CHAPTER 2.1

Transforming Africa's Agriculture to Improve Competitiveness

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Agriculture persists as an important sector of the African economy. Although its significance in the economy varies widely across African countries, agriculture remains a vital sector for most countries. It contributes from 2.4 percent of GDP in Equatorial Guinea to 70 percent of GDP in Liberia,[1] providing an average of around 15 percent of GDP for the continent. The declining GDP contribution of agriculture to the economy is a sign of low productivity and limited value addition to agricultural commodities, as the sector provides employment for 50 percent of the labor force (see Chapter 1.1, Figure 4); 47 percent of these workers are women.[2] It is the main source of income for Africa's rural population—estimated to represent 64 percent of the total. Africa's agriculture is dominated by a variety of staple food crops (maize, rice, sorghum, millet, cassava, yams, sweet potatoes, etc.) and a few traditional cash crops (coffee, cotton, cocoa, oil palm, sugar, tea, and tobacco). The sector is also characterized by a high percentage of smallholder farmers (80 percent) cultivating low-yield staple food crops on small plots with a minimal use of inputs. These farms depend on rainwater, thus subjecting production to the vagaries of the weather.

Despite its importance, agricultural productivity remains dismal, undermining Africa's overall productivity and food security. The sector's productivity in Africa considerably lags other developing regions (see Figure 1 for cereal yields; see also Chapter 1.1, Figure 5a) and, unlike other regions, Africa has not benefited from the green revolution.[3] In spite of its vast natural resources, including a huge expanse of arable land, Africa has the highest incidence of undernourishment (estimated at almost one in four persons) worldwide. Africa imports food staples valued at about US$25 billion annually, essentially because food production, supply, and consumption systems are not functioning optimally. The level of value addition and crop processing of agricultural commodities is low and post-harvest losses in sub-Saharan Africa average 30 percent of total production, meaning that the region loses over US$4 billion each year.[4]

Moreover, the poor performance in agriculture undermines poverty reduction and inclusive growth. Despite its fast economic growth in the last two decades, poverty reduction in Africa has remained limited. *The Millennium Development Goals Report* finds that the share of people in sub-Saharan Africa living on less than US$1.25 a day slightly decreased, dropping

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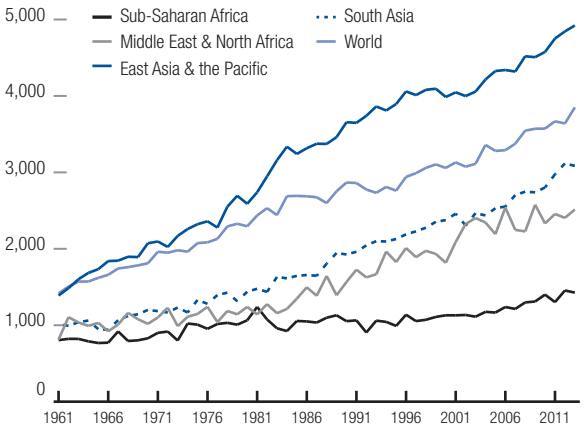
Figure 1: Cereal yields by region, 1961–2013
Kilograms per hectare



Source: World Bank, 2015.

from 56 percent in 1990 to 48 percent in 2010.[5] The limited decrease in poverty is partly the result of the fact that growth has been driven mostly by low labor-intensive sectors such as mining, while agriculture played a minor role. A substantial body of the literature finds that agriculture-led growth has greater impact on poverty reduction than non-agriculture-led growth.[6] The agriculture sector is a key to achieving inclusive growth because, in Africa, it consists mostly of smallholder farmers, the majority of whom are women.[7] With higher agricultural productivity; gender-equal access to land, seed, and fertilizer; and overall better performance in rural economies, growth will reach the most disadvantaged—namely women and youth. However, considerable effort is needed to ensure that institutions and mechanisms for inclusion are put in place, while at the same time pushing toward the development of large commercial farming.

The slow productivity growth in agriculture is also constraining Africa's structural transformation process and economic diversification. As reported in several studies on structural transformation, reliance on subsistence production and weak productivity growth in the agriculture sector prevents the workforce from moving out of this sector into manufacturing and services.[8] Globally, countries that have developed successfully are those that have shifted their resources from agriculture to manufacturing.[9] However, as indicated in Chapter 1.1 Figure 4, this is not the case for Africa, where labor tends to move more into services, in particular trade, rather than into the manufacturing sector. Given the low productivity in services and the prominence of the informal service sector, this current pattern of structural transformation will not yield sustainable income growth for the majority of people nor will it lead to economic development.[10] Inclusive growth and higher income for the majority requires higher productivity in labor-intensive sectors, including agriculture. As outlined in its 10-year strategy 2013–22,[11] the African Development Bank (AfDB)—the first and overarching objective of which is to promote inclusive growth—will pay particular attention to agriculture and food security, to fragile states, and to gender.

