recent investments in Ethiopia-based factories by foreign companies are helping to add value locally and create jobs for millions of Ethiopians.

For Kenya, value addition in the leather sector has been minimal, and most of Kenya's exports have been unprocessed raw hides and skins. A vibrant and competitive informal sector in Nairobi produces low-cost leather footwear and goods for Kenya and the region. Most leather good producers are micro and small enterprises. Kenya's leather exports consist of semi-processed tanned "wet blue" leather (89%), raw hides and skins (5%), finished leather (2%), and leather footwear and handbags, travelware, and other leather products (4%). The leather sector can however contribute to economic growth through expanding exports of both semi-processed and finished leather goods. Its development involves improving the raw material base (especially the quality of hides and skins), boosting the tanning subsector, producing leather goods, and marketing. Kenya's is the third largest livestock holder in Africa and, with its low relative labor costs, has a natural comparative cost advantage in leather production. It is important, however, that policies ensure that producers internalize environmental and social costs associated with sustaining the sector, including water resource clean up, long-term health care, and natural resource replenishment.

For many other African countries, the following value-adding opportunities present themselves:

- *Low value-added leather footwear.* Countries can seek to increase their share of the domestic leather footwear market—particularly with low-cost men's shoes, low-cost school shoes, and boots—and increase exports to regional markets (such as the East African Community and ECOWAS).
- *High value-added specialty products.* Increasing exports of specialty leather products, leather handbags, travelware, and cases, can focus on EU and US markets while seeking to increase in domestic and regional sales, especially safari-type products sold to tourists in places like Kenya and Ethiopia.
- *Finished leather exports.* Increasing exports of higher value-added finished leather (and crust leather) are especially promising to China and Europe.

The livestock and its related leather products provide a good opportunity for regional integration and trade. Supply chains can span several countries and regions, as marketing and manufacturing agents set up global production networks. The main challenges to integration include the lack of mechanisms for regional collaboration, the limited contact between firms and support institutions, and the low visibility of the industry. Regional bodies have to recognize that each stage of the supply chain —from recovering hides and skins, to converting them into leather in tanneries, to manufacturing and marketing leather products—requires specific policies, human skills, and support systems.

Building the agricultural input industry: Fertilizer, equipment, and packaging

The development of other aspects of agribusiness, especially input supply, including fertilizer, and packaging services,[44] is as critical as agro-processing for transforming agriculture. Equipment for processing agricultural raw materials, including machinery, tools, storage facilities, cooling technology, and spare parts, have to be available. But unlike other developing regions, Africa has not fostered its agricultural input industry, creating barriers to increasing agricultural productivity and leveraging agriculture for industrialization.

Fertilizer

Fertilizer production and consumption in Sub-Saharan Africa are much lower than in many other regions of the world (see table 3.1 in chapter 3 on fertilizer consumption). All African subregions consume at least some amount of fertilizer, but produce little except North

Africa, which satisfies domestic demand and is a net exporter. A few countries have discovered raw materials for producing fertilizer within the last couple of decades, but only countries with commercially extractable deposits are manufacturing intermediate products. That includes phosphates, which are being commercially extracted in North Africa (Egypt, Morocco, and Tunisia), West Africa (Senegal and Togo), and Southern Africa (South Africa, Tanzania, and Zimbabwe). Potash salts have been identified in Democratic Republic of Congo, Ethiopia, and Nigeria; however, there is no commercial extraction for manufacturing muriate of potash.

Africa produces three main final fertilizer products: urea, nitrates, and diammonium phosphate/monoammonium phosphate (DAP/MAP). Urea is produced in Egypt, Nigeria, and most recently, Gabon; nitrates are manufactured in South Africa, Zambia, and Zimbabwe; and DAP/MAPs are manufactured in North Africa (Algeria, Morocco, and Tunisia), West Africa (Côte d'Ivoire, Senegal and Togo), and Southern Africa (South Africa, Tanzania, Zambia, and Zimbabwe).[45] While industries in North Africa are generally internationally competitive, industries in Sub-Saharan Africa remain only regionally competitive, except for South Africa, which competes internationally. Yet in the last decade or so, even South Africa has relied increasingly on imports of final products, which now meet more than half its consumption needs. In fact, almost all fertilizer (about 95%) used in Sub-Saharan Africa is imported, with prices in Africa often higher than imports to other global regions.[46] The small size of fertilizer plants in Sub-Saharan Africa by international standards, the high cost of feedstock, and obsolete, energy-inefficient technology make the cost of production high.

Developing more efficient fertilizer value chains involving both domestic production and imports is one of the critical challenges for building competitive agro-industries in Africa. The recent investment of US$530 million by the Moroccan Group, Office Cherifien des Posphates (OCP), in 2016 created the African Fertilizer Complex (AFC), the first fertilizer plant with production exclusively dedicated to the continent.[47] But more efforts are needed to increase domestic production of fertilizers, especially through regional cooperation to take advantage of scale economies and guarantee market size. Before production can be increased, however, several bottlenecks need to be eased to improve efficiency and reduce fertilizer costs, including:

- Reducing transport and logistical costs through targeted infrastructure improvements, as most studies show that the single largest reduction in fertilizer costs comes from gains to port logistics and internal transport systems.
- Setting up blending facilities to produce locally suited fertilizer and special warehousing facilities at the port to better coordinate with truck transport.
- Privatizing fertilizer procurement and rationalizing fertilizer subsidy systems, converting them to market-smart approaches.
- Ensuring that financing is available to the fertilizer supply chain, while building a strong network of well-trained input dealers.

Agricultural equipment

The supply chains for agricultural machinery in Africa cover the manufacturing and import of machines, mechanized service provision, and spare parts and repair services for machinery maintenance (chapter 3). A few manufacturing firms in Sub-Saharan Africa produce a wide range of hand tools, farm implements, and processing equipment, but facilities vary widely across and within countries.

Some countries make only the simplest hand tools in the artisanal (blacksmith) sector, while a few others, like South Africa and North African countries, have sophisticated manufacturing or assembly facilities. Generally, the machinery and equipment manufacturing industry is underdeveloped, resulting in fairly poor quality and high prices for locally made agricultural machinery. Also, the sustainability of this industry has often been problematic, because of erratic raw material supplies, fluctuating demand, and issues of quality and lack of spare parts.

The main agricultural machines used in Africa are four-wheeled tractors, power tillers, and combine harvesters. These are manufactured almost exclusively outside the continent. According to the latest data (for 2007 from FAOSTAT), tractor imports are concentrated in North Africa, South Africa, and countries in Sub-Saharan Africa with large commercial farming sectors (Nigeria, Swaziland, and Zimbabwe,).

A few tractor manufacturing initiatives have been created through joint ventures. One of the latest, created in mid-2012, was a joint venture between the Algerian brand Etrag and the American Group AGCO Massey Ferguson. The joint venture, called Algerian Tractors Company (ATC Spa), is producing (mostly assembling) at least three types of Massey Ferguson tractors and one type of Etrag tractor.

Some earlier joint ventures in some African countries attempted to adapt tractor designs to local conditions, but the machines, such as the Kabanyolo tractor in Uganda and the Tinkabi tractor in Swaziland, were

not competitive and production was eventually abandoned.[48] Most efforts to establish tractor assembly plants, usually by governments, also failed: domestic plants in Nigeria and Tanzania, for example, lacked the technical capacity and managerial efficiency to compete with imports. The main exception is Ethiopia, where the Nazareth Tractor Assembly Plant, established in 1984 and still operating, assembles roughly 300 tractors a year, or 46% of tractors entering the Ethiopian market between 2005 and 2010.[49]

Agricultural machinery manufacturing is at an early stage in many countries in Sub-Saharan Africa and therefore faces stiff international competition from imports. Further, machinery and equipment produced by Western countries, which used to be an important source of farm machinery for Africa, have become less suitable for African smallholder conditions in both design (they have become too large for effective use on smallholder farms) and cost.

Promotion of machinery and equipment manufacturing would accelerate in Africa only if it follows increased mechanization on the continent. While agricultural mechanization can develop through imports and without a local machinery and equipment manufacturing industry, it will be difficult, if not impossible, for the latter to develop without expanding mechanization in Africa. Countries have to provide basic conditions for a largely self-sustaining agricultural mechanization subsector. Mechanization needs to be looked at holistically and not be regarded just as a question of supplying farmers with tractors and machinery or of making mechanization services available to them through the public sector. The use of mechanized inputs must be profitable to all parties, including farmers and farmer organizations, crop processors, and rural transporters, as well as the importers, manufacturers, blacksmiths, distributors, repairers, machinery support service providers, and service contractors. Regional cooperation can open regional markets to potential manufacturers of agricultural machinery and equipment. And regional bodies can agree on policies that would influence the development of a regional agricultural machinery industry in each subregion.

In recent years, African farmers have turned to Brazil, China, and India as sources of farm and other agricultural machinery. This machinery, often more suitable for African farming conditions, is far cheaper than machinery manufactured in Western Europe or North America. Eventually, foreign direct investment from these countries, or possibly partnerships, could alleviate some of the machinery and equipment shortages in Africa. Some Chinese and Indian companies are establishing joint ventures and single ventures in Cameroon, Chad, Mali, and Nigeria. But since most markets for tractors are still small in many of these countries, the framework of regional economic groupings is pertinent.

Packaging materials

Packaging is essential to the supply chains for food, beverages, and other agro-processed products—and represents an opportunity for Africa. The principal types of packaging produced and marketed in the region are made from cardboard, metal, glass, plastic, and natural fiber. Plastic has become the most important packaging material and is gradually taking over from glass and metal. Paper products come second, with cartons the most widely used packaging products. While cardboard and paper packaging have long been common in many African countries, plastic has been capturing more market share because its costs have steadily declined and it is more flexible for packaging.

The packaging industry in Africa presents a strategic investment opportunity as it serves to meet the needs of emerging consumer goods companies (especially food and drink companies) and middle-class consumers. On a smaller scale, it is an opportunity for building value in a company by enabling it to increase its product offerings. Local African packaging markets are fragmented, however, as companies try to orient themselves toward either domestic or export consumers. The investor who can build a supply chain around aligned demands of domestic and exporting producers can do very well. Yet only Kenya, Nigeria, South Africa, and Tanzania in Sub-Saharan Africa have seen major scaling up by companies.[50]

South Africa is the largest African manufacturer and supplier of packaging material, followed by Nigeria. The total value of South Africa's packaging industry is around US$3 billion, equivalent to 1.5% of GDP. More than half of South Africa's packaging exports are to other African countries, with Europe the second biggest market. Nigeria's packaging industry is estimated at US$600 million and is growing at 12% a year.[51] The food and beverage packaging end users are by far the market leaders in Africa, with 51% of the packaging used for food and 18% for beverages

Africa is a potential high-growth region for the packaging industry, with demand driven by consumer products, burgeoning individual incomes, a swelling population of youthful consumers, and expanding economies—particularly those in East and West Africa. The global consumer packaging market was valued at US$431 billion in 2013 and is expected to reach US$519 billion by 2018.[52] Africa will have to meet the challenges

of the global consumer packaging market, including increased demand for premium packaging, biodegradable plastics, multipacks, and small packs, and demands for sustainability and innovation.

Investors and governments in Africa should see the packaging industry as a strategic investment opportunity. Packaging is a critical determinant of product salability. Trying to reduce costs, many African manufacturers have reduced packaging to a bare minimum, often to a suboptimal level. The Food and Agriculture Organization has argued that a large share of Africa's food loss and waste is due simply to improper packaging and care.[53]

To be effective, packaging should differentiate a product from competitors and attract customers. Good packaging should represent the company image and provide the necessary and legal information on usage and content, accentuate the intrinsic qualities of the product to facilitate consumers' use, respond to customer expectations, and protect the environment. Packaging products must also be simple, easy to handle, and protect the product against wear and tear. Given the huge potential for growth of the industry in Africa, packaging is more than an economically viable investment opportunity; it is also imperative for food security and poverty alleviation. The packaging industry must be encouraged to support and facilitate the recycling, re-use, and recovery of packaging and the development of sustainable products in order to minimize environmental impacts.

Conclusion and policy considerations

African countries need to foster agro-industrial development as part of their economic transformation within a new framework for industrial policymaking that is strategic and selective, integrates lessons from experience, and considers the realities of a changing global environment. Adopting a value chain approach will be crucial. Agro-processors cannot succeed without a supply chain upstream to guarantee consistent supplies of produce at adequate scale and quality and adequate markets downstream. Regional integration will create bigger and more efficient markets and increase trade in agro-processing industries across Africa. It would link individual country markets and permit free movement of goods within and across the region. And it would provide much larger markets for industrial output and a strong impetus for investors seeking to set up agro-industry, fertilizer plants, or equipment or machinery manufacturing.

Because of the continuing dominance of smallholders in all African countries, broad-based growth of the agro-processing sector depends on connecting smallholders to markets (chapter 4). And that requires tackling the most common and well-known constraints, including erratic policies on tariffs, prices, exchange rates and taxes; poor infrastructure, including energy; fragmented and risky markets; poorly functioning input markets; difficulties accessing land and finance; and inadequate skills and technology. Adopting a value chain approach would also imply identifying, producing, and processing commodities in which Africa has a comparative advantage, such as cocoa, oil palm, cassava, cashew, rubber, and sugar cane, and whose processing tends to be labor-intensive—Africa's low-cost labor would give African producers an edge.

To modernize processing and to upgrade the informal sector, countries should rethink their industrialization policy and provide incentives to strengthen linkages between artisanal processors and urban small and medium-scale processors. In a mutually beneficial model, artisanal processors would be able to supply a product in bulk to small and medium-scale enterprises, which would then package and market it. Tax breaks and subsidies on equipment should be extended to firms that have developed contracting models with rural and artisanal processors. Going hand in hand with this should be support for marketing and branding, including directing part of the government agriculture budget to advertising firms that would promote the products of more innovative companies. Using the new model of joint state–private sector participation in industrial policy that is emerging in Africa, governments should promote public–private initiatives, ranging from basic infrastructure to services aimed at leveling the playing field for market access, while maintaining good macroeconomic stability.

Notes

1. Agribusiness includes suppliers of inputs to the agricultural, fisheries and forestry sectors and distributors of food and non-food outputs from agro-industry.
2. According to the International Standard Industrial Classification (ISIC).
3. FAO, UNIDO, and IFAD 2008.
4. World Bank 2013.
5. Based on GDP forecasts by the African Development Bank and population projections by the United Nations.
6. Ilboudou and Kambou 2009, reprinted in UNIDO 2011.

7. ACET 2014b.
8. ACET 2015f.
9. This section draws on a Report prepared for ACET by Dahlberg in 2014 titled "The Cotton Agroprocessing Opportunity in Africa" as well as a Bill Gates funded study done by ACET on Promoting Sustainable Rural Development and Transformation in Africa (ACET 2015a, 2015d).
10. http://www.indexmundi.com/agriculture/?commodity=cotton.
11. Known less technically as garments.
12. Apparel is normally considered to be clothing (or garments) and made-ups (home furnishings such as bed linen and towels) while textiles represent a type of cloth or woven fabric (not specifically cotton).
13. The cotton by-products chain (oil, meal, hulls, and linters) offer few value-capture opportunities, mainly in more efficient ginning and promoting greater use of cottonseed oil and meal in domestic markets.
14. Based on ACET (2014a).
15. Calculated from FAOSTAT. http://www.fao.org/faostat/en/#compare
16. Based on the latest data available from the World Integrated Trade Solution website.
17. FAOSTAT. http://www.fao.org/faostat/en/#compare.
18. http://www.africastrictlybusiness.com/news-analysis/africa-seeks-control-its-textile-industry.
19. AGOA provides duty-free access to the U.S. market for garments or apparel manufactured in qualifying African countries, subject to conditions. Garments qualify for AGOA preferences provided that countries have met the "wearing apparel provisions" by having implemented a special apparel visa system, subject to the specific rules of origin requirements being met in the manufacture of qualifying items.
20. https://agoa.info/data/apparel-trade.html.
21. The global financial crisis in 2008–09 placed pressure on U.S. imports, including those sourced from African producers, but exports have since rebounded. U.S. imports of apparel under AGOA by rule of origin category were US$1.02 billion in 2015 and US$1.04 billion through end-September 2016.
22. ACET 2014.
23. Primarily Benin, Burkina Faso, Cameroon, Chad, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mali, Mozambique, Nigeria, Senegal, Tanzania, Togo, Uganda, and Zambia.
24. Vitale and Greenplate 2014.
25. This has not hurt farmers. The increased yield and farm cost reduction for the farmer of Bt cotton, while beneficial to farmers, has, however, led to lower lint production for ginning companies because of lower ginning ratios and lower lint quality, affecting their profit margins per ton of seed cotton bought from the farmer.
26. http://www.indexmundi.com.
27. http://www.indexmundi.com.
28. ACET 2012.
29. http://www.worldwildlife.org/pages/which-everyday-products-contain-palm-oil.
30. FAOSTAT.
31. Gari (also known as garri, garry, gali) or "cassava flakes" is a popular West African food made from cassava tubers. It is a granulated and toasted cereal-like cassava food product which is convenient for consumption in urban environments because it is in a ready-to-eat form and it has an extended shelf life.
32. ACET 2015b.
33. Cassava is one of the most efficient producers of ethanol.
34. ACET 2015b.
35. C:AVA 2012.
36. ACET 2015b.
37. Current cassava yields of 15 MT/ha to 25 MT/ha can potentially be increased to 30–35 MT/ha.
38. FAO 2003.
39. Kenya Ministry of Industrialization and Enterprise Development 2015.
40. UNIDO 2002.
41. International Trade Forum Magazine 2014.
42. UNIDO 2007.
43. Embassy of Ethiopia in Brussels 2015.
44. Finance and financial services are discussed in chapter 4.
45. IFPRI 2015.
46. World Bank 2013.
47. http://www.africanfarming.net/crops/agriculture/ocp-group-launches-new-subsidiary.
48. IFPRI 2016.
49. World Bank 2012.
50. Davis 2017.
51. http://www.vanguardngr.com/2014/07/nigerias-packaging-industry-growing-12-yearly-report/.
52. https://www2.deloitte.com/za/en/pages/manufacturing/articles/packaging.html.
53. Davis 2017.