This chapter presents the ingredients needed to transform Africa's agriculture in order to make it more competitive. The next section explains the missed green revolution in Africa and draws lessons for the continent from Asia's experience. The following section analyzes the mechanisms for productivity improvements, with a particular focus on the role of information communication technologies (ICTs) in agriculture and the importance of land reforms. It also considers the opportunities and challenges of biotechnology for facilitating a quantum leap in productivity. The next section considers the role of value chains in unlocking markets for smallholders, who make up the bulk of agriculture producers in Africa. It begins with a discussion of Africa's positioning and potential within global and regional value chains and then addresses the means for creating a conducive environment that fosters greater value chain integration. The chapter then outlines the AfDB's recent and planned future support of the agriculture and agribusiness sectors to enhance both inclusiveness and competiveness. Conclusions and policy recommendations are then discussed.

IMPEDIMENTS TO AFRICA'S GREEN REVOLUTION

The green revolution benefited most regions of the world, particularly East Asia, as it resulted in regional food surpluses within 25 years. Asia benefited the most, with significant increases in cereal yields (Figure 1); in East Asia and the Pacific, for instance, cereal yields almost quadrupled between 1960 and 1990. Driven by the political will to make their countries food self-sufficient, Asian countries doubled cereal production between 1970 and 1995, while the total land area cultivated with cereals increased by only 4 percent.[12] Drawing lessons from India's experience, this success has been attributed to several factors.[13] First, the adoption of high-yielding seed varieties resulted in a substantial increase in food grain production, particularly wheat and rice. Second, the use of pesticides positively contributed to increased yields, albeit at the expense of the environment, discussed later in this chapter. Third, the availability and expansion of agricultural infrastructure facilities such as irrigation facilities, machinery, extension services, and broader infrastructure facilities—including transport and communication as well as storage and warehousing facilities—further supported the green revolution. Fourth, the expansion of better crop and soil management techniques, including multiple cropping practices, fostered the advance of the green revolution. Fifth, agricultural credit and land reform were crucial ingredients that enhanced agricultural productivity. Short-term credit facilities were provided by cooperative

banks, while long-term credit was provided by development banks. This was done together with land reforms aimed at consolidating land holdings and giving farmers security of tenure, thereby enabling farmers to access credit facilities.

However, the green revolution is more than a technology fix, and a supportive economic and policy environment remains vital to its success. Addressing the need for functioning markets to handle the surge in production went hand in hand with addressing the need to educate farmers about the new technology and to ensure that they both have access to inputs and receive a fair reward for their investments. In addition, government interventions were crucial to ensure that small farmers were included rather than left behind.[14] For instance, Asian governments formulated various pro-small farms policies including policies relating to credit, incentive prices for crops, and subsidized input prices. Consequently, the green revolution successfully reached poor and remote rural population on the Asian continent.

In contrast, Africa did not benefit from the green revolution. Figure 1 reveals that cereal yields in Africa have been virtually constant during the period 1960–90. This lack of progress—together with factors such as high population growth, policy distortions, weak institutions, poor infrastructure, extreme weather events, and political instability—explains why African countries are still dependent on food imports. While Asian countries largely increased cereal yields per hectare, African countries mainly expanded the area cultivated to enhance production. The increase in the land area cultivated, coupled with poor crop husbandry, resulted in extensive environmental problems such as nutrient mining; desertification; degraded soils; and loss of forests, wetlands, and pastures. Moreover, this poses a challenge to Africa's long-term agricultural productivity and the sustainability of its agricultural production. As a result, in the face of rapid population growth, sub-Saharan Africa imports about US$25 billion of staple foods annually despite the continent's vast agricultural potential, putting a strain on scarce foreign exchange reserves.

This chapter next considers the main reasons for the missed green revolution in Africa, focusing primarily on ecological, technical, policy, and institutional factors before drawing lessons from past green revolution experiences in Asia and adapting them to Africa.

EXPLAINING THE MISSED GREEN REVOLUTION IN AFRICA

With regard to ecological factors, Africa's soils vary by region and are, in general, very different from, and less fertile than, the Asian volcanic soils and alluvial valleys. Weather shocks such as droughts are frequent, and rainfall varies dramatically across Africa, with the northern half of the continent containing large arid areas. These ecological factors are a significant impediment to Africa's agricultural development, given the continent's low use of irrigation and overwhelming dependence on rain-fed agriculture.