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CHAPTER 7

Leveraging Agriculture for Employment

Agricultural transformation can be an important part of the solution to the growing problem of unemployment in Africa, particularly among the educated youth.[1] By modernizing farming and strengthening its linkages to other economic sectors, agricultural transformation can help drive industrialization and overall economic transformation and thereby expand employment in the whole economy.

Historically, agriculture has shed labor to other sectors as economies have developed. This labor shift came about through two forces: increasing productivity on farms meant that the same output could be produced with fewer people, and expanding productive job opportunities in other sectors—initially manufacturing—absorbed people who left agriculture as well as the bulk of new entrants to the labor force.[2] In Africa, productivity growth in agriculture has been slow (chapters 1 and 3), and other sectors, particularly manufacturing, are not expanding fast enough to create sufficient employment opportunities. Yet labor, particularly youth, is leaving agriculture. Using estimates based on data from the Living Standards Measurement Survey–Integrated Survey of Agriculture (LSMS-ISA), table 7.1 offers a partial view of the lack of interest among African youth for farming. Among the six countries shown, the share of the working youth (16 to 25 years) engaged in agriculture is lower than the share in the general population, except in Niger.

So, as farm productivity rises with agricultural transformation, should African countries prepare for even more people, particularly the youth, to leave agriculture to join the growing number of unemployed in the towns and cities? Probably not, for two main reasons.

First, agricultural transformation involves more than raising productivity on farms. It also covers developing and expanding agricultural value chain activities, upstream and downstream from the farm. It covers the logistics of providing inputs and services to farms and of storing and transporting agricultural produce to processors and consumers. And it covers the manufacturing of agricultural inputs and the processing of farm produce (chapter 6). Expanding employment opportunities in these off-farm segments of the value chain and in agriculture-related manufacturing will provide productive employment for people leaving the farms, in contrast to the current situation, where they end up in vulnerable employment or unemployment in cities and towns. Thus, the historical structural transformation process of labor leaving farms as productivity rises and moving

TABLE 7.1 Percentage of workers in agriculture by age group in six African countries

	Ethiopia	Malawi	Niger	Nigeria			Tanzania	Uganda	
Age group	2011–12	2010–11	2011	2012–13	North	South	2010–11	2011–12	Average
16–20	49.1	53.9	66.8	33.8	42.9	12.2	54.0	56.3	52.3
21–25	47.1	55.3	59.5	27.2	35.3	15.6	51.3	49.1	48.2
26–30	55.5	55.4	65.8	27.0	30.5	21.7	51.8	53.4	51.5
31–35	51.8	55.3	59.8	29.4	37.1	19.8	56.6	57.5	51.7
36–40	54.7	58.9	60.9	39.8	44.2	32.6	58.1	54.9	54.5
41–45	52.7	59.1	67.1	46.1	52.8	38.6	63.0	61.5	58.3
46–50	55.9	61.9	64.9	47.1	55.2	36.5	64.6	68.1	60.4
51–55	62.2	67.6	61.4	46.8	56.8	37.7	65.9	69.0	62.1
56–60	57.7	62.6	65.8	55.1	65.5	45.9	60.5	69.3	61.8
25+	54.6	58.1	63.2	38.8	44.7	31.3	58.6	59.3	55.4
Average	52.9	57.4	63.5	37.3	43.8	28.2	56.8	57.8	54.3

Source: Maïga et al. 2015.

to productive employment in manufacturing and other sectors would be restored in Africa's development.

Second, by upgrading agricultural technology and making agriculture more profitable as a business (through the policy and institutional measures discussed in this report), farming will become attractive to some of the educated youth who now move to cities and towns, even when the prospects of finding productive jobs are dim. This process will not only create employment for the educated youth, it will also rejuvenate Africa's farmer population, whose average age now is estimated to be more than 60 years. It could create a dynamic subsector of young and educated small and medium-scale commercial farmers that would become the backbone of African agriculture. These young farmers would fill the "missing middle" between the subsistence and smallholder peasant farmers, who now make up more than 80% of Africa's farmers, and the sliver of large-scale commercial farmers who have emerged in some countries.

This chapter expands on these two points, drawing on the analysis in chapters 2–6. The first part highlights the types of jobs that could be created in off-farm segments of the value chain and in agriculture-related manufacturing, showing how policymakers could encourage the expansion of these employment opportunities. The second part discusses the types of policies, institutions, and programs that could attract educated youth into farming to create a dynamic subsector of small and medium-scale commercial farmers to fill in the missing middle of African agriculture. Although the chapter focuses on activities in off-farm value chains and on attracting the educated youth into farming, it complements the discussions in chapters 2–5 and chapter 8 that address what it will take to raise the productivity and incomes of all farmers, particularly smallholders.

Employment in off-farm agricultural value chains

Figure 7.1 shows the types of economic activities that would be linked to modern farming and that could provide employment. It groups employment opportunities into three broad categories: manufacturing, services that support farm production, and the logistics of carting farm produce to domestic and export markets in attractive packages and with the advertising and marketing services that go with that.

The yellow circles describe the manufacturing of agricultural inputs—from simple agricultural hand tools by artisans and small firms to the manufacturing or assembly of sophisticated machinery like tractors and the manufacturing of modern farm inputs, including fertilizers, animal feeds, and packaging materials. The green circles represent services to a modern farming system, while the blue circles represent the transportation, processing, and marketing of agricultural produce.

Manufacturing

Agricultural transformation throws up many opportunities in manufacturing employment both upstream and downstream from the farm. Governments need to be pragmatic. It would not be wise for them to set up agriculture-related factories, but they can encourage the private sector to build and operate factories, and they can support rural artisans in upgrading their skills to manufacture or repair simple farm implements and machinery. To attract both domestic investors and foreign direct investment, governments would need to explicitly prioritize agriculture-related manufacturing in their investment promotion strategies. Governments could also prioritize support to rural artisans and small firms in the manufacture of simple tools and spare parts and in machinery repair (box 7.1). Support could include facilitating and subsidizing training in technical institutes in rural areas and reforming trade policy to make it easier and less expensive to import spare parts that cannot be manufactured cost-effectively domestically (chapter 3). Indeed, a national industrialization strategy could be part of an agricultural transformation strategy and vice versa.

Services to a modern farming system

The green circles in figure 7.1 represent services and nonmanufacturing inputs that support farm operations. Extension and veterinary services have traditionally been the province of governments. But in Africa, it has long been clear that strained government budgets are not adequate to the task. Under the structural adjustment programs implemented in the 1980s and 1990s, many African governments cut employment in extension and veterinary services, and some even privatized them. The privatized model has not worked particularly well either, but most African governments are not in a fiscal position to ramp up these services again on the scale required. Fortunately, other actors have now emerged—mainly nongovernmental organizations (NGOs) and private commercial input dealers and contract farmers (chapters 3 and 4). Governments could explore opportunities to incentivize these actors to expand their operations and employment or to help small groups of young agronomy graduates set up extension services.

Not every operation on the farm has to be undertaken by the farmer. Some operations can be

FIGURE 7.1 Sources of modern off-farm employment opportunities in a transforming agricultural sector

Source: Authors.

BOX 7.1

Cassava value chain: Driving industrialization by creating off-farm rural enterprises and employment in Ghana

The cassava value chain in Ghana includes an innovative rural fabrication sector that delivers a variety of locally adapted and fabricated machines to process cassava and creates jobs in rural areas. Ready access to this machinery is crucial as cassava needs to be processed within 48 hours of harvest, and because cassava is 70% water, it is costly to transport elsewhere for processing. For cassava farming to remain competitive, processing must be done on the farm and the processed product, mainly *gari* (processed cassava), must be transported to urban markets.

The rural fabrication sector has produced several innovations. For example, roadside welders have developed a manual cassava grater by mounting a sheet of perforated metal onto a flat piece of wood and then improved it by adding a motor. Copying designs from elsewhere, roadside welders have been able to produce a mechanized presser, which is a simple hand-operated machine made from wooden plates and an automobile jack. Gari roasting technologies have moved from earthen roasting ovens to the use of stainless steel saucepans, and from open wood fires to smokeless stoves. Innovation has also extended to business models: for farmers unable to buy the machines, roadside welders provide a grating service by bringing a portable machine to the farm. Roadside welders have been so successful that today they fabricate more than 85% of the machines used by cassava farmers and processors.

The development of this local fabrication sector, driven by the cassava value chain, has spilled over to the creation of many other types of rural enterprise. For example, rural fabricators have transferred their expertise in making cassava processing machines to making other food processing machinery such as fruit juice processing equipment. Many rural jobs have been created as result. A strong fabrication sector has enabled the emergence of cassava-based artisanal foods enterprises in urban areas of Ghana (and Nigeria), an important source of income for young women.

Graduates of polytechnic and engineering schools could be encouraged and supported to enter the vibrant rural fabrication sector.

Source: Gatune 2016.

outsourced—in the same way that manufacturing firms outsource some activities to other firms. Chapter 3 discussed the growing importance of tractor-hire services, and the emergence of some businesses that engage youth in spraying and weeding (box 7.2). Harvesting is also ripe for such outsourcing. This kind of outsourcing makes economic sense by enabling more intensive utilization of equipment and by involving more professional and specialized operators. A young educated African may be uninterested in being a farmer but could be attracted to owning or working in a small business that provides these services to farms. In addition to jobs related to operating the machines that provide the services, there could be back-end jobs in accounting, business management, advertising, web-site design, and related activities.

Seed replication is critical for a green revolution as is the production of day-old chicks for taking advantage of the growing demand for poultry in Africa. Adoption rates are still low for improved seed varieties, particularly of food crops (chapter 3). Often, the improved varieties exist, but the inability to replicate them on a sufficient scale is a bottleneck. Similarly, the poor quality and high prices of day-old chicks and of feed constrain growth of the poultry industry (chapter 5). Public–private development programs could facilitate and support young people to set up and enter these businesses.

Logistics and marketing

The blue circles in figure 7.1 cover the logistics of carting farm produce to processors, domestic consumers, and export markets. In many African countries, produce is transported from farm to market mainly by trucks that are also used to transport people. As agriculture commercializes on a larger scale, so that farms need to meet time-sensitive delivery schedules with specific quality requirements, the need will grow for specialized trucking services, including refrigerated trucks. This will provide employment opportunities for drivers, packers, quality inspectors, and other occupations that will appeal to educated youth in the way that farming or employment in today's rural–urban truck services do not.

Getting educated youth into farming and filling in the "missing middle"

So far, the discussion has described employment creation in off-farm value chain activities upstream and downstream from the farm. The discussion now turns to

BOX 7.2

Young agricultural service providers

Farmers may find it advantageous to hire outside companies to deliver some of the services required on the farm. Hiring inputs from service providers has several potential advantages. The farmer can avoid some of the fixed cost associated with using some inputs, such as knapsack sprayers for applying pesticides. Farmers do not need to tie up capital in purchasing inputs they do not need at once, since the input providers apply only the amount needed at the time. And trained service providers are more likely than farmers to prepare and apply inputs properly.

Youths could provide some of these services by establishing new companies or working for them. Two examples of youth involvement are the Integrated Cassava Project in Nigeria and the Cocoa Mass Spraying in Ghana.

The Integrated Cassava Project focused on mitigating the impact of the cassava mosaic disease, which causes severe stunting, and increasing cassava productivity, processing, and marketing. The project resulted in an 80% increase in productivity. The success was due mainly to increased use of fertilizer and pesticides through an inputs-as-a service business model. The project team worked closely with fertilizer and pesticide companies to provide spraying services on the farms using well trained youths.

Ghana initiated the Cocoa Mass Spraying program in 2001 with the goal of achieving cocoa production of 1 million tons by 2011. The increase was to be achieved by controlling the cocoa pests and disease that had ravaged cocoa yields. A mass spraying program was implemented using groups of 6 or 10 sprayers contracted and equipped by the government through the Ghana Cocoa Board. A mechanic was attached to each set of 20 groups to oversee the maintenance and repair of the spraying machines. The program boosted production in the first season from 380,000 tons to an all-time high of more than 736,000 tons in 2003, and in 2011, production reached the 1 million target.

Source: Adekunle et al. 2012; Afrane and Ntiamoah 2011; Afrane et al. 2012.

attracting the educated youth to farming to form a new class of small and medium scale commercial farmers that over time can become the fulcrum of the transformed agricultural system. Chapters 2–5 focused on measures that will help all farmers increase their productivity and incomes. But the African farming population is aging, and it is not being replaced in adequate numbers by the young, particularly by educated youth. In many African countries, modern commercial farming is still an emerging activity, often a sideline for retired professionals and civil servants. The few young people who are trying to make a go of commercial farming struggle against the myriad challenges discussed in chapters 2–5.

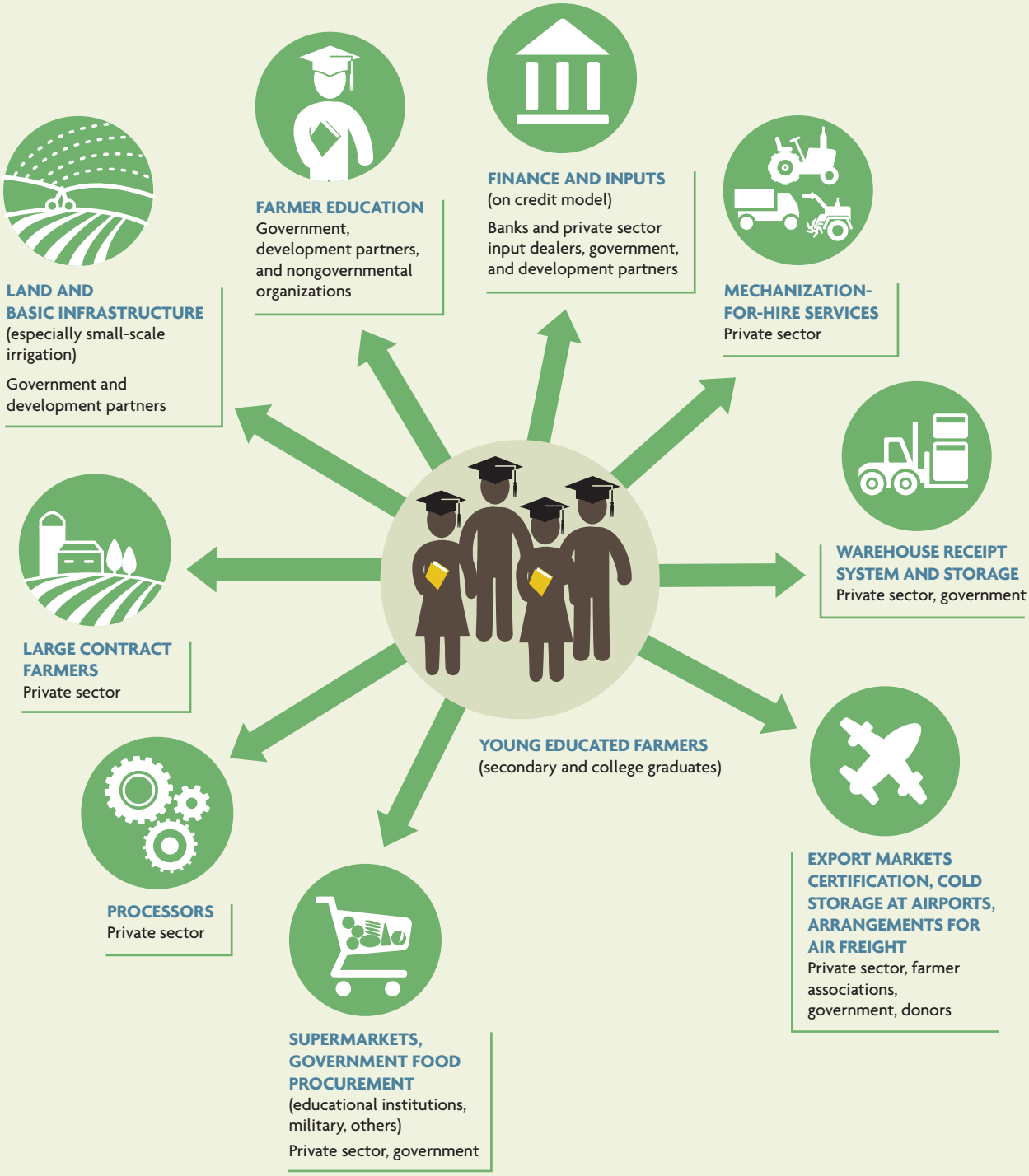
Setting up a pilot demonstration model

Increased access to education has broadened the horizons of Africa's youth, who are not prepared to accept the drudgery and the low and uncertain incomes that smallholder agriculture as now practiced offers. So although governments are urging youth to take up farming, those exhortations will continue to fall on deaf ears unless governments also work assiduously to remove constraints and to support the emergence of a new farming system that youth will find attractive. Governments need to demonstrate that it is possible to make a decent and interesting living as a farmer. This means working with the private sector, development partners, NGOs, and youth to address the key constraints that youth face in farming. Beyond the general policies and measures discussed in chapters 2–5, this would require piloting specific demonstration models. One possible model is shown in figure 7.2. (The text in large print are the types of activities or services needed and the text in small print indicate the types of possible providers).

Agricultural parks

We elaborate on the various components of the model in figure 7.2 below, but in simple terms, what is being proposed is an agricultural analogue to the industrial park for manufacturing enterprises—providing in a specific location, a comprehensive package of solutions to the barriers that the youth face in entering farming. The key is to demonstrate to youth that there is a farming business model that is interesting and profitable. The "agricultural park" would also be in a sense a modern, more commercially oriented, and a public–private version of the old agricultural settlement schemes; one that caters to educated youth. It is similar to what Brazil, with Japan's support, did to open up the Brazilian Cerrado to agriculture from the mid-1970s (box 7.3). The Cerrado has since become a global powerhouse of agricultural

FIGURE 7.2 Filling the "missing middle" of African agriculture with the educated youth



Source: Authors.

BOX 7.3

The Brazilian agricultural Cerrado's miracle—Possible in Africa?

Brazil has experienced one of the most profound agricultural revolutions. The country received food aid until the 1960s, and up to the 1980s, Brazil was still a large food importer. Today Brazil has turned itself into one of the world's great breadbaskets. It is the first tropical food-giant in the league of traditional food exporters (America, Canada, Australia, Argentina and the European Union). The growth story has been spectacular. Within a decade—1996 to 2006—the total value of the country's crops rose by 365%. Brazil increased its beef exports tenfold in a decade, overtaking Australia as the world's largest exporter. It has also become the world's largest exporter of poultry, sugar cane and ethanol. Since 1990 its soyabean output has risen by 400%, making it the second biggest exporter of soyabean.

This miracle is largely due to the transformation, starting in the mid-1970s, of the Cerrado region of Brazil, a tropical savanna, that was previously considered unsuitable for agriculture. Today the Cerrado region accounts for 70% of Brazil's agricultural output, producing a variety of crops including soyabean, maize, feijao bean, sorghum, wheat, cotton, coffee, vegetables, sugarcane, and high-value fruits. It also supports a deepening agro-industrial value chain network, especially for meat and dairy products.

The transformation is a story of development cooperation between the governments and private sectors of Brazil and Japan. Organized under PRODECER (the Japanese-Brazilian Cooperation Program for Cerrados Development), the development effort rested on three pillars: research, finance, and a coordinated program of settling new farmers in the Cerrado region and providing them with support for them to succeed, including finance, infrastructure, and the results of research.

Research. The transformation involved years of focused research and technology transfer spearheaded by the Brazilian government's Agricultural Research Corporation (Embrapa) with the support of Japan through the Japan International Cooperation Agency (JICA) and the Japan International Research Center for Agricultural Science (JIRCAS). Some of the remarkable breakthroughs by Embrapa include:

- Turning soyabean, traditionally grown in temperate regions, into a tropical crop through breeding. Embrapa also sped up the growing period, making it possible to grow two crops a year.
- Pioneering and encouraging new operational farm techniques. Brazilian farmers pioneered "no-till" agriculture, in which the soil is not ploughed, enabling retention of more nutrients. In 1990, Brazilian farmers used no-till farming for 2.6% of their grains. Today, far more than 50%.
- Revolutionizing cattle production by importing *Brachiaria* grass from Africa and the zebu from India and then improving them dramatically. These two innovations were key to making Brazil a leading exporter of beef.
- Introducing agriculture and livestock integration. The adoption of these mixed systems has been associated with a 15% increase in the soil organic matter content and up to 90% increase in apparent phosphorus use efficiency. This has helped restore degraded pasture lands.

Settlement and support of farmers. Settling new farmers in the Cerrado to convert Embrapa's research and development into productive farms and agribusinesses was coordinated by the Agricultural Production Company (CAMPO), a joint Japanese–Brazilian public–private company. CAMPO acquired land in the Cerrado (from absentee landlords) after conducting meticulous aerial and ground surveys, title searches, and negotiations with owners. It then serviced the land with infrastructure (roads and electricity) and subdivided them into farm plots. For each settlement, CAMPO entrusted the selection of farming households to an agricultural cooperative. An example of such a cooperative was Cotia, the Japanese–Brazilian agricultural cooperative, then the largest in Brazil. Cotia selected knowledgeable and motivated people as settlers. Indeed, the Cerrado settlement program was based on an earlier project managed by Cotia in the state of Minas Gerais. Under that project, many settlers selected by Cotia were college or university graduates with degrees in agronomy and with knowledge of farm management.

CAMPO played a major role in transferring agricultural technologies to the settlers. In consultation with Embrapa, other research institutes, and agricultural agencies in the public and private sectors, it produced a "technical guidance manual" for each crop and settlement site, taking into account local conditions. It also managed an agricultural experiment station and a farm in cooperation with the research institutes for adaptive research with inputs from the settler farmers. CAMPO also helped strengthen the capacity of the cooperatives it worked with on the PRODECER program.

Finance. Funds for the PRODECER program came from the Brazilian national budget and from Japan through JICA and the Japan-Brazil Agricultural Development Corporation (JADECO), a consortium of private Japanese companies. These funds were channeled to the settlers through Brazilian banks, both state and private, under criteria set by CAMPO.

The PRODECER program lasted 22 years and eventually comprised 21 project sites in seven states covering an area of 345,000 hectares. It helped establish a new class of farmers, supported by a constellation of agribusinesses, in Brazil and translated the R&D results of Embrapa into the production and commercial success that has become the "Cerrado Agricultural Miracle."

An important reason for CAMPO's success in effectively coordinating activities and supporting the farmers under the PRODECER program was that even though it was engaged in public sector activities, it was a public–private institution that was run professionally and that was able to move at the speed usually seen in private companies. And decisions on project design, farmer selection, and beneficiaries of the financial and other types of support were based on efficiency and competency, rather than political and patronage, considerations.

Source: Economist 2010; Hosono et al. 2016; Pereira et al. 2012.

production, processing, and exports.[3] The model is comprehensive, involving many components, but it also demonstrates that farming can be profitable and attractive for educated youth. With the help of Japan and Brazil, Mozambique is trying to transfer and adapt the Cerrado model (see box 7.3).

Acquiring land for pilot projects

Farming requires land. To set up pilot projects, governments, perhaps with contributions from donors, would need to acquire suitable land—a large tract that could support about 100 farmers, each farming about 10 to 20 hectares of land. Customary land tenure systems still hold sway in many areas (chapter 2), making it more difficult for young people to acquire 10 to 20 hectares of contiguous land, even setting aside the issue of getting the money to pay for it. Finding such land will require government negotiations with communities, adequate compensation for the land, whether purchased or leased, and attention to the equitable distribution of the compensation within the communities.

Selecting pilot farmers for training

Youth who are interested in the pilot programs will have to be selected according to some objective criteria and trained. The pool of candidates could consist of interested youth with a secondary or college education. Training should cover both the science and the business of running a farm, with a focus on a few selected crops or livestock based on the agroecological features of the selected land and market demand analysis. The training should be provided at the project site, and the trainers should remain available as extension agents once farming gets under way. As stressed in the next chapter, the opportunities that are created in agricultural transformation should be gender equitable, so young women should be equally represented in the selection of farmers for the project.

Providing inputs

Certified input dealers ("agrovets") should be incentivized to locate on the project site, and financial institutions should be incentivized to support them in providing inputs on credit to the farmers. Government, with the support of development partners, could provide credit enhancements (such as payment guarantees) to encourage financial institutions to lend to farmers. Similarly, privately owned and operated mechanization-for-hire and other farm services could be encouraged to set up near the project site. Where programs for financial support of small enterprises exist, agricultural enterprises could be prioritized for support.

Improving storage

As discussed in chapter 3, privately run storage and warehouse receipt systems are emerging in several African countries. Government should support them and encourage them to link up with the farmers on the project.

Creating markets for outputs

To be profitable, farms need reliable markets and prices. Without them, the whole pilot scheme collapses. Chapters 4 and 5 discussed the importance of linking farmers with large contract farmers, processors, middlemen, and supermarkets. In consultation with farmer associations and these potential buyers, governments could produce simple standardized contracts and expedited dispute resolution systems. Government institutions, such public schools and colleges and the military, could also be encouraged to procure from these farms for their feeding programs. For export markets, the government could, with support from donors and others, help with certification training and systems and also with logistics at seaports and airports.

Replicating successful pilot programs

The idea is to begin with modest pilots and then replicate successful ones in other parts of the country. A key principle is government support to and harnessing of markets, the private sector, donors, NGOs, and other stakeholders to address challenges. The government would be a "residual actor," stepping in only to either encourage and incentivize the others to act (such as through public–private partnerships) or undertake pure public-sector services. Once the pilot has demonstrated its profitability, the other actors, particularly the private sector, will be more motivated to participate during the model replication stage. The pilot could be replicated in various parts of a country, with each successful project becoming a demonstration to nearby smallholders of the viability of the model for their own activities. These nearby smallholders could also be given access to the services available in the project. In this way, not only will a large number of the educated youth be encouraged to get into farming, but the incomes of traditional smallholders would also be raised.

Modifying some of the new agricultural schemes to increase focus on the youth

Some African countries, including Democratic Republic of Congo (Agricultural Business Park of Bukanga Lonzo),[4] Mozambique (ProSavana; box 7.4), and Tanzania (Southern Agricultural Growth Corridor of Tanzania; box 7.5) are implementing industrial parks for agriculture, providing

BOX 7.4

ProSavana—a Cerrado in Africa?

Brazil and Japan, working with the government of Mozambique, are trying to replicate the Cerrado miracle in Africa under the ProSavana project. The project aims to transform parts of the savannah spreading along the Nacala Corridor in northern Mozambique into highly productive agricultural land, while addressing food insecurity in a sustainable manner.

ProSavana has three main components. First is improving research and extension capabilities for the agricultural development of the Nacala Corridor, focusing on strengthening the institutional capacity of Mozambique's Agrarian Research Institute. Second is implementing pilot projects for small and commercial growers. Third is designing an integrated agro-industrial master plan for the Nacala corridor, looking not only at agricultural production and productivity, but also at broader regional development issues, such as infrastructure and markets. The program envisages support for both commercial large-scale production systems and smallholder subsistence agriculture, through adaptive technology (improved varieties of soya, maize, rice, and other crops, suitable for Mozambican soils) as well as conservation agriculture techniques (no-till farming).

The governments of Japan, Brazil, and Mozambique provided initial seed capital and about US$13 million have been committed since 2011 to support the first component for about five years. Additional resources will be provided by Japan to Mozambique through grants and concessional loans to support developing complementary infrastructure across the Nacala corridor. The project also aims to identify opportunities for the deployment of Brazilian and Japanese capital. The recently launched Nacala Fund is expected to attract investment of US$2 billion into the corridor, mainly for agribusiness projects. Its promoters claim that it will benefit 10 million Mozambicans by supporting family farming as well as medium and large agricultural projects. Implementation started in 2011. The overall timeframe for the program is at least 20 years.

Some point out that transferring the Cerrado miracle may be challenging because Mozambique's agricultural governance, institutions, and politics are all quite different from the context that hosted the Cerrado transformation. Therefore, success will hinge on development of institutions and incentives that will align the interests of key stakeholders.

Source: Cabral et al. 2012; JICA 2014.

BOX 7.5

The Southern Agricultural Growth Corridor of Tanzania

The Southern Agricultural Growth Corridor of Tanzania (SAGCOT) is a multistakeholder partnership initiated in 2010 by the President of Tanzania to rapidly develop the agricultural potential of the corridor that stretches from the west of Dar es Salam through Morogoro, Iringa, and Mbeya to Sumbawanga, as area of more than 28 million hectares.

SAGCOT envisions mobilizing US$2.1 billion in new private sector agribusiness investments, backed by US$1.3 billion in public sector facilitating investments in infrastructure, including irrigation, and related public goods. It aims to facilitate the development of profitable agricultural businesses in clusters along the corridor to take advantage of economies of scale, synergies, and increased efficiency to accelerate sustainable growth in agriculture in the southern corridor of Tanzania.

In 2016, the World Bank approved a US$70 million SAGCOT Investment Project to support Tanzania's agriculture sector and strengthen it by linking smallholder farmers to agribusinesses to boost incomes and job-led growth. The project aims to provide opportunities for smallholder producers to engage in profitable agriculture by incentivizing stronger links between smallholders and commercial agribusinesses, including outgrower schemes that allow nearby smallholders to access inputs, extension, value-adding facilities, and markets. It provides support to smallholder producer associations and helps them to enter into equitable commercial relationships with agriprocessing and marketing businesses.

Source: SAGCOT n.d.; World Bank 2017.

land with infrastructure to attract private investors, mainly foreign, into commercial farming and agribusinesses, with envisaged linkages to smallholders. So far, however, these schemes have not included a component to attract, train, and support educated youth to become commercial farmers. On the other hand, there have been many schemes to train youth in agricultural science and entrepreneurship and to provide access to finance for farming and agribusiness (boxes 7.6, 7.7, and 7.8). But there have not been schemes that provide the comprehensive support—from land to market—envisioned here.

Conclusion and policy considerations

Modernized, higher productivity agriculture will require fewer people working on farms. That will not exacerbate

BOX 7.6

Boosting the productivity of rural youth, on and off the farm

Most young Africans work in agriculture, and improving the financial returns to farming can improve their prospects. Not easy, because farms are small, land tenure is uncertain, crop yields are low, infrastructure is poor, and the use of farm machinery is limited. But as this report shows, those impediments are surmountable, if new methods displace the old.

To attract rural youth and boost their productivity, agriculture has to become more innovative. Switching to new seeds, fertilizers, and farm practices can increase yields. Innovation can also occur through new products and markets, as well as through new opportunities further up the value chain in food processing and distribution, as with exports of coffee from Ethiopia, flowers from Kenya, and vegetables from Tanzania. Indeed, the more that young people remain in agriculture, the more that agriculture is likely to be innovative.

New products and markets require coordination, however, and that typically comes from government. Most basic research on new agricultural varieties and techniques is in government research centers. And public interventions can help young people develop their skills, get access to land and credit, and upgrade their technology.

Source: Betcherman and Khan 2015.

BOX 7.7

Integrated agricultural skills development in Songhaï Centers

Songhaï Center is a training institution that trains individuals to become modern farmers. Started in 1985 near Porto-Novo, Benin, it is a center for training, production, and research and development of sustainable agriculture. It relies on an integrated production system that creates and sustains links between production activities (crop, animal, aquaculture, agro-industry), technology, and services sectors (including micro-finance). In other words, the center is value chain oriented as the produce are processed -yoghurt and tomato processing, cashew, rice and palm oil processing- and marketed.

Three more centers were later established in Benin as training and production sites in three agro-ecological zones and from 2002 the model spread to other countries (nine centers in Nigeria and one each in Liberia and Sierra Leone). The Songhaï centers are in public–private partnership with institutions such as Africa Rice, International Institute for Tropical Agriculture, University of California system, West and Central Africa Council for Agricultural Development, International Crops Research Institute for the Semi-Arid Tropics, United Nations Development Program, Amudike-Nigeria, Bio-Organics, Plumex, and Underhill International among others.

The Songhaï Centers in Benin have trained more than 1,500 youths who are now successful farmers and are sharing their knowledge within the communities where they operate their farms. This knowledge sharing is important in creating a critical mass of highly productive young famers.[5] Since 2008, the Songhaï Center has been promoted as a Center of Excellence in Agricultural Training by the United Nations, and the UNDP is supporting planned replication in 15 African countries.

Source: Maiga and Kazianga 2016.

Africa's growing unemployment problem, particularly youth unemployment, if agricultural transformation is pursued by modernizing agriculture and strengthening its links with industry and other economic sectors. This require a tight alignment between agricultural and overall development policy, particularly industrial policy —facilitating growth of output and employment in agriculture-related manufacturing and service activities. Jobs in these areas will be more attractive to the educated youth who generally shun farming. But programs must also be designed to attract some educated youth directly into farming, to create a new class of commercially oriented small and medium-size farmers. In the long term, bringing more young people into farming is essential for replacing the aging traditional smallholders who are now the backbone of African agriculture.

BOX 7.8

ENABLE Youth: Empowering Novel Agribusiness-Led Employment for Youth in African Agriculture

ENABLE Youth: Empowering Novel Agribusiness-Led Employment for Youth in African Agriculture plans to engage at least 800,000 youth in 20 countries in an agriculture employment program. The effort is being financed by the African Development Bank, with technical support from the International Institute of Tropical Agriculture (IITA).

The ENABLE Youth Nigeria program, with an approved US$250 million loan, plans to create business and employment opportunities for young women and men along priority agricultural value chains, including aquaculture, crop farming, processing, and marketing. The program intends to achieve equal participation by young women and men ages 18–35. The program is seeking unemployed young Nigerian graduates from any field of study who have finished their National Youth Service Corp program, as well as young graduates who are already successfully engaged in agribusiness but who lack access to commercial loans to grow their businesses.