International research on high-yield crops did not focus on African staple foods and agro-ecological systems. Although the green revolution in Asia can be attributed to the extended use of irrigation, improved crop varieties, and expanded use of chemical fertilizers, the implementation of similar strategies in Africa has not been successful.[15] According to the World Bank, the heterogeneity of both agro-ecological conditions and crop production (maize, cassava, millet, sorghum, cassava, yams, sweet potatoes, etc.) suggests that "outside" technologies are often not directly transferable to improve the continent's productivity. In other words, the productivity revolution in Africa needs a tailored approach and a more careful contextualization to better fit with Africa's specific agricultural conditions.[16] This includes a focus on the development of technology more suitable for Africa that is aimed not only at increasing productivity of root and tree crop production systems but also at saving labor for cereal production.[17] Likewise, improved varieties have to be developed to take into account the African environment with its specific requirements. This has started happening with the development of NERICA rice (see also Box 2) and high-yielding varieties of cassava.

Inadequate policies have distorted Africa's agriculture sector, thereby constraining technology adoption. In the past, indirect and direct taxes distorted prices and prevented farmers from adopting modern inputs such as fertilizers. In addition, many African governments established agricultural marketing boards that purchased products from farmers at fixed prices and resold the products in domestic and international markets at prevailing market prices, while controlling exchange rate to protect the local market. This scheme served to control prices so as to ensure income stability to the farmers. The implication was a lack of incentive to invest in intermediate inputs such as fertilizers.[18]

Policy and market failures account for the slow adoption of productivity-enhancing inputs such as equipment, fertilizers, and pesticides. Figure 2 shows that fertilizer use is still low in most countries. Voortman argues that several market and institutional factors have discouraged African farmers from using fertilizers.[19] First, underdeveloped markets (low volumes), high prices, and high transport costs have

Box 1: Lessons for Africa from the Asian green revolution

Some important lessons for Africa that can be drawn from the Asian green revolution include:

- **"Double green" the agricultural revolution.** Higher productivity came at the expense of environmental issues in Asia. The environmental effects of increased agricultural productivity in Africa depend heavily on the sources of productivity growth. Water- and soil-saving innovations undoubtedly have positive effects. However, such techniques are often achieved through the intensive use of manufactured inputs such as fertilizers and chemicals with negative externalities. Instead, productivity can be improved with best practices in terms of environmental impact at all levels of the value chain. Resilience to climate change will be an increasingly difficult challenge to tackle.
- **Promote responsible farmers' borrowing.** In Asia, the technological dimension of the green revolution was supplemented by heavy government intervention through subsidies on inputs. However, these massive government expenses were not sufficient to limit farmers' indebtedness. Green revolution packages ended up indebting a large number of smallholder farmers, eventually pushing them into landlessness and poverty.
- **Develop rural non-farm activities to diversify income.** The green revolution in Asia focused on rural farm activities. Kanu et al. highlight the importance of emphasizing rural non-farm activities to diversify income sources, finance on-farm investments, buy food, and stabilize household income during difficult times of drought or price shock.[1] To enhance its sustainability, income has to come from diverse sources.

Note

1 Kanu et al. 2014.

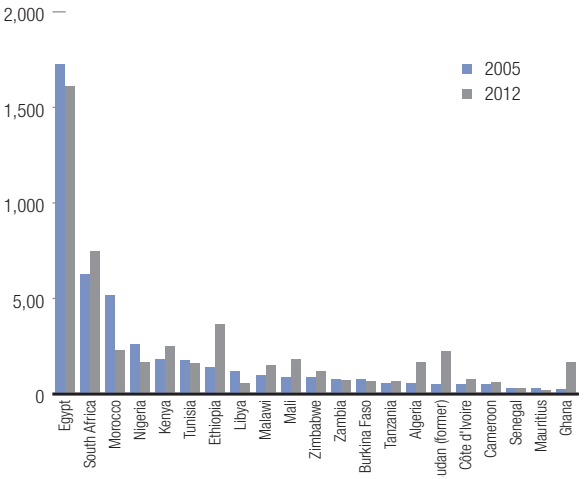
Sources: Based on Lappé et al., second edition, 1998; Kanu et al., 2014.

limited the availability of fertilizers. Indeed, as Chapter 1.1 documents, sub-Saharan Africa's infrastructure deficit (mainly roads and electricity, as well as ICTs) is significant, particularly in small and landlocked countries. This impedes the provision and use of productivity-enhancing inputs. For example, as Gollin and Rogerson argue, poor transportation networks account in large part for the low productivity of Uganda's agriculture.[20] Second and most importantly, fertilizer costs have not been recouped because soil analysis has not been taken into account to determine the appropriate fertilizers. The popular fertilizers (nitrogen and phosphorous) developed for Asian and Latin American soils have had minimal or no effect on yield in Africa.[21] Indeed, the heterogeneity of African soils requires the usage of targeted fertilizer applications.