Youth entering the program will receive two weeks of agribusiness orientation training at an incubation center before interning at an agribusiness to gain practical experience in modern farming and agribusiness operations and management skills. Entrepreneurs will then be supported for up to nine months in agricultural incubators. In general, it is expected that all youth who have successfully completed the incubation program and who have met the established criteria will move to the next stage of accessing loans to set up their agribusinesses or will find employment in the private sector and the rural development community. Most of the loans will be about US$50,000. The ENABLE Youth agricultural entrepreneurs, or "agripreneurs," can have individual or joint businesses that must be legally registered. The target is to reach 1,000 agripreneurs in each state to establish enterprises, as individuals and as groups of 10–50. The businesses are expected to generate about 185,000 additional jobs.

Source: AfDB 2015; AfDB 2016.

Notes

1. ACET 2014.
2. Johnston and Mellor 1961; Timmer 1988 and 2007.
3. Hosono et al. 2016.
4. Ulimwengu 2016.
5. The centers in Benin generated revenues of US$11.7 million in 2014, based on anecdotal reports (http://www.africa24tv.com/fr/africa-news-room-elevage-au-benin-lexperience-des-centres-songhai-23).

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CHAPTER 8

Promoting Gender Balance in Agricultural Transformation

Women are vital to Africa's agricultural transformation.[1] Not only do they account for about half the population, but they also make up half the labor force in agriculture and a large share of the food producers in most African countries. However, African agriculture has multiple gender gaps that need to be bridged to accelerate progress in agricultural transformation and to ensure that women benefit equally from the opportunities created in the process.

Many constraints and opportunities overlap, and in many cases there is too little knowledge or data to identify the best leverage points for reducing the gender gap in agriculture and reaching the goal of gender equity. Institutional factors overwhelm purely technological factors in explaining the lack of more, or faster, progress. Factors related to a less conducive environment for female farmers, traders, and processors—such as insufficient time and inadequate access to services, markets, and communication technologies—are well-known gender-based constraints.

Addressing them will be necessary but likely will not be sufficient to promote the desired change. Social norms need to shift, and though they run deep, they can change—quickly at times with the right incentives in place.

This chapter first provides an overview of male–female productivity gaps in African agriculture. Next, it reviews the existing empirical evidence on gender differences in acquiring and using modern agricultural inputs, which are vital for sustainable agricultural transformation. Then, it discusses ways to improve women's access to, control of, and ownership of productive assets, focusing on: natural, physical, financial, human, and social assets, which will help them bridge the gender gap in agriculture and enable them to participate fully in agricultural transformation.

The gender productivity gap

The gender productivity gap in agriculture in Africa refers to differences in output between plots managed by men and those managed by women. Often, there is also a related scale gap arising from the smaller size of women's plots. Even if there were no productivity gaps, constraints (such as in access to land, credit, and other inputs) that prevent women from having the same size farm as men mean that women farmers will have lower output and incomes.

Significantly lower productivity in crop production was found among female-headed households in Nigeria and on women-owned plots in Uganda. Gender differences in the control of agricultural inputs (land area, tenure security, irrigation, fertilizer and seeds, extension services, and labor inputs) and intrahousehold bargaining power were key factors influencing productivity gaps between male and female farmers.

The World Bank's Living Standards Measurement Study–Integrated Surveys on Agriculture show substantial differences in yield, plot size, fertilizer application, and use of hired labor between male- and female-managed plots in African countries (table 8.1). In Uganda, plots managed by women are 18% less productive than those managed by men. The gap is attributed to women's poorer access to inputs, greater childcare responsibilities, difficulty accessing input and output markets from areas without transport, and differential uptake of and return to improved seeds and pesticides.[2]

In Niger, plots managed by women produce on average 19% less per hectare than plots managed by men.[3] As with earlier findings,[4] the gender productivity gap is attributable to the challenges women experience in accessing, using, and supervising male farm labor; women's use of less fertilizer and fertilizer of lower quality; and the lower rates of land ownership among women. Gaps between men and women in agricultural inputs and outputs were also observed in Malawi (see table 8.1). Some intrahousehold researchers caution, however, that many agricultural decisions are made jointly and that such findings may be oversimplifying matters in the quest to identify gender-based decisionmaking and to differentiate plots managed by women and those managed by men.[5]

Productivity gaps all but disappear when farmer characteristics and differential access to inputs and plots are taken into account.[6] Disentangling individual productivity is difficult as many plots are jointly managed. Explicitly targeting women may not necessarily lead to higher returns. Yet programs that do not consider gender-based

TABLE 8.1 Outputs and inputs on farm plots managed exclusively by men and those managed exclusively by women in Niger, Malawi, and Uganda

Country and outputs/inputs	Men's plots	Women's plots
Malawi		
Value of output (Malawi kwacha per hectare)	56,810	42,477[a]
Area per plot (hectares)	0.41	0.36[a]
Amount of inorganic fertilizer applied (kilograms per hectare)	147.61	132.29[a]
Hired labor (days per hectare)	6.33	6.83[a]
Number of plots	12,029	4,534
Niger		
Value of output (CFA francs per hectare)	50,369	35,885[a]
Area per plot (hectares)	1.69	0.98[a]
Amount of inorganic fertilizer applied (kilograms per hectare)	3.10	0.14[a]
Hired nonfamily labor (days per hectare)	5.14	3.72
Number of plots	2,288	613
Uganda		
Value of output (US dollars per acre)	158	129[a]
Area per plot (acres)	0.85	0.54[a]
Value of fertilizer applied (US dollars per acre)	1.17	0.12[a]
Purchased seed applied	29.2	21.3[a]
Hired labor used on plot (percent of total farm labor)	30.5	23.3[a]
Percentage of plot managers who received government extension services	22.9	16.9[a]
Number of plots	3,500	3,499

a. Differences were significant at the 0.1% level.

Source: World Bank Living Standards Measurement Study–Integrated Surveys on Agriculture (2014); for more details see http://www.worldbank.org/en/region/afr/publication/levelling-the-field-improving-opportunities-for-women-farmers-in-africa. Data period for each country are at http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:23512006-pagePK:64168445-piPK:64168309-theSitePK:3358997,00.html.

responsibilities, resources, and constraints in different locations are unlikely to succeed, either in increasing productivity or in benefiting male and female smallholder farmers equally.

Female farmers' lack of access to agricultural training is another factor contributing to lower productivity.[7] Agricultural knowledge is often not shared across the gender divide within the household, so training that has in the past been provided solely to the male household head is now being recognized as contributing to missed opportunities for increasing overall household productivity.[8]

Acquiring and using agricultural inputs

In addition to constrained access to agricultural training and knowledge, there is evidence in many African countries of the unequal access that women have, relative to men, to many of the agricultural inputs required to increase productivity, including improved seeds, fertilizers, and pesticides. Traditional agricultural research and development systems have historically failed to consult female farmers, and thus the development and diffusion of improved seed varieties have not taken into account women's needs, preferences, and resources (box 8.1). As a consequence, women lack access not only to improved agricultural inputs but also to inputs that meet their needs.

Many women face barriers in access to money and credit to purchase inputs. In Zimbabwe, men's greater access to financial assets and formal marketing institutions led to a greater adoption of high-yielding maize varieties, while women preferred open-pollinated varieties that did not require them to obtain loans for fertilizer

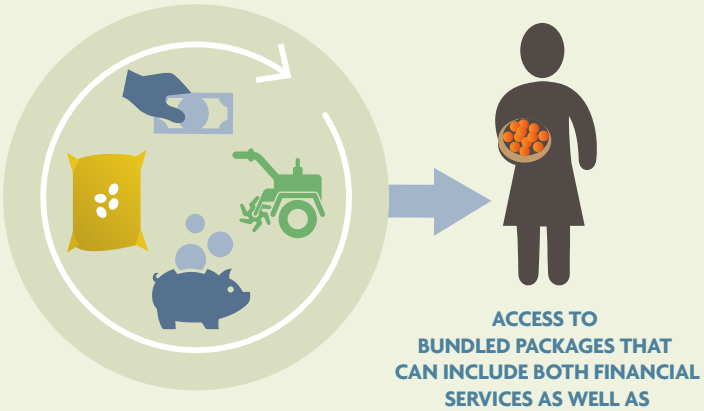
Achieving gender balance in farming

ACCESS TO CHEAP TECHNOLOGIES AND INPUTS

ACCESS TO LAND

MORE WOMEN AS EXTENSION OFFICIALS AND MORE INNOVATIVE TRAINING PROGRAMS ADDRESSING CONSTRAINTS FACING WOMEN

ACCESS TO DIGITAL FINANCE, MICROFINANCE, AND BASIC SAVINGS AND LOANS ACCOUNTS



ACCESS TO BUNDLED PACKAGES THAT CAN INCLUDE BOTH FINANCIAL SERVICES AS WELL AS AGRICULTURE INPUTS

BOX 8.1

Women and men have different preferences

Women and men often have different preferences for maturation periods, yields, tastes, and color, which can influence farmer willingness to adopt new varieties. For example, in one area of Zimbabwe, women who cooked the maize ranked the taste of maize varieties highly while men did not, as they considered maize a cash crop. Participatory plant breeding approaches that involve women are leading to better performing varieties and enhanced adoption and benefits to women, as shown in examples of beans in Rwanda and NERICA (New Rice for Africa) upland rice in West Africa.

Source: Bourdillon et al. 2007; Sperling and Berkowitz 1994; Somado, Guei, and Keya 2008.

and seeds and could be sold through women's informal networks.[9] Women's ability to obtain credit is restricted by their inability to meet collateral requirements (where they cannot own land), high transaction costs, limited education and mobility, social and cultural barriers, and the nature of women's businesses (often concentrated in low-return sectors).[10]

A review of 24 studies of access and adoption of technological inputs (including inorganic fertilizer, seeds, and pesticides) found that in 19 of the studies (79%) men had higher access to the given input, on average, and that in 5 (21%) women had higher access. Key factors accounting for the differences included women's lower education levels, wealth/asset levels, and access to land. Many of these studies identified areas where gender disparities persist, including women having little or no access to markets and receiving lower prices for their produce.[11]

Several steps could improve female farmers' access to and control over productive resources:[12]

- Promoting and disseminating simple and cheap labor-saving technologies and inputs in small quantities to address women's limited access to credit and cash.
- Communicating extension messages in ways and through channels that make it easier for women with little formal education to access and understand them (such as pictures and videos).
- Adapting credit products or service delivery to female clients' needs (such as changing the terms of credit through microfinance institutions) or providing different/innovative types of savings instruments, such as female-owned individual accounts, mobile and branchless banking (both M-Pawa in Tanzania and M-Shwari in Kenya offer M-Pesa clients the opportunity to take loans and make saving deposits, which would allow more women to access credit and have savings).
- Providing bundled services (such as packaging together access to loans, making saving deposits, accessing inputs such as fertilizers and technology, and/or extension services) which can help women circumvent credit, educational, and infrastructural barriers.

Easing access to, control of, and ownership of assets

The international development literature uses a sustainable livelihoods framework to examine five types of capital—natural (land, water), physical (agricultural and household durables), financial (cash or savings), human (health, knowledge, skills), and social (group membership, social networks)—because these have been found to be key asset types that underlie the ability of households to engage in livelihood strategies.[13] All five asset types are needed for agricultural production, and gender gaps exist in all of them.

Work led by the International Food Policy Research Institute (IFPRI) highlights the importance of understanding that men and women control, own, and dispose of assets in different ways, and also access, control, and own different kinds of assets.[14] A critical asset for rural women is livestock, and ownership rights here vary across countries and cultures and by type of animal. For example, women often own and control decisions on chickens, sheep, and goats, but not cattle. The work also recognizes that some assets are held individually and some jointly by household members, which is important in light of the evidence that improved control of assets by women has a wide range of impacts, including enhanced nutrition of young children.[15] When livestock products such as eggs, meat, and milk are controlled by women, they are more likely to be consumed by the family. In cases where women do not own the livestock, they may not be able to make decisions over use of the products. In Kenya, when women own the animals, animal products are more frequently consumed within the household and both their own and their children's dietary diversity (a nutritional proxy) is higher.[16]

Assets, not just income, are important for poverty reduction. Assets serve multiple purposes: they can generate income and diversify its sources, provide access to credit, and act as a store of wealth.[17] Assets increase an individual's bargaining power—for a woman, enhancing her and her children's well-being.[18]

The CGIAR (the Consultative Group for International Agricultural Research), a global research partnership for a food-secure future, identified some key strategies and approaches to reduce the gender gap in assets in its global Gender Agriculture and Assets Project (GAAP—box 8.2), which is jointly led by the International Food Policy Research Institute (IFPRI) and the International Livestock Research Institute (ILRI):

- Develop projects that increase access to or the stock of agricultural assets (such as land redistribution, irrigation development, and livestock provision) and allow for joint ownership.[19]
- Design projects that increase the returns to assets (benefit-sharing mechanisms).
- Support programs that protect assets (insurance for the asset or products derived from it).[20]
- Include women in agricultural training and men in nutrition training.[21]
- Use existing producer groups with male and female members to accumulate women's assets, particularly livestock and land.[22]

BOX 8.2

CGIAR's Gender, Agriculture, and Assets Project

Gender Agriculture and Assets Project (GAAP) is a capacity-building and evaluation initiative which aims to enable a "better understanding of gender and asset dynamics in agricultural development programs" (CGIAR). Four GAAP initiatives that focused on agricultural interventions to develop value chains by increasing the stock of men's and women's assets were particularly successful at increasing the stock of jointly owned assets. These projects also increased women's social and human capital by providing training and ensuring benefits to female producers and suppliers. However, providing other targeted support to different types of farmer groups (such as strategies aimed at strengthening horizontal linkages between different producer associations, cooperatives, and business associations, particularly those at the same node of the value chain) is key to converting assets into greater opportunities for women further along the value chain.

Note: The four projects were the Land'O'Lakes Manica Smallholder Dairy Development Project in Mozambique (Johnson et al. 2015); CARE's Strengthening the Value Chain project in Bangladesh; Helen Keller International's Enhanced Homestead Food Production program in Burkina Faso (Berhman, Billings, and Peterman 2013); and a HarvestPlus Reaching End Users project in Mozambique and Uganda (de Brauw et al. 2010; Johnson et al. 2015).

Source: Quisumbing et al. 2014b.

Accessing agricultural information and advisory services

Most rural advisory services in Africa reach only a small percentage of farmers and fail particularly to reach female farmers.[23] Women have less access to agricultural advisory/extension and climate services than men in Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Niger, Senegal, Tanzania, and Uganda.[24] The service providers typically consider men to be the lead farmer and focus on men's market interests, assuming that women are engaged in subsistence farming.[25] Yet advisory services can benefit women greatly by improving their crop cultivation practices and yields.[26]

One contributing factor to female farmers' lack of access to rural advisory services is the fact that only around 15% of extension workers are women. Social norms discourage close and regular interaction between adults of the opposite sex who are not married or family members.[27]

This highlights the need for more investment in innovative communication and learning-based approaches to reach female farmers. New approaches are being tried within various farmer trainer programs. A recent appraisal of the use of text messages by farmer trainers found that they are increasingly using mobile phones to receive and disseminate information on agricultural technologies.[28] Agricultural production, market, and value chain information can be more accessible to women by using mobile phone–based services, such as those in East Africa, including the Africa Knowledge Zone in Kenya[29] and the Community Knowledge Worker Initiative in Uganda.[30]

Many programs are now using farmer-to-farmer extension approaches.[31] The East Africa Dairy Development Project, for example, uses a gender-responsive volunteer farmer trainer approach to disseminate information and knowledge on improved feed technologies and management strategies to dairy farmers in Kenya, Rwanda, Tanzania, and Uganda, and results have been solid.[32] The volunteer farm advisor approach has shown promising results in Mozambique as well. Extension agents identified female volunteer farm advisors within communities and brought extension demonstrations closer to women's homes. An evaluation showed that in communities with female farm advisors, both female and male farmers were more likely to adopt sustainable land management practices.[33]

In Malawi's lead farmer program, social networks provided clear channels for spreading agricultural

BOX 8.3

Gender-transformative change to dairy cooperative bylaws in Kenya

The Kenya Dairy Sector Competitiveness Program aimed to transform the Kenyan dairy industry into a globally competitive, regional market leader and increase smallholder household incomes through the sale of quality milk. The program worked to lower production and processing costs throughout the dairy value chain, while ensuring that Kenyan milk meets domestic and international quality standards.

The program reached out to women and youth as active participants, insisting that women form at least 30% of dairy cooperative membership. Support was provided to poor male-headed and female-headed households as follows:

- Paying the same amount per liter regardless of delivery size.
- Ensuring that the cost of inputs is the same regardless of the size of the order.
- Encouraging men to allow women to apply for loans at lower interest rates.
- Instituting payment in-kind with milk through the addition of a cooperative store for the purchase of school books, basic food items, seedlings, and inputs. Some cash was provided to the man of the family in male-headed households to help secure his agreement to this payment modality.

Source: Farnworth and Colverson 2015.

knowledge.[34]Even though other farmers did not view female lead farmers as favorably as their male counterparts, male and female lead farmers were equally successful in sharing new information on agricultural practices. Under a Malawi Ministry of Agriculture program, lead farmers in rural areas received training on innovative methods for growing maize, including using compost and planting pits for water retention in dry areas. Male and female lead farmers performed equally well in transferring knowledge, with female lead farmers far outperforming men when both sexes received a cash incentive.[35]

Ethiopia shows that it is not just access to extension services that lifts farm productivity. Farmers, both men and women, have to consider those services to be useful. Services driven by user needs were linked to higher productivity by female heads of household in the production of barley, fruits, and vegetables.[36]

Gender-responsive farmer field schools for farmers with low levels of education are another promising option.[37] Farmer field schools with flexible training schedules and covering the crops, livestock, trees, soil and water management, and aquaculture opportunities that especially benefit female farmers are likely to achieve greater impacts. Farmer field schools in Kenya, Tanzania, and Uganda—open to women and to farmers with little formal education—led to gains in per capita agricultural income of female-headed households, their crop and livestock production, and their access to rural services.[38]

Much still needs to change if women are to work better with extension and advisory services in Africa, including the male–female market crops–subsistence crop bias and the persistent belief that male household heads are the primary farmers meriting services (most surveys until recently have been administered to men) and that all household members have the same interests.[39] Gender-transformative extension and advisory facilitation systems, as in Kenya's changing of dairy cooperative bylaws, have also helped elucidate underlying gender relations (box 8.3).

Adopting agricultural technology

Gender differences are also found in the uptake of transformational climate-smart agricultural practices. These are practices that contribute to diversified livelihoods, buffer households against the effects of climate change, increase assets, and require substantial investments of time, labor, and cash. A study in four countries in East and West Africa and South Asia found that farmers in a diverse range of smallholder environments, especially women, are not yet aware of locally appropriate practices and options that can enhance their resilience to change, including long-run climate change.[40] These farmers base their decisions on farming practices on traditional and local sources of information, which do not always recommend the uptake of improved practices.

Half of male farmers in the study had made at least one transformational climate-smart practice change in recent years, against only a quarter of female farmers. Factors positively influencing uptake by women included participating in decisions about household income, having access to agricultural credit, receiving weather-related information from neighbors, and participating in groups that share labor. These findings point to the need to expand women's access to information and training in improved agricultural practices and to improve their access to credit.

Zambia has implemented more equitable, gender-oriented participatory extension approaches in recent

years, leading to some positive gender outcomes (box 8.4). The family-oriented approach also led to positive outcomes related to men's greater supportiveness of women's activities. Programs and interventions aimed at promoting adoption should engage both men and women within households and not target solely women. In Uganda, adoption of the orange-fleshed sweet potato, promoted as part of a strategy to improve household nutritional levels and reduce vitamin A deficiency, is more likely on plots that are jointly owned by a husband and wife, but where the wife is the primary decision-maker about what to grow.[41]

The design of technology affects its adoption by men and women.[42] Promising approaches include those that recognize that different types of farmers will try different approaches and therefore explicitly seek farmers' inputs (box 8.5).

Techniques and technologies that save women farmers time and effort are still widely needed. A project aimed at modernizing shea butter processing technology in Ghana focused on improving the extraction efficiency rate of different mechanized kneaders. By involving women, who were the main users of the technology, engineers designed a kneader that saved women time, with just a slight loss of efficiency.[43]

That women face particular labor constraints in taking up new practices points to the importance of approaches that enhance women's access to labor and labor-saving technologies. Options include cash vouchers for hiring labor, price discounts on buying labor-saving machinery, and doorstep delivery of machinery and training.[44] Zambia provides female farmers with cash transfers for hiring labor (box 8.6).

Enabling more women to participate in agricultural training requires making training times and venues more convenient for women.[45] Training should include both men and women in a household. This last point draws on a dairy development project in Mozambique, which found that two members of participating households had to attend training in animal and fodder husbandry to increase milk production and income.[46]

Securing land rights

Women's control and ownership of land varies across African countries, but is generally markedly lower than men's (table 8.2). Rapidly growing demand for agricultural land is testing the limits of property rights systems in most African countries, where customary tenure systems have historically provided secure land access (chapter 2).

BOX 8.4

Gender-oriented participatory extension approach in Zambia

Zambia's Ministry of Agriculture, Food, and Fisheries launched a gender-oriented participatory approach to extension services in 1994. Extension staff were trained in gender awareness and in household, or family, joint learning approaches that aim to bring about changes in gender relations within the household.

An impact assessment showed that the approach empowered women to participate more actively, make decisions, and move around more freely; they were also able to retain control of their income. Women's responsibilities and labor demands also increased, while the family approach led to men being more supportive. Another positive outcome was the introduction of legumes, which increased family nutrition and women's incomes, as well as improving soil quality.

Source: Beucheldt and Bandstue 2013; Kürschner et al. 2000; Bishop-Sambrook and Wonani 2009; Klos 2000.

BOX 8.5

Promoting gender-sensitive participatory technology and innovation

Participatory innovation development promotes local innovation and farmer-led research and development in ecologically oriented agriculture and natural resource management. Developed by Prolinnova (Promoting Local Innovation), a multi-stakeholder international network backed by civil society organizations, the approach builds on local innovations that women and men pursue based on their own needs and priorities. These farmer-directed innovations serve as entry points for farmer-led joint research, with scientists and development agents joining local people to further develop, adapt, and test these home-grown initiatives, combining local knowledge with more scientific-based knowledge.

Gender equity issues are addressed by ensuring that women innovators are involved in setting the agricultural research agenda, and joint experiments are designed that are based on women's innovations and led by women. Innovative communication approaches also strive to reach women and youths as well as men. Farmer innovation fairs highlight female and male innovators through awards and other promotional materials.

Source: Wettasinha and Waters-Bayer 2013; FAO 2015 box 8.7; www.prolinnova.net; https://ccafs.cgiar.org/blog/photo-story-fair-promotes-farmer-innovations-west-africa#.VplYH1LWRek.

BOX 8.6

Cash transfers for hiring labor in Zambia

Many women cannot afford to hire laborers in periods of peak demand for tasks such as planting, plowing, weeding, or harvesting. Interventions to help female farmers hire outside labor for farm tasks can include vouchers aimed specifically at hiring labor, cash transfers, and access to credit.

One of Zambia's largest social protection programs is the Child Grant Program, which provides a monthly cash payment of 60 kwacha (US$12) to very poor households with children.

A preliminary evaluation (based on a randomized control trial of 2,515 households) of cash transfers to households with children under the age of five in Zambia found that they increased women's spending on hired labor substantially (as well as on other agricultural inputs, such as seeds and fertilizer).

Source: Seidenfeld et al. 2014; World Bank/One 2014.

Some African countries, including Ethiopia, Kenya, Rwanda, and Uganda, have changed land rights regimes to allow women to own land. But reforms on paper are not leading swiftly to changes in practice. In Ethiopia, for example, despite a highly successful gender-sensitive reform of land rights, many women are unaware of the change, and as a result they are still slow to undertake such long-term investments as adopting soil conservation practices and planting tree crops, which take years to mature.[47] Similarly in Uganda, many households reported husbands and wives as joint owners of the land on surveys, but in practice, women were much less likely to be named on title deeds.[48] And in Tanzania, laws may grant equal land ownership and inheritance rights to men and women, but customary laws still lock women out.[49] Lack of awareness by women of their right to own land and of the land registration process may be an important factor.

Rwanda, however, has made huge strides in reducing the gender gap in land rights with policy reforms

TABLE 8.2 Total agricultural holders and share of female holders for selected countries

Percent of total holders

Country	Year	Agricultural holders total	Share of female holders (%)
Cape Verde	2004	44,450	50.5
Botswana	2004	50,690	34.7
Malawi	1993	1,561,416	32.1
Lesotho	1999–2000	337,795	30.8
Mozambique	1999–2000	3,064,195	23.1
Tanzania	2002	4,901,837	19.7
Ethiopia	2011–2012	14,747,439	19.2
Zambia	2000	1,305,783	19.2
Seychelles	2011	642	18.7
Uganda	1991	1,704,721	16.3
Madagascar	2004–2005	2,428,492	15.3
Côte d'Ivoire	2001	1,117,667	10.1
Nigeria	2007	15,732,850	10.0
Senegal	1998–1999	437,036	9.1
DRC	1990	4,479,600	8.9
Burkina Faso	1993	886,638	8.4
Gambia	2001–2002	69,140	8.3
Tunisia	2004–2005	515,850	6.4
Egypt	1999	4,537,319	5.2
Morocco	1996	1,492,844	4.4
Algeria	2001	1,023,799	4.1
Mali	2004–2005	805,195	3.1

Source: FAO Gender and Land Rights Database.

begun in 2004 (box 8.7). Legal reforms need to be accompanied by awareness campaigns and other information dissemination efforts that educate men and women on women's right to own property—or jointly own it. Stronger enforcement of rights, for example, through legal advice and capacity strengthening, are also possible entry points to increasing awareness and implementation.[50]

Changes in laws and regulations on marriage and inheritance rights are empowering women in some African countries. Rwanda has reformed laws governing marriage, divorce, and succession. In Tanzania, women's economic advancement accompanies changes in women's community-level property and inheritance rights.[51] The establishment of community-based legal aid programs to help women and others secure their land rights are also helping, although they face challenges.[52] Ethiopia, besides instituting gender-equal land rights, has also reformed marriage laws to improve women's rights within marriage, which has enhanced women's well-being and increased girls' attendance at school.[53]

Preliminary findings from a large-scale randomized control trial of a land formalization/demarcation program in Benin—involving communities in the mapping and attribution of land rights—suggest that improved tenure security under demarcation induces a shift toward long-term investment on treated parcels.[54] The study identifies significant gender-specific effects of the program, including that female-managed landholdings in treated villages are more likely to be left fallow, an important soil fertility investment.

Strengthening governance

Progress in governance reforms in African countries should be improving agricultural service provision and making it more gender responsive, but evidence is mixed.[55] Gender-targeted approaches that have shown success and that could be taken up by more countries include measures to:

- Conduct gender audits of the ministries of agriculture and associated ministries and agencies, to prompt organizational learning on gender, as is done in Ethiopia's Agricultural Transformation Agency.
- Develop gender roadmaps and action plans in different agricultural value chains.
- Improve wages and working conditions for female agricultural laborers and other agricultural workers, enforce equal-pay legislation for women, and train employers to respond to gender equity concerns (box 8.8).

BOX 8.7

Securing land tenure for women in Rwanda

The Rwandan government, in its National Land Policy (2004) and Organic Land Law (2005), has made great strides in clarifying land rights and establishing rules to overcome inequalities. These laws were followed by a land tenure regularization program aimed at registering every landholder in the country. The law mandates that legally married wives be recognized as co-owners in the land registration process.

The program has demarcated and digitized 10 million plots and has issued 6.1 million land titles. An impact study found that households with registered plots were more likely to invest in improved agricultural and natural resource management practices (such as building terraces and dams), especially female-headed households. Women who took part in the program were more likely to be regarded as joint landowners with their husbands.

Source: World Bank/One 2014; Ali, Deininger, and Goldstein 2014; DFID 2013.

BOX 8.8

Improving wages and working conditions for women in agriculture in North Africa

Researchers with the International Center for Agriculture Research in the Dry Areas (ICARDA), a member of the CGIAR, looked at how working conditions, opportunities, constraints, and sociocultural norms in Egypt and Morocco interact to shape the experiences of female and male agricultural laborers working under different terms and conditions (full time, part time, formal, informal, seasonal, and permanent). Men tend to be assigned to higher-paid, equipment-intensive tasks, whereas women are much more likely to be assigned to lower-paid, time-intensive tasks. Even in the informal sector, men are routinely paid more than women for the same work.

Source: http://www.icarda.org/features/addressing-gender-gaps-agricultural-production-systems#sthash.gY8coTX8.dpuf.

Considering informal institutions: cultures and norms

Institutions in the wider sense can be thought of as the rules of the game. These include the cultures and norms that play a huge role in all components of the gender gap. Among others, they include customary land tenure practices, discussed above and in chapter 2, and the

components of social capital—the networks, norms, and trust that enable people to cooperate and work effectively together.

Gender norms in agriculture could further restrict women's access to land, labor and nonlabor inputs, training, and output markets. In some societies, women are not allowed to drive tractors or operate machinery. Gender norms may indeed predict the trajectory of women's participation in agricultural transformation. It has been documented that plow-intensive farming communities that were historically more dependent on male labor limit women's role in agricultural activity and their access to land.[56]

Farming activities such as ploughing and spraying have traditionally been done by men (primarily due to cultural norms). That may cause female farmers—who are not able to hire male workers (or enlist males in their families) to undertake these activities on their farms—to incur losses in output. In Malawi, women maize farmers have experienced such outcomes and end up with smaller plots and lower yields. Outcomes were similar among women farmers in Ethiopia.[57]

In some rural communities, women are not allowed to hold individual bank accounts, use financial services, enter into contracts, or negotiate with suppliers and buyers. This severely limit the options available to women farmers to access modern inputs, use technology, and expand production. It almost certainly prevents women farmers from participating in the better-return segments of the value chains. In many cases, increasing women's social capital may be the only option to overcome some of these norm-related constraints.

Social capital is critical in helping people reduce and share risk; it enhances their resilience and ability to adapt to change.[58] The ability to act collectively and tap into social networks enhances women's (and men's) adaptive capacity by enabling resource pooling, risk sharing, access to new markets and information, and lowering of labor costs.[59]

Strengthening female farmer and marketing-oriented groups may allow women to scale up investments and access markets by reducing unit costs. Such interventions can also enable women to address labor shortages by receiving help from others in the group.[60]

In Ethiopia, Mali, and Tanzania, women's participation in agricultural marketing groups contributed to their empowerment and yielded other economic benefits.[61] In all three countries, group members were more empowered than nongroup members in accessing credit. Often, participation in informal groups (especially rotating savings and credit associations) had a stronger positive relationship with empowerment than formal group membership. Women's participation tended to legitimize women's efforts to enter selected value chains. This, in itself, is significant change.[62] A similar example comes from Mali (box 8.9).

Women's participation in community meetings and group-based activities can often be enhanced through

BOX 8.9

Women's shea butter groups are changing gender norms in Mali

The shea sector in Mali is fertile ground for women's collective action (WCA). Shea production, processing and marketing are almost entirely female-dominated activities, and, in the four villages studied for the WCA research, the shea sector has always been exclusively female. Furthermore, community involvement and different forms of collective action (CA) and solidarity are an age-old tradition in Koutiala cercle [a cercle is the second-level administrative division] in Mali, where women have long been accustomed to working together to undertake a host of group activities, helped by recent government policies that support women's engagement in CA groups.

The increasing visibility of women's organized economic activities in Mali's shea butter sector and their growing incomes and capacity to contribute economically to meeting household needs, in a context where men's earnings from cotton production are in decline, were found to have contributed to shifts in perceptions on what are legitimate activities for women. Male community members and village authorities regularly invite women cooperative members to consultations on community development. The president of the cotton producers' cooperative in N'Gountjina (Koutiala district, Sikasso region) explained that the men in the village now believe that "Women should always be consulted on important decisions relating to the survival and future of the family." Women's groups have also successfully negotiated with community leaders to have access to land plots in their villages to establish group shea butter plantations in order to sustain and expand their activities."

Source: Extracted from Davies (2013) and Baden (2014).

fairly simple steps. Due to their multiple roles, women may not be able to attend meetings at certain times or participate unless childcare is provided.[63]Thus, potential solution steps include:

- Scheduling meetings at times and in places appropriate and convenient for women.
- Strengthening female farmer groups, especially those oriented to marketing, so women can achieve scale in that area.
- Improving women's access to markets through expanded mobile networks and mobile phone market information initiatives directed to women and youths in particular.
- Increasing access to credit to relieve female farmers' constraints in buying quantity- or quality-enhancing inputs.[64]

Integrating a gender perspective in agricultural and food value chains

Across Africa, women are represented disproportionately in low-value agricultural chains and in lower-value nodes within these chains.[65] Men tend to dominate functions with relatively high barriers to entry and correspondingly greater returns and to control value chain management functions. This is seen for example in horticultural value chains (such as green beans and cut flowers) in East Africa and in cocoa, coffee, and cotton value chains in West Africa.

One reason rural women occupy lower skilled roles in value chains is their typically lower education and literacy levels. Less education also means that there are few women in management positions, reducing their ability to communicate with buyers and suppliers and limiting their bargaining power.[66] Rural women are also often unaware of what financial services are available or of how to better manage their money through such services—and even if they are aware, they may not have the time or mobility to get to banks that may not be close by.[67]

Many initiatives are focusing on improving agricultural value chains in Africa,[68] including developing new products, adopting new production processes, engaging in further processing or other activities that add value, and selling through new marketing channels. Any of these actions can lead to changes in gender roles and relations (whether they have an explicit gender focus or not): new technologies can shift labor practices, sales of agricultural production can change control over resources, and formalization of transactions can affect intrahousehold financial management.[69]

Policies and practices that move women and others into higher-value opportunities will contribute to a shift to new transformative agricultural systems in Africa, but attention to gender-related effects and constraints will be key to their success. For example, women may shy away from growing higher-value crops due to labor or cash constraints, and if the culture views growing cash crops as a male activity.[70]And because women cultivate smaller plots than men, own much less land, and have weaker land tenure rights, they may be less motivated to make investments in cash crop cultivation.[71]

Gender perspectives in citrus value chains in Ghana and sweet potato value chains in Kenya suggest three areas that are particularly relevant for improving women's circumstances: money management, business practices, and value chain relationships. When women were paid directly for their output, they were more likely to adopt new practices and better value chain strategies (box 8.10).

A review of gender issues in agricultural value chains suggests the following steps help:[72]

- Linking mobile money to savings accounts and other bank services, to increase women's banking.
- Introducing or expanding payment systems that target women as individual contract farmers or as joint farmers with their husbands, payment accounts that are linked to savings accounts or loans, and financial education that improves women's financial skills and knowledge of financial services.
- Increasing face-to-face interaction between female farmers and information providers (such as input suppliers and processors), and establishing more formal agreements between buyers and women farmers.