Despite recognition of the importance of the sector in Africa, investment in agriculture has been neglected by African governments and donors.

Figure 2: Fertilizer consumption in selected African countries, 2005–12

Tons of nutrients (thousands)



Source: AfDB Statistics Department, 2015.

Although official development assistance has increased by about 250 percent between the 1980s and the 2010s, allocation to agriculture has halved. According to the Food and Agriculture Organization of the United Nations (FAO), on average, African governments reduced their spending on agriculture from 4.5 percent of total expenditure in 2001 to 2.5 percent in 2012,[22] despite their 2003 pledge to spend at least 10 percent under the African Union's 2003 Maputo Declaration target. Limited funding has prevented the development of research capability in biotechnology, the provision of adequate support for agricultural research, and private-sector participation in agriculture.

Low investment in agriculture has partly led to overreliance on rain-fed farming with very little irrigation. The irrigated share of Africa's cropland is less than a quarter of the world average.[23] Only 4 percent of crop areas are irrigated in sub-Saharan Africa; in comparison, this represents only a small fraction of the Asian investment in irrigation, where 39 percent of the production area is irrigated in South Asia and 29 percent in East Asia.[24] In contrast, Africa has numerous river systems that are not fully exploited and significant groundwater resources that remain largely untapped. These groundwater resources are unevenly spread over a wide range of agro-ecological zones, especially in Southern Africa and some parts of North Africa. Irrigation on the African continent is also hampered by poor water management, which is one result of underdeveloped institutions. Furthermore, while Asia's green revolution mainly focused on irrigated wheat and rice, sub-Saharan Africa's main staples comprise a much wider variety, including maize, cassava, millet, sorghum, yams, sweet potatoes, and plantains. This wide range of food crops reinforces the argument that Africa's agriculture needs to focus on its specific context, as discussed earlier.

Furthermore, the lack of good governance and economic institutions in Africa, especially in the financial and insurance sectors, has hampered farmers' ability to develop. The general low financial inclusion in Africa is even worse in agriculture, where the production cycle consists of high initial investment, a medium to long period of no cash inflow during the growing season, and large cash windfall after harvest. Many of the products offered by banks and financial intermediaries are inappropriate for smallholder farmers because loan repayment schedules do not take into account crop cycles. Modern financial services—such as microloans, credit registries, and value chain financing—are therefore needed to improve access to credit to smallholder farmers. The challenges of providing acceptable collateral for agricultural lending are enormous. Moreover, most countries lack tailored insurance products. This means that adverse shocks, such as droughts, often lead to famine because farmers are unprepared to respond. In this context, micro-insurance is emerging as a valuable instrument for protecting farmers. Land governance pertaining to land access, distribution, and female ownership will be further discussed below in the section on mechanisms for productivity improvement. In many countries, land ownership is governed by customary laws; this has resulted in high land inequality. Indeed, although women constitute the bulk of the labor force in the continent's agriculture sector, rules governing ownership and transfer of land rights are unfavorable to women in Africa.[25]

The green revolution in Africa is not a lost cause. Africa can gain from productivity improvements with the right set of policies, institutions, and resources, while also drawing from the lessons of the Asian green revolution (Box 1). Today many organizations are working toward this goal. Among them is the Alliance for a Green Revolution in Africa (AGRA), founded through a partnership between the Rockefeller Foundation and the Bill & Melinda Gates Foundation. AGRA is focusing on many of the issues highlighted above, including the development and distribution of high-yield seeds and the improvement of soil health, market access, and financial access. Other research institutions, such as the Africa Rice Center and the International Institute of Tropical Agriculture (IITA), are also working to develop high-yield crops. In general, international research funding and coordination among stakeholders in the agriculture sector have both expanded as the value-added of the green revolution for reducing poverty and eliminating hunger has been increasingly recognized. Some success stories are highlighted in Box 2.

The next section discusses ways to improve agricultural productivity by leveraging technology and reforming land governance.

Box 2: Recent success in the development of high-yield crops in Africa

In recent decades, research efforts have resulted in high-yield crop varieties.