BOX 8.10

Enhancing women's access to income through cellphone money transfer services in Kenya

Payments to sweet potato farmers in Kenya are now made through M-Pesa, a cell phone money transfer service. Women like M-Pesa because it increases their control over their income. Other programs also use M-Pesa to increase women's control over income, such as a carbon-reduction program that pays women for planting trees.

This mobile money service is putting cash (stored on their mobile phones) directly in the hands of women, allowing them to save discreetly and control lump sums for investing in improved agricultural practices.

Source: Sepstad and Manfre 2011.

- Identifying suitable timing and location of group meetings so that women can attend, and using women's networks to disseminate information.
- Reducing the distance between service providers and women to improve women's access to services and inputs and to build trust.

While upgraded infrastructure, logistics, institutions, and information and communication technologies are needed in general to reduce input, information, and marketing costs in agriculture, special efforts are needed to ensure that women are not left out.

Conclusion and policy considerations

Eliminating the many challenges women farmers face can go a long way toward ensuring a more inclusive and sustainable agricultural transformation in Africa. Women in Africa's agriculture are more likely, relative to men, to face significant barriers in accessing and using modern inputs. While several possible solutions have been put forward, it seems that bundling several inputs together may help ease some of the most severe constraints.

Women's weak asset ownership is often a binding constraint. Policymakers should focus on policies and actions that would ease access to, control of, and ownership of natural, physical, financial, human, and social capital. Obviously, these five capitals are interlinked, and striking the right balance in influencing them requires smart policymaking and likely some tradeoffs. So, research, technological inputs, and agricultural machinery should take into account the needs and preferences of women.

Agricultural transformation may lead to outcomes that could be biased against women either by excluding them from participating or by increasing the gender gap in other areas. The right policy actions can mitigate at least three pernicious effects.

First, in many countries, agricultural transformation will lead more men than women to move to urban areas and nonfarm employment, creating an opportunity for unemployed women to gain paid employment in agriculture. While this may be beneficial in having access to paid work, the danger is that it might increase the gender gap in income and asset ownership and contribute to the feminization of agriculture.[73] Several policy actions —some discussed in this chapter—could eliminate or at least mitigate these potential adverse effects. Examples include making land ownership laws gender inclusive and facilitating women's access to productive inputs, especially credit.

Second, in some countries, agricultural mechanization may be biased against women because of social norms or because educational requirements to use heavy or sophisticated machines are very high.[74] Policymakers can address these impediments through education and skill development. They can also "work around the behavioral effects of social norms,"[75] for example, by using female peer-farmers in extension services and training and women as role models in radio and television programs and transformation campaigns.

Finally, in most African countries, women tend to participate much less in commercial agriculture than men, and agricultural transformation may make this worse, especially given women's low participation in contract farming and in farmer organizations, and this may persist or even get worse with agricultural transformation, increasing the associated gender gaps. Policy recommendations include changing laws and regulations governing contract farming and farmer organizations—for example, by instituting minimum quotas for women in leadership positions in farmer organizations and in contract farming arrangements. Even more important is training women on how to market agricultural output.

Notes

1. This chapter is based on Kristjanson (2016).
2. Ali et al. 2015.
3. Backiny-Yetna and McGee 2015.
4. FAO 2011, for example.
5. Quisumbing et al. 2014a, for example.
6. Doss 2015.
7. FAO 2011.
8. IFPRI 2014; Twyman et al. 2014.
9. Bourdillon et al. 2007.
10. Quisumbing and Pandolfelli 2010.
11. Peterman et al. 2010.
12. Quisumbing and Pandolfelli 2010.
13. Scoones 1998.
14. Meinzen-Dick et al. 2011a; Aberman et al. 2015.
15. Gilligan et al. 2015.
16. Njuki and Millar 2012; Njuki 2011.
17. Johnson et al. 2015.
18. Agarwal 1994; Doss 2013; Allendorf 2007; Meinzen-Dick et al. 2011a, 2011b; Quisumbing and Maluccio 2003.
19. McIntyre et al. 2010.
20. Johnson et al. 2015.
21. IFPRI 2014.

22. IFPRI 2014.
23. Perez et al. 2015; Ragassa et al. 2012; World Bank and IFPRI 2010; Ragassa 2014.
24. Twyman et al. 2014 ; Perez et al. 2015; Bernier 2016.
25. Colverson 2015.
26. Buehren et al. 2013.
27. Kiptot, Franzel, and Degrande 2014.
28. Kirui et al. 2015.
29. http://www.africaknowledgezone.org/.
30. Van Campenhout 2013.
31. Khaila et al. 2015.
32. Lukuyu et al. 2012; Kugonza et al. 2015.
33. Kondylis and Mueller 2013.
34. World Bank/ONE.2014.
35. Benyishay et al. 2014; Khaila et al. 2015.
36. Ragassa et al. 2012.
37. World Bank/One 2014 and Davis et al. 2010.
38. Davis et al. 2010.
39. Farnworth and Colverson 2015.
40. Bernier et al. 2015.
41. Gilligan et al. 2015.
42. IFPRI 2014.
43. Appleton 1995.
44. World Bank 2015a; Duflo, Kremer, and Robinson 2009; Seidenfeld et al. 2014.
45. Perez et al. 2015; Jost et al. 2015.
46. IFPRI 2014. Similarly, a nutrition project in Burkina Faso narrowed the gap by choosing two distinct beneficiary groups to deliver advice on agriculture and improved nutrition practices: groups of influential older women leaders, and village farm leaders, made up of both men and women leaders.
47. Quisumbing and Kumar 2014.
48. Doss, Meinzen-Dick, and Bomuhangi 2014.
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CHAPTER 9

Harmonizing Intensification, Sustainability, and Climate Change

Raising the productivity of Africa's farms will require more intensive use of modern inputs such as fertilizers and other chemicals, irrigation, and machinery and more widespread continuous cropping. But such agricultural intensification could further damage the environment and exacerbate land degradation. In addition, the drive for greater intensification must also consider the potential impacts of climate change.

Some of the extreme environmental consequences of unsustainable intensified use of resources include irreversible soil degradation, erosion, nutrient and organic matter depletion, water contamination, and loss of biodiversity and forests.[1] Any attempt to transform agriculture could prove counterproductive unless the potential feedback effects of these factors on productivity are taken into account.

While agricultural intensification has the potential to boost productivity, climate change may undermine—or in some cases enhance—its effectiveness. Although agriculture in Africa is expected to be adversely affected by climate change, not all agricultural subsectors will be hurt or hurt equally. One study found that climate change will reduce revenues from agricultural activities more in drylands and in the livestock sector than in irrigated agricultural production.[2] And climate change impacts will differ across crops. For example, while tubers and root produce such as yams may see a 19%–33% productivity loss, carbon-4 (C4) plants such as maize, sugarcane, millet, and sorghum may show an increase because higher carbon dioxide in the atmosphere will improve photosynthesis.[3] Geographic differences in climate change impacts are also likely: by 2100, agricultural gross domestic product (GDP) losses are expected to be greater in West and Central Africa (in the range of 2%–4%) than in North and Southern Africa (0.4%–1.3%).[4]

This chapter identifies agricultural intensification practices that maximize productivity while safeguarding the environment and responding to threats posed by climate change. The chapter first discusses the determinants of agricultural productivity (or intensification) and highlights the potential negative impacts of these contributors to higher productivity on environmental sustainability. It then suggests how the potential negative (or positive) impacts may be attenuated (or scaled up).[5] It also reviews ways to adapt to climate change as agriculture intensifies, looking specifically at the influence of anticipated climate changes (precipitation and temperature) on the effectiveness of the various intensification practices. The chapter closes with a discussion of promising approaches that are already being implemented and of the role that policymakers and development partners can play in scaling them up.

Determinants of agricultural intensification and their impact on the environment

This section focuses on how four factors—fertilizer, irrigation water, seed variety, and machinery—that physically influence productivity might affect the environment (for good or ill), and on possible responses.

Application of fertilizers

Soil fertility management consists mainly of the application of inorganic and organic fertilizer to enhance soil fertility by increasing plant nutrients and improving the soil's structure and water retention capacity. Countless analyses have shown the positive impact of such practices on yields. However, one key holdback to fertilizer's impact is the initial soil fertility level, which in many smallholder farming systems in Sub-Saharan Africa differs greatly at the farm and agroecological zone level, leading to differences in the crop response to fertilizer and organic-nutrient resources.[6]

As inorganic fertilizers are manufactured from extracted nonrenewable resources, higher fertilizer demand and use will hurt the ecology in the area where its components are extracted (as in Morocco, the world's second-largest producer of phosphate). In addition, over-application or improper placement of fertilizer on farms can contaminate surface water and groundwater. Eutrophication—excessive quantity of nitrogen, phosphorus, and other fertilizers in a body of water—induces excessive algal and aquatic plant growth and can lead to further loss of biodiversity and fish stocks, degrade water quality, and affect the recreational value of beaches. Eutrophication was one of the drivers of the growth of water hyacinths in Lake Victoria in East Africa,

which eliminated more than half the 500-plus species of endemic cichlid fishes.[7] Nearly half the nitrogen applied worldwide (36 million tons of 78 million) is lost annually to the environment through leaching, erosion, runoff, and gaseous emissions.[8]

"Fertigation"—the injection of fertilizers, soil amendments (such as compost and manure), and other water-soluble products into an irrigation system (mostly drip)—is a potential solution to the inappropriate use of fertilizers that damage the environment. However, while fertigation is widely used in large-scale horticultural production in places such as Ethiopia, Kenya, and Uganda, the infrastructure is too expensive for smallholder farmers. Instead, small farmers can use microdose fertilizer application—applying small, more affordable quantities of fertilizer using a bottle cap, either during planting or as a top dressing three to four weeks after crops emerge.[9] Microdosing technology has been developed by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and its partners to help subsistence farmers in the Sahel improve inorganic fertilizer application and minimize environment impacts.

Agricultural water management

Agricultural water management involves the application of water resources to increase agricultural productivity and prevent reductions in productivity caused by droughts and high temperatures. Instruments for agricultural water management include irrigation, drainage, water harvesting, soil and water conservation, agronomy, and integrated watershed management. Managing agricultural water use is especially important in drylands (lands with an aridity index of 0.65 or lower), which cover three-quarters of Sub-Saharan Africa's agricultural land area.[10] The drylands include arid, semi-arid, and dry subhumid areas; they experience severe water stress that increases the need for irrigation and other water management practices. The drylands are home to more than half of Africa's population of 1.2 billion and to a substantial share of the region's population living below the international poverty line (US$1.90 a day). The arid lands support more than 80% of Sub-Saharan Africa's livestock population. These conditions underscore the importance of enhancing agricultural water management as part of Africa's agricultural transformation strategy.

Despite the important benefits to agricultural productivity from irrigation, only 4% of Sub-Saharan Africa's total cropland area is irrigated, with the highest share in Southern Africa.[11] Across Africa, only 20% of irrigable area in the drylands is equipped for irrigation, and the rate of expansion of new irrigation is only about 1% a year (chapter 3).

Although returns to irrigation are high, irrigation infrastructure usually damages natural ecosystems by disrupting water flows and increasing erosion. Excessive irrigation increases the rate of mineral weathering of the soil and can transport and leach soluble and colloidal material.[12] Irrigation using groundwater may cause soil and water degradation through water logging and salinization and may accelerate other types of groundwater pollution.

Small irrigation systems linked to reservoirs for harvesting surface water have been introduced in places such as Mount Kilimanjaro in Tanzania, where smallholder farmers face increasing risks of uncertain rainfall. These systems reduce evaporation by using closed underground irrigation pipes in place of the traditional open-furrow systems used in most rural areas. In Tanzania, training accompanied the introduction of the new infrastructure, to strengthen the ability of the local water users association to maintain the infrastructure through user fees and to manage their members' contributions. The increased revenues expected from the closed pipe system would pay for the cost of building the system within 8–10 years, according to a cost-benefit analysis (using a 5% discount rate).[13]

The positive environmental impacts of the closed-pipe system are also important. The underground pipes dramatically reduce water evaporation from ambient air temperatures. Water user associations also ensure that farms are watered when the temperature is low, which further reduces evaporation. In addition, the water harvested in these reservoirs minimally affects the ecology that used to depend on it because of the reservoirs' relatively small size.

Adoption of improved seeds

The productivity-enhancing potential of improved seeds depends not only on the development of appropriate varieties but also on programs that multiply and market the seeds to ensure quality, availability, and affordability (chapter 3).

The adoption of disease- and pest-resistant seeds lowers the need for pesticide use, as with genetically modified cotton (Bt-cotton), and reduces the pressure to expand agricultural land since farmers can get more from the land they are already planting. On the negative side, adopting improved varieties can lead to environmental disruption, as the use of hybrids and other improved crop varieties contribute to a loss of agricultural biodiversity in native varieties (landraces).[14] This has caused genetic drift (change in the frequency of different genotypes in a small population) and disturbed natural selection, increasing crop vulnerability to stresses.[15]

Because farmers know which varieties are economically and socially important in their community, plant breeders should consult with them on their evaluations of new varieties based on local knowledge and preferences. Such a participatory arrangement will reduce unintended disruption to the local ecological food chain. It will also enable public research systems to fine-tune new seeds to existing conditions and farmers' preferences, which will increase adoption rates while minimizing environmental impacts. This approach differs from the current system, which creates commercial networks to ensure that farmers must buy seeds rather than multiply and distribute them on their own, with few environmental protection measures.

Mechanized agriculture

Mechanization is a key component of the technology that allows agricultural production to be intensified.[16] When more land has to be brought under cultivation to meet increased market demand, or when existing land has to be more intensively cultivated (requiring more labor per unit of land), mechanized plowing and harvesting are more likely to be adopted. For this reason, the dynamic relationship between land and labor (changes in the land–labor ratio, in particular) that is part of the intensification process is another key factor influencing mechanization.[17]

While improper use of plows and other farm equipment could further disturb soil structure and cause waterlogging, erosion, and soil degradation, proper use can reduce greenhouse gas emissions and improve the efficiency of nutrient use. By properly covering manure, farm machinery can reduce methane emissions,[18] and by properly placing and covering inorganic fertilizer, farm machinery can reduce nitrous oxide emissions.[19] Two-wheeled tractors are ideal tillage tools that meet the plowing demands of farmers while promoting soil conservation. They are relatively affordable and, with a little government support, can be assembled, if not manufactured, locally.

Climate change and agricultural productivity in Africa

Climate change will bring opportunities and challenges to African agriculture through its effects on precipitation and average temperatures, and its influence on the effectiveness of agricultural intensification measures.

Effects of climate change impacts on precipitation and temperature

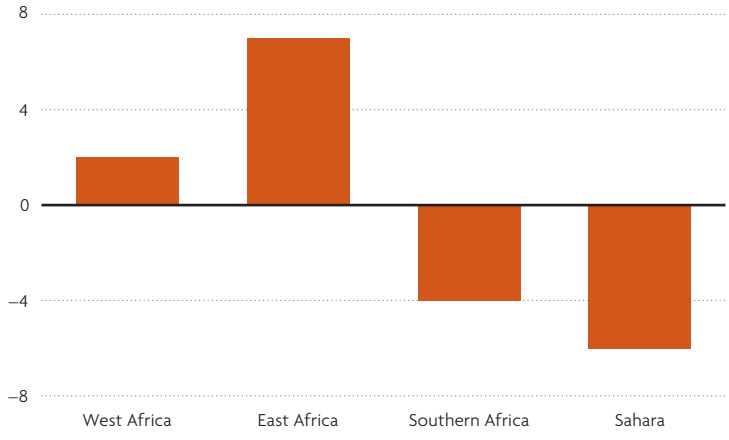
As the effects of climate change build, humid and subhumid areas in Sub-Saharan Africa are expected to receive higher rainfall, while the drier areas are likely to experience less—and more erratic—rainfall.[20] A simulation using a set of 21 global models showed that East Africa will experience a 7% increase in precipitation in 2080–2099 relative to 1980–1999.[21] The increase will be more evident around the Lake Victoria basin. West Africa's humid and subhumid zones will see a 2% increase in precipitation, while the Sahara subregion will see a 6% drop (figure 9.1). New opportunities could open up for farmers in the areas experiencing an increase in precipitation, allowing them to produce crops that would otherwise be impossible to grow.

Temperature is expected to increase across Africa,[22] which could undermine the positive effects of increased precipitation by accelerating evaporation in East Africa and parts of West Africa. While higher temperatures are generally expected to lower productivity by reducing soil water content, they may benefit farming at higher altitudes by prolonging the growing season, reducing the amount of time needed for crops to mature, increasing the survival rate of young animals, and generally raising livestock productivity.[23]

Cereal crops are a key to adapting to climate change because the increased carbon in the atmosphere will improve their productivity (enhanced photosynthesis due to higher levels of carbon in the atmosphere, known as carbon fertilization), although higher temperatures and greater variation in rainfall are expected to outweigh the positive impact of carbon fertilization in some parts of the world. By 2080, a consensus estimate of six climate

FIGURE 9.1 Average projected change in precipitation due to climate change between 1980–1999 and 2080–2099, by African subregion

Percent change



Source: Extracted from Christensen et al. (2007).

models and two crop modeling methods—assuming a 4.4°C increase in temperature and a 2.9% increase in precipitation—finds that global agricultural output potential is likely to fall by about 6%, or by about 16% without factoring in the positive effect of improved photosynthesis from increased carbon in the atmosphere.[24] The potential agricultural output decline ranges from 10% to 25% among the world's regions.

By 2080 across Africa, as climate change progresses, cereal output potential could fall by 16%–27% on average and by up to 60% in some countries, depending on the effect of carbon fertilization (map 9.1). These effects are in addition to general water scarcity and changes in rainfall patterns.

The influence of climate change on the effectiveness of agricultural intensification

The following assessment considers mainly the direct impacts of climate change on the four determinants of productivity just discussed, not the indirect effects such as disturbance of natural selection, which require more sophisticated modeling that is beyond the scope of this chapter.

Application of fertilizer. If water shortages intensify, that could undermine the effectiveness of fertilizer application. An experiment on maize in Niger found that the grain yield response to nitrogen differed with the level of the water deficit and with the level of nitrogen application.[25] Under conditions of water shortage (low rainfall), yield reductions were much more severe at high nitrogen rates. This implies that areas where climate change causes a decline in precipitation will experience a greater reduction in fertilizer effectiveness, holding everything else constant. In addition, if fertilizer is not applied at the right time, increases in rainfall could also reduce the effectiveness of fertilizers by washing them off the soil before they have a chance to nourish plants.[26] And because fertilizer requires the correct amount of water at the right time to work effectively, temperature increases will also reduce the effectiveness of fertilizers by increasing the evaporation rate. For carbon-4 crops, however, which will be affected by countervailing forces, it is difficult to draw any conclusions about the impact of temperature change on fertilizer effectiveness.[27]

Irrigation infrastructure. Official records for irrigated areas in Sub-Saharan Africa show that full-control surface water irrigation accounts for more than half of the total irrigated area of 7.1 million hectares (figure 9.2), including mainly publicly funded irrigation schemes.[28] Performance of these irrigation systems is poor, as 20% of the developed area is no longer cultivated.[29] Irrigation's contribution to raising productivity in Sub-Saharan Africa is expected to decline with the anticipated reduction in annual rainfall.[30]

The effectiveness of irrigation under climate change is likely to vary across African subregions. Irrigation effectiveness is expected to be enhanced in East Africa and parts of Central Africa and in the humid and subhumid zones of West Africa, but reduced in Southern African because of diminished rainfall. However, the overall effectiveness of irrigation may be weakened by a higher rate of water evaporation, especially for open furrow irrigation, as a result of expected higher temperatures across the continent.

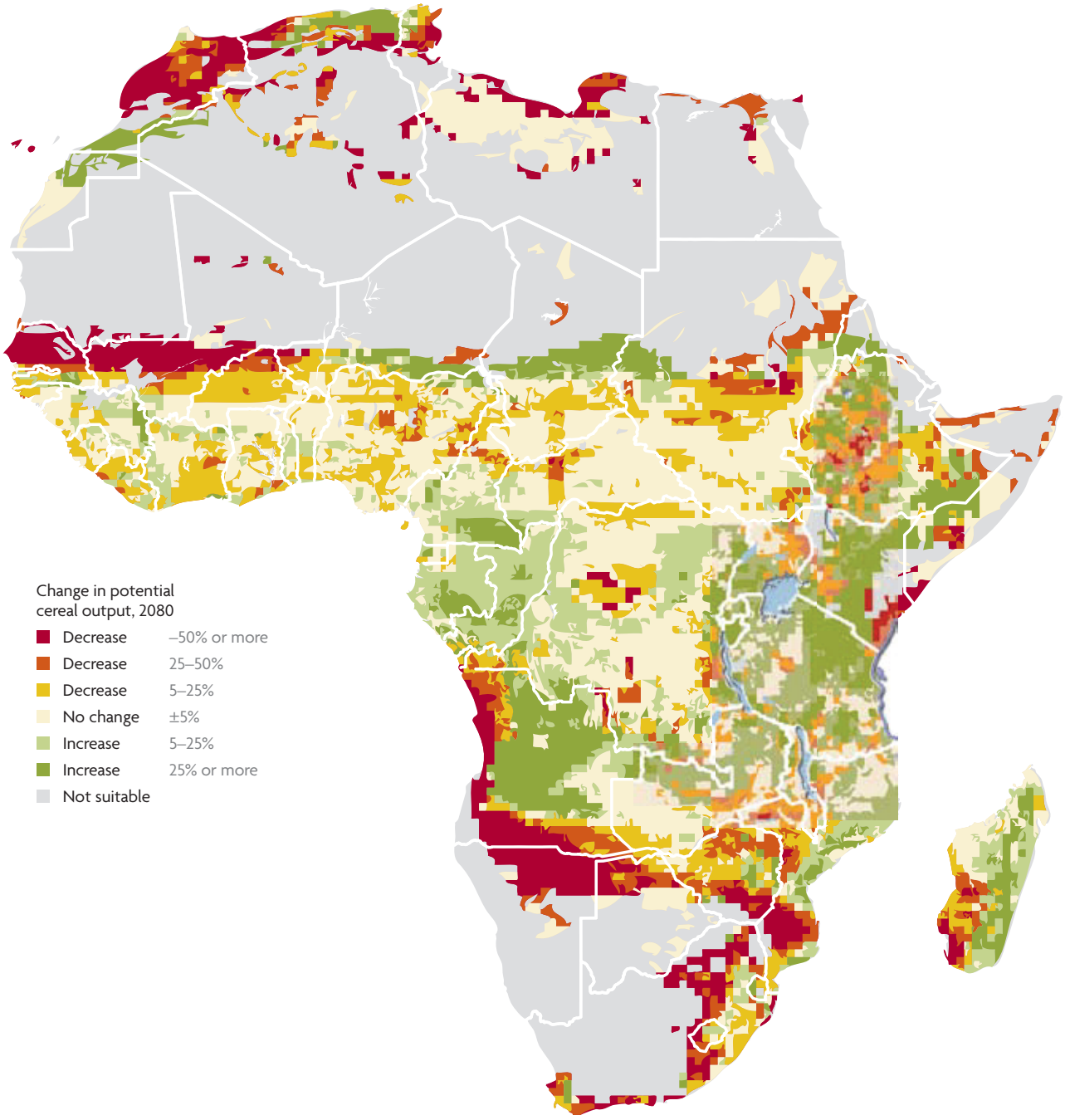
Adoption of improved seeds. The impact of climate change on improved seeds is ambiguous. Seeds are constantly being improved to increase crop resilience to shocks associated with climate change, such as water stress and temperature change. Nonetheless, if climate change effects are severe enough, they may undermine the effectiveness of drought-resistant seeds. Improved seeds that strengthen crop tolerance to flooding appear to be less needed. While such tolerance could be useful in places where flooding is likely, it would be useless everywhere else, as this type of seed would not be suitable for areas that do not flood or are far from water.

Mechanization. Dry conditions caused by both water shortages and higher temperatures (evaporation) can make plowing more difficult. Plowing may therefore require more machine effort, which would raise the cost of mechanization. For farmers who can already barely afford to mechanize, higher costs would mean forgoing or limiting the use of machinery for plowing and increasing the use of hand hoes. A hand hoe does not lead to the land-degrading soil disturbance and compaction experienced in highly mechanized farming,[31] but by increasing the drudgery and the need for labor, it could constrain farmers' adoption of some land management practices that lead to higher yields and adaptation to climate change.

Making agricultural intensification environment-friendly and climate-smart

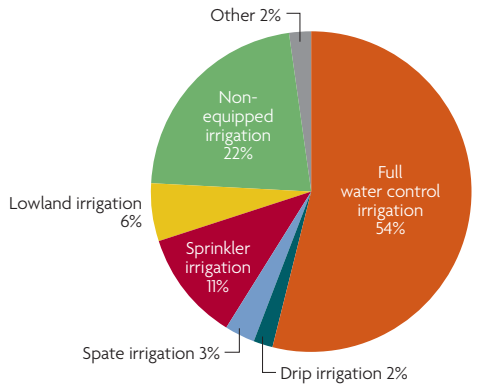
African countries and countries with conditions that are comparable to those in Africa have adopted solutions that can sustainably increase productivity while adjusting to the effects of climate change and preserving the

MAP 9.1 Projected impact of climate change on cereal output in Africa in 2080



Source: Fischer 2009.

FIGURE 9.2 Distribution of irrigation types in Sub-Saharan Africa



Source: Nkonya, Mirzabaev, and von Brau 2016.

environment. This section examines some of these scalable solutions and identifies the appropriate enabling environment needed to scale up these solutions elsewhere. Table 9.1 summarizes the issues and proposed solutions.

Identifying scalable solutions

Coordinating crop and livestock production to reduce need for inorganic fertilizers. Complementing the use of inorganic fertilizers with organic fertilizer should be encouraged to mitigate the greater adverse environmental impact of inorganic fertilizers and the potential impacts of climate change on the effectiveness of fertilizers in general. However, the use of organic fertilizers, especially farm produced, requires strict coordination of crop-production and livestock-raising activities that can be a deterrent to most farmers.

The details of such coordination will necessarily vary by country, subregion, and even community. More research is recommended on the appropriate coordination model for crop production (cash crops and food crops) relative to livestock raising (large or small ruminants and poultry). One study, however, presents some ideas from a new maize-based farming system in the highlands of Kenya:[32]

- Use stall-fed cows (not grazed cows), so all dung and urine can be collected. Intercrop feed crops for stall feeding with maize, to which manure or compost from stall-fed cows is applied.

TABLE 9.1 Increasing agricultural productivity while protecting the environment and mitigating climate change—an overview

Determinants of intensification	Environmental impact	Potential climate change impact	Solutions used elsewhere	Enabling environment factors
Fertilizers	• Nonrenewable resource mining to manufacture fertilizers • Eutrophication	• Heavy rain will wash away applied fertilizers • Drought will reduce fertilizer effectiveness	• Appropriate mixed crop production–livestock raising model to maximize home organic fertilizer production; greater access to weather information	• Research to identify the appropriate model • Extension officers equipped to disseminate knowledge
Irrigation	• Rise in water table • Water logging • Alteration of soil structure • Soil erosion	• Drought will reduce availability of irrigation water • Higher temperatures will increase water evaporation, especially for open-furrow irrigation	• Small, closed underground pipe irrigation infrastructure managed by a multifunctional water users association	• With the irrigation infrastructure identified, the most important enabler is a well-functioning water user association
Improved seeds	• Lowered use of pesticides and less pressure on land expansion • Loss of agricultural biodiversity	• Ambiguous, but higher incidence of drought may reduce the effectiveness of drought-resistant seeds, while higher incidence of floods may make improved seeds irrelevant	• Seed multiplication and distribution models that include a public–private partnership with a development partner or private seed company can reduce the commercial risks faced by seed companies • Public partner also provides extension services, including sustainable agricultural practices	• Flexible agricultural seed policy that provides the necessary guidance for engaging private actors • Work groups for addressing inefficiencies not foreseen by the policy
Mechanization	• Inappropriate tillage intensity releases more carbon into the atmosphere • Mechanization can be used to properly place and cover synthetic fertilizer, reducing nitrous oxide emissions and increasing nutrient use efficiency	• Dry conditions caused by water shortage and higher temperatures will make plowing harder, requiring more machinery and increasing cost of mechanization	• Small, multipurpose, and inexpensive power sources, such as two-wheeled tractors • Promotion of energy saving/environmental conservation/climate-resilient approaches such as conservation agriculture	• A commercially oriented agriculture sector • Development of repair services of machinery • Removal of tariffs on imported spare parts

Source: Authors' analysis.

Climate-friendly agriculture

REDUCING THE NEED FOR INORGANIC FERTILIZERS

INTRODUCING MORE ENVIRONMENT-FRIENDLY IRRIGATION SYSTEMS

COUPLING CONSERVATION AGRICULTURE WITH TWO-WHEELED TRACTOR USE

- Use dairy cows that are cross-breeds between European and indigenous cows, as they produce more milk and manure than indigenous varieties.
- Plant high-yielding hybrid seeds on most of the maize fields.

This system helps build farm resilience to extreme weather events caused by climate change. Beyond enabling the use of less inorganic fertilizer, using organic fertilizers, with their rich soil-nutrient content, will increase the soil's water retention capabilities.

Introducing more environment-friendly irrigation infrastructure and improving irrigation system governance. Irrigation is important to transforming Africa's agriculture, but irrigation infrastructure usually damages natural ecosystems. To minimize these adverse impacts, environment-friendly structures have been introduced (see the example above from Mount Kilimanjaro in Tanzania in the section on agricultural water management). These and other irrigation systems also need proper governance of the infrastructure, often through strong local water user associations, to reduce market failures, including the need to raise irrigation user fees to reflect higher costs resulting from changing weather patterns.

Coupling conservation agriculture with two-wheeled tractor use. Conservation agriculture entails land management practices that reduce soil disturbance, maintain permanent soil cover of at least 30%, and diversify crop species in a given area over time. It covers practices adopted to sustainably intensify agriculture in light of climate change risks, including combinations of tillage intensity, cover crop, manure application, crop rotation patterns, and residue application.[33] Applied successfully, conservation agriculture practices can bolster a community's resilience to risks today and ensure its food security in the future. Further, by improving the organic content of the soil, conservation agriculture increases the soil's water-retention capacity, thus easing the water constraint that many smallholder farmers face.

Based on information from 15 Sub-Saharan countries that reported conservation agriculture adoption rates, only about 1.5% of cropland area is under conservation agriculture.[34] Lack of appropriate implements to seed to the right depth with minimum soil disturbance is one of the major constraints for African smallholders,[35] especially as labor-intensive drudgery leads African youth to favor nonfarm activities.[36] For these reasons, tying the promotion of technologies in energy saving, environmental conservation, and climate resilience such as

conservation agriculture to the promotion of small, multipurpose, and inexpensive power sources such as two-wheeled tractors could be the most appropriate model for mechanizing agriculture and promoting conservation agriculture in Africa.

Creating an enabling environment for scaling up

In light of the effectiveness of the scalable solutions described above, policymakers might consider the following actions to foster the appropriate enabling environment for scaling up.

Increasing access to agricultural extension and other advisory services. Famers' access to agricultural advisory services on the cost and benefits of intensification tools is key, yet extension services are not well equipped to inform farmers about appropriate farm management practices.[37] Conventional extension services in Sub-Saharan Africa have weak capacity to provide advisory services on climate change, organic soil fertility management practices, and other environment-friendly land management practices. Not surprising then, according to a study in Kenya, Niger, Nigeria, and Uganda, is that one reason farmers fail to adapt to climate change even after noticing its effects is a lack of knowledge of adaptation strategies.[38] Receiving timely and accurate information alleviates some of the uncertainty about the outcome of farm management practices and may influence farmers to adopt them.[39]

Short training in climate change adaptation, conservation agriculture practices, and environmental protection are required to increase the capacity of advisory services on these fairly recent knowledge sets. As governments may lack the resources to fully fund such training, they could consider establishing a public–private partnership with an active input provider that has a network of dealers. That could leverage the existing network to deliver extension services for a fiscal incentive, such as reducing custom duties paid by input companies on imported inputs. Given the gender imbalance in access to the information needed to adopt appropriate farm management practices, it is important that extension services also use female extension officers to enhance women's access to information.

Building the capacity of water user associations to address tensions between social and commercial roles. The example in Tanzania shows that proper training of members of a water user association is key to the success of a small irrigation system. Many irrigation systems face recurring problems with poor management partly due to tensions (often from conflicting goals and functions) that may jeopardize the association's performance, especially in the long run. The most common tensions are between the social activities and the business functions of the water user association.[40] While the social activities boost membership, they are often achieved at the expense of economic performance.

Dealing with such tensions is a major managerial and organizational challenge for each water user association. The right way to address them depends on individual circumstances. A core requirement is to improve the business management capabilities of the association's leadership. That task could be assumed by a donor or government body that equips the association to manage the infrastructure and revenue, introduce sanctions, and link the irrigation system to service providers and markets.

Designing seed policy and working groups for addressing frictions in implementing policies. The success of seed multiplication initiatives in Kenya and Zimbabwe was due to having a national framework to guide the seed system. That approach ties in with experiences around the world indicating that addressing the infrastructure and other hardware needs of the seed industry in isolation may not be enough to ensure success in developing the industry. Also needed are good policies that guide the actions of government agencies and foster partnerships between the public and private sectors.

Although policies may be well written, frictions often arise when implementing them, especially in the context of environmental protection rules. Policymakers must be alert to such frictions and work to diffuse them through regular dialogue in small working groups with all stakeholders to agree on ways to address policy challenges, especially those that cut across government agencies.

Removing import duties and custom clearance burdens on environment-friendly imported spare parts. Import policies should provide incentives to import environment-friendly machinery and parts. Raw materials for farm machinery and mechanical tools and for completely knocked down and semi–knocked down tractor parts are still subject to full tariffs in many African countries.[41] If there is potential for locally manufactured implements or locally assembled environment-friendly tractors to compete with imports of tractors and parts, governments could encourage the sector by removing or lowering duties on imports of raw materials needed to manufacture such parts.

Notes

1. Lal 2015.
2. Kurukulasuriya et al. 2006.
3. C4 plants follow a carbon pathway that allows them to minimize photorespiration. This process is sometimes referred as carbon fertilization. Srivastava et al. 2012.
4. Mendelsohn, Dinar, and Dalfelt 2000.
5. The chapter focuses less on the determinants, which are discussed in chapter 3, and more on their impacts on the environment.
6. Zingore et al. 2007.
7. Verschuren et al. 2002.
8. Roy et al. 2006.
9. Murendo and Wollni 2015.
10. Morris et al. 2015. Drylands are also defined as areas with an aridity index (AI) of 0.65 or less, where 0 is very dry and 1 is very wet. Drylands fall into four subgroups: hyper-arid (AI 0–0.05), arid (AI 0.05–0.20), semi-arid (AI 0.20–0.50), and dry subhumid (AI 0.50–0.65).
11. You et al. 2010.
12. Murray and Grant 2007.
13. Mulangu and Kraybill 2015.
14. A domesticated regional ecotype; a locally adapted, traditional variety of a domesticated species of animal or plant that has developed over time through adaptation to its natural and cultural environment of agriculture and pastoralism and due to isolation from other populations of the species.
15. Esquinas-Alcazar 2005.
16. Mechanization is a very broad term but here refers mainly to machinery for plowing the soil, with a few references to combine harvesters.
17. Diao, Silver, and Takeshima 2016 (chapter 3).
18. Eagle et al. 2012.
19. Roy et al. 2006; Roberts 2008.
20. Christensen et al. 2007.
21. Christensen et al. 2007.
22. Cline 2007.
23. Aydinalp and Cresser 2008.
24. Cline 2007.
25. Pandey, Maranville, and Admou 2000.
26. Nkonya, Mirzabaev, and von Brau 2016.
27. Nkonya, Mirzabaev, and von Brau 2016.
28. FAO and IFAD 2008.
29. Xie et al. 2015.
30. Christiensten et al. 2007.
31. Schafer-Landefeld et al. 2004.
32. Otsuka and Muraoka 2015.
33. FAO 2014.
34. Kassam et al. 2015.
35. Hobbs, Sayre, and Gupta 2008; Giller et al. 2009; Johansen et al. 2012.
36. Diao, Silver, and Takeshima 2016.
37. Nkonya, Mirzabaev, and von Brau 2016.
38. Nkonya, Mirzabaev, and von Brau 2016.
39. Caswell et al. 2001; McCarthy, Lipper, and Branca 2011.
40. Muradian 2013.
41. World Bank 2014 (chapter 3).

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ANNEX 1

What Global Agribusiness Executives Say About Unleashing Africa's Potential

Africa can play a crucial role in meeting the world's growing demand for agricultural output. But the continent as a whole remains highly food insecure and is still a net importer of food. What will it take to help Africa meet its potential in agriculture? And can it support the expansion of large-scale, commercial farming while at the same time nurturing the growth of smallholder farmers and integrating them into the agri-business supply chain?

To find answers to those questions, ACET interviewed 28 senior executives from a broad range of actors in the agribusiness sector. The interviews provided the opportunity to listen to these executives' experiences in Africa and gather their thoughts and ideas on what is needed to fully unleash Africa's potential.

Some of what the survey set out to discover included:

- What does the agri-business supply chain look like in Africa today?
- What are the current linkages between multinational businesses and smallholder farmers and agribusiness SMEs across the supply-chain? Can they be enhanced?
- What are the constraints to achieving Africa's full potential and how can they be addressed?
- What models/structures are currently working in Africa—and why? Can they be replicated?

The 28 companies participating in the survey are headquartered across the globe—Asia (1), the European Union and the United Kingdom (6), North America (4), Africa, including North Africa (15), and Multinational (2). All have been operating in Africa for 10 or more years.

The companies range in size from sole proprietorships with operations in one country and focused on one product or service to fully-integrated multinational corporations with operations across the globe. They include producers, processors, off-takers such as supermarkets and retailers, service providers, including logistics and packaging, representatives from investment banks and private equity funds, and providers of risk insurance.

High cost business environment

The high cost of doing business in Africa—resulting from the cumulative impact of the constraints and challenges identified—was referenced by all. An oft-cited phrase during the interviews was: "The cost of doing business is too high to be competitive." Only by addressing the individual constraints can African policy-makers lower the overall cost of doing business and make Africa globally competitive.

- "Africa is unpredictable in its unpredictableness." "Would never advise anyone to establish an agricultural business in Africa."

- Another executive recounted walking away from 40 transactions over the last two years when faced with overwhelming government regulations, varying degrees of corruption, poor infrastructure, and the lack of delivery, especially as it related to labor productivity. One of the financial service interviewees, whose company also operates outside of Africa, indicated that the rise of its loan default rate was directly related to its expansion into Africa.

- All the executives interviewed saw tremendous opportunity in the sector if the continent could "... just get it right."

Supply chains

- Supply chain constraints created the greatest hurdles. As one executive remarked: "The chain is only as strong as its weakest link."

- Transparency of the full supply chain was of great importance, especially for those operating in markets outside Africa. Of major concern was the use of counterfeit and/or banned inputs which can undermine the integrity of the entire chain. An example given was E.U. legislation related to pesticides: even the smallest trace of pesticide will cause the entire lot to be rejected. This accounted for one company not working with more outgrowers: It was too difficult to verify and vouch for the integrity of the entire supply chain.

- The lack of availability of spare parts and equipment was also a major constraint, and those available were

mostly sub-standard. Many interviewees sourced equipment and parts from overseas, with delivery taking six months, on average. Companies cannot afford that amount of downtime; one keeps an inventory of US$100,000+ of parts and accessories. Some were able to request colleagues to carry needed equipment with them on an already scheduled trip across, while others have paid prohibitively high prices to express-ship the needed part. As one said, "[You] have to make things last as long as they can … if not longer."

- To address supply chain constraints, many companies were vertically integrating. By controlling the chain from "seed-to-shelf," they can ensure consistency and quality of the goods. As one company pointed-out, by controlling the chain and instituting a ready market for the farmers' produce, the farmers were able to reduce their postharvest losses by at least 40%. Another had established a separate not-for-profit entity to invest in the socio-economic development of rural communities to secure the sustainability of the supply chain.

- Technology was also aiding in supply chain constraints. For example, while Africa is the #1 producer of cassava, it has a virtually nonexistent scalable processing industry due to the need for processing immediately after harvesting. Using simple technologies, including GPS and mobile processing units adapted for the rural environment, one company was able to take the processing to the farmer. Going around on motorbikes, "Mobilizers" for the company visit the farmers and schedule times for them to use the mobile unit, using an iPad. GPS coordinates and all other pertinent data is then entered into the database. The day before, an SMS reminder is sent to the farmer.

- "[We] need to find innovative ways for smallholder farmers to succeed in order for Africa to reach its potential." Across the supply chain, companies were trying to increase their work with local smallholder farmers. Yet at the end-of-the-day, contracts must be fulfilled "by hook-or-crook," and often times, local suppliers were inconsistent, the quality was not up-to-standard or it was difficult to verify the inputs used.

Quality and consistency

- One step in addressing quality and consistency was to provide inputs, including seeds and fertilizers, to the farmers. One company provided financing to nucleus farmers who then provided input credits for seeds, fertilizer, and equipment to the out-growers. Repayment was "in-kind" with the crops harvested.

- To address the problem of "side-selling" (farmers selling product to competitors), companies were directly "selling" the seeds to farmers and providing a list of acceptable inputs, or taking only two-thirds of net production, allowing the farmers to sell the remaining third for their own accounts.

- A number of interviewees indicated that it was difficult managing 200+ small farmers and ensuring consistency. Therefore, many were working through aggregators and with cooperatives.

Skills

- Lack of skills was another major deterrent to working with smallholder farmers. As one interviewee said, "You can grow anything (in Africa) … you just need to improve skills." Workers do not have the technical skills and knowledge specific for the machinery, inputs, and land with which they were working.

- A West Africa–based processor currently sourcing from more than 2,000 local farmers (primarily farming less than 5 hectares) suggested that to increase productivity, farmers needed to have the technical skills and knowledge specific to the inputs (such as seed varieties) and the land (such as size), giving several countries in Southeast Asia as an example.

- Like Africa, typical farms in Southeast Asia are less than 10 acres, yet farmers there have figured out how to produce and develop skills to farm small holdings. For example, because farms are small, the equipment is equally sized. (A typical harvester has a 4m cutting bed; a similar one in the United States has a 12m cutting bed.) To create economies-of-scale, Southeast Asian farmers were aggressively forming cooperatives and trading skills (each farmer focuses on one skill set and one equipment set), with pay in rice produced that can then sold at market prices.

- Companies were increasingly taking the initiative to address the skills gap, providing training to improve productivity and expand farmer capacity. An East Africa–based company built training centers at its

operations. In addition to training local workers, it expanded its classes to include students from neighboring countries.

- Others were working directly with cooperatives. One UK-based company put 2% of gross revenue each year into a fund to benefit cooperative members. Together with the cooperative, they would decide how the funds were disbursed, supporting programs that innovatively addressed the emerging needs of the members. The focus is increasingly on increasing farmers' capacity and skills base, including an educational radio talk show and call-in program for the member farmers.

- There was an increasing recognition that women are doing a large percentage of the agricultural work. However, a chief obstacle to training is the high-level of illiteracy amongst women (85% among women vs. 65% for men.) To address this, one company offers literacy programs in local villages three times a week for 2 hours each session. Another company established 800 women's clubs of 20–25 women that provide training and access to credit. As the executive said, "Women are better credit risks than men, and form better communities of support."

- As the economies grow, there is increased competition for skilled—and unskilled—labor outside agriculture. The growing shortage of agricultural workers is being exacerbated by the aging population of farmers, and the lack of the younger generation to take up farming. When looking for solutions, one suggested making farming more "cool," positioning it as a business and entrepreneurial endeavor. The younger generation needs to see it as a career option.

Logistics

- In Africa, logistics costs are 50%–75% higher than elsewhere due to a logistics gap (the lack of infrastructure, technology, and expertise affecting everything from road networks to payment systems and warehousing facilities). Executives cited lack of infrastructure, adequate power, and poor intermodal transportation networks, especially road and rail, as significantly adding to costs. The lack of cold-chain storage was a particular problem for those dealing with perishable goods. One interviewee said they would export more if logistics were better.

- Given the high costs related to agri-business in Africa, companies are unable to compete in the global marketplace. So, rather than looking at export markets, companies were focusing on local and regional markets—addressing import substitution and working to ensure food security. Of those that did, the majority were exporting nonperishables due to the poor state of logistics and difficulty in border-crossings.

- Many of those interviewed recognized the importance of technology in transforming Africa's agricultural sector. Simple technologies, such as GPS and mobile banking, allow information and resources to flow more smoothly along the supply chain.

- But there were also examples given of more sophisticated innovations such as MagGrow, an Irish company that has a magnetic spraying technology system for the horticulture and arable sectors of the agricultural industry. The magnetized water adheres to the plants, using less water, thus reducing costs and improving yields.

Financing

- Agriculture is a capital-intensive industry, yet investing in agribusinesses is extremely risky. Nonetheless, without adequate financing, Africa cannot hope to meet its agribusiness potential. (One executive succinctly summed up the situation, as "Send fewer consultants and more tractors.")

- Alternative financing options, such as private equity, bring stable, patient growth capital, allowing businesses to gain scale and strengthen operations. Similarly, more established operations can find it difficult to obtain credit; specialty insurance products, such as crop insurance, and political risk guarantees and other risk management solutions provide financers some assurance against risk.

- Early-stage investing into primary agribusinesses is particularly difficult. As one interviewee stated, there is a lot of capital "splashing around at the top-end," but it is not getting down to the people on the ground. On his point, all of the financial sector interviewees were investing higher up on the supply chain. Traditional banks see primary agriculture as "too risky." Alternative sources, such as equity funds, have investment time frames (typically 8–10

years), which are too short for early-stage agribusiness investing.

- Development finance institutions—which have much longer investment spans, more competitive credit terms, and lower internal rates of return requirements—need to take a greater role and be the main investors in primary agribusinesses.

Governance and policy

- Constraints cited were those often heard across industries: over-regulation and regulatory uncertainty, government interference (including price setting), poor leadership, and internal bureaucratic inefficiencies. Specific examples included governments changing the rules of the game and setting minimum prices well above global market prices. One company indicated they could no longer operate profitably, so they closed the business. Another mentioned that after experiencing over US$100 million in annual losses as a result of in-country market reforms they, and other major agricultural companies, were retrenching from Africa.

- Interestingly, whereas corruption was more of an afterthought in a similar survey conducted with manufacturing executives, it figured prominently in this one, and was found across the supply chain—from the raw material producer all the way through to the consumer. One executive recounted having engaged with a dubious transporter and becoming embroiled with problems, including goods stolen and money taken. And yet, as another described, once the local community saw the tangible benefits from the farming operations, versus the promises given by the government, they rallied against the corruption.

- Land availability and distribution was also of concern. Rather than finding ways for sharing land between extractives and agriculture (such as underground vs. strip mining), governments were forcing the sectors to compete. One company cited specifically the lack of land availability as a detriment to attracting the younger generation of farmers. And the constant threat and uncertainty around land redistribution led to producers leaving the countries in which they were operating.

- Lack of regional integration and harmonization was also raised. As one interviewee stated, "Africa is missing a massive opportunity in coordination across the African continent." It was felt that there is a need to look at border crossings holistically: to facilitate trade and reduce bureaucracies across borders in Africa—making it an easier place to do business and stimulate trade between the various African countries.

- Border crossings were currently a "pain," especially trying to keep-up with the plethora of documentation. Other issues included: antiquated technologies and/or incompatible IT systems, incompetent border officials, differing valuations, and corruption. ("You just sit there because... [for no apparent reason].") The World Food Programme estimates there is a 9% loss of perishable goods resulting from the inefficiencies of customs and border officials.

- Of those that export, some viewed international agricultural policies and standards, such as current phytosanitary protocols, as trade barriers.

Currency risks

- Currency exchange risks and the lack of foreign exchange were constraints particularly to producers and processors. The lack of forex was especially difficult given the need to purchase inputs abroad. To address this, companies were taking on debt funding to purchase inputs, which added on 20% or more in cost.

- Added to this was the need to manage the exchange losses related to dollar-denominated debt. Dealing with exchange rates and commodity price fluctuations was especially difficult for smaller companies, since it was not as easy for them to "eat" the increased pricing as easily as bigger companies. Mitigating the loss by forward currency buying and "self-hedging" also proved risky and expensive.

ANNEX 2

The voice of small and medium-size enterprises

In 2015, as part of Gates Foundation–sponsored studies to identify interventions that would effectively raise the income and resilience of agribusiness and create links to the broader economic transformation agenda, ACET interviewed 53 small and medium-size enterprises in five countries—Burkina Faso, Ghana, Kenya, Tanzania, and Uganda—across the agribusiness supply-chain, in the dairy, poultry, sorghum, millet, rice, cassava, and cocoa sectors. Farmers surveyed ranged from the ultrapoor subsistence farmer to the marginal smallholders to the viable small-scale farmers, and to the emergent commercial farmer.

The overall high cost of doing business in Africa was a significant factor, with even more pressure on SME businesses given their lack of capital and sensitivity to price fluctuations.

The availability of financing was a critical challenge for those interviewed. This is most profoundly felt by farmers who are already poor and thus have few reserves to invest in agriculture and rely heavily on savings.

Banks are generally unwilling to lend to the agriculture sector. As a result, the cost of credit is quite high, ranging between 25% and 40%, making it not just unattractive but unaffordable.

The failure of credit markets to finance farmers has seen traders take on the role of financing to some extent. For example, 70% of rice farmers in northern Ghana receive financing from middlemen and traders, using a variety of informal arrangements and contracts as security.

The lack of skills and knowhow was also identified as a major constraint, yet few surveyed had received any type of extension services. Of those who did, 72% had received it from their respective governments.

The studies found that women are paramount to farm production, trading, and processing, especially for subsistence production and artisanal processing. But many of the processing machines were not easily used by women. So, even in women-owned processing centers, a significant proportion of the staff are male because women cannot operate the processing machines.

Female-designated activities also attract a wage 46% lower than that of men. The common explanation was that women's activities are less labor-intensive.

Cooperatives are critical for the SME farmer. Those interviewed identified multiple benefits derived from being a member of a cooperative, including: access to information and extension services (27%); source of finance/credit (23%); capacity building (14%), and ready markets (13%).

Despite this, overall membership remains relatively low as past experience with corruption has left many farmers wary. In Kenya, only 23% of millet farmers participate in a cooperative.

And while contract farming provided an avenue for processors and millers to link with smallholder farmers, the farmers preferred working with processors they know and have a strong relationship with rather than just a generic contract to which they felt no allegiance.

Access to viable, growing markets continues to be a major obstacle for SME farmers. For many, trade is limited due to low production volumes and underdeveloped marketing channels, with farmers more oriented to subsistence farming than supplying the market.

Local traders can bridge the gap between producers and the market. In Kenya and Uganda, they act as logistic providers, interfacing with and managing contracted farmers.

Even so, there continues to be a mutual distrust between farmers and local traders. The traders are demonized as exploiting farmers, paying them a small amount, and charging much more when selling to end-buyers. (Traders argue the costs are justified by the risks, such as poor roads, adulterated products, and spoilage.) For their part, traders are wary of farmers cheating them with unreliable and poor-quality products.

Those with means find alternative avenues for accessing markets. For example, poultry farmers in Kenya enter independent supply contracts with hotels and institutions. But it is difficult for individual farmers to sustain production to meet demand.

The full studies can be found at http://acetforafrica.org/publications/series/promoting-sustainable-rural-transformation.

Agricultural transformation incorporates two main processes. The first is transforming or modernizing farming by boosting productivity and running farms as modern businesses. The second is strengthening the links between farms and other economic sectors in a mutually beneficial process, whereby farm output supports manufacturing (through agroprocessing), and other sectors support farming by providing modern manufactured inputs and services.

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