For the second most important staple food in Africa, *cassava,* productivity changed with the introduction of an improved drought-tolerant cassava variety in 1977. Along with continuous improvement in breeding and pest control, the cassava yields have increased by over 40 percent in the past three decades. West Africa has seen up to 60 percent in productivity gains, which has clearly helped to reduce poverty in the region. More recently Malawi and Rwanda have demonstrated rapid production growth; it tripled in Rwanda between 2007 and 2011.[1]

The introduction of modern, high-yielding varieties of *maize* in East and Southern Africa during the 1960s allowed the crop to develop into one of the continent's major sources of calories. Over the last decade, maize production has been particularly significant in West Africa. Nigeria, for instance, has seen its maize yields rise steadily as farmers adopted improved varieties and hybrids, which are drought tolerant. Overall maize production in Africa has increased at an average 5.5 percent per year between 2000 and 2010, while areas harvested remain lower than in 1990, indicating an improvement in production technology.[2]

***Beans* are another major staple in Africa, particularly in East Africa.** Recently, nearly 10 million farmers in the region, especially in Kenya, Tanzania, and Uganda, have intensified production by relying on high-yielding climbing beans, which are more tolerant to warm temperatures. These improved varieties have brought about substantial productivity gains, as yields in Rwanda and Uganda increased 53 percent and 60 percent, respectively.[3] Moreover, in both the Democratic Republic of Congo and Rwanda, bio-fortified beans have been introduced to a wider audience, and by 2014 about one-third of the population in Rwanda farmed and consumed them.

In 1999, the NERICA (New Rice for Africa) rice, especially developed for African conditions, was released to farmers. The NERICA rice—a combination of African and Asian rice varieties—has proven to be drought tolerant, high yielding, early maturing, and resistant to African's major pests and diseases. It is now cultivated on about 200,000 hectares across Africa. The rice yields in sub-Saharan Africa have increased significantly over the last years as yields grew by 30 percent from 2007 and 2012, and with a faster rate than the global average.[4] Efforts to develop other high-yield varieties of rice are underway for other types of soils.[5]

Notes

1 FAO 2013.

2 Cadoni and Angelucci 2013.

3 Pabra 2015.

4 AfricaRice 2015.

5 Kimani et al. 2011; Singh et al. 2013.

MECHANISMS FOR PRODUCTIVITY IMPROVEMENT IN THE CONTEXT OF THE GREEN REVOLUTION: LEVERAGING TECHNOLOGY AND LAND REFORMS

The Comprehensive Africa Agriculture Development Programme (CAADP) is at the heart of the quest for agricultural productivity improvement in Africa. It was established by the African Union and the New Partnership for Africa's Development (NEPAD) in 2003, with the goal of an annual productivity growth rate of at least 6 percent.[26] The program has four pillars: (1) land and water management, (2) market access, (3) food supply and hunger eradication, and (4) agricultural research. Since 2003, agricultural GDP has grown on average by 4 percent. Nin-Pratt et al. estimate that total factor productivity (TFP) for the 2001–10 period grew on average by 2.1 percent.[27] Although this is a considerable improvement over the 1.4 percent growth seen in the 1990s, it is still below expectation. Assuming the same growth rate of inputs as observed in the 1990s, Ludena estimates that a TFP growth rate of 4.4 percent is needed to achieve an output growth rate of 6.2 percent.[28] To bridge this gap, the important factors that contributed to the green revolution (as discussed in the previous section)—including the introduction of high-yield varieties, irrigation, increased and better use of fertilizers—are still pertinent. As aptly put by Hazell, "there is an urgent need to bring the green revolution in an appropriately modified form to Sub-Saharan Africa."[29] Indeed, Africa's agriculture should take advantage of recent developments in ICTs and genetic research, which have the potential to revolutionize the sector. Land redistribution policies are also crucial for improving productivity. Before discussing the role of ICTs and land reforms in these efforts, the chapter summarizes the various factors raised in the earlier discussion of the green revolution that are necessary to transform agriculture in Africa.

The productivity drivers of the green revolution

The introduction and development of high-yield crops is at the heart of Africa's agricultural transformation. This was the most important factor in Asia and will also be the key driver of agricultural productivity in Africa. This development entails increased international and national research of plant breeding, taking into account the different types of soils on the continent. As pointed out above, research focusing on African agricultural conditions has increased, thanks to the work of various organizations, providing new hope for agriculture sector transformation. CGIAR (Consultative Group on International Agricultural Research) and AGRA, for instance, are working intensely to develop high-quality grains for African soils. Investments in research by international organizations and local government are highly beneficial. A US$1 invested by CGIAR is estimated to yield US$6 in benefits, while the same US dollar invested by governments in sub-Saharan Africa leads to US$3 in benefits.[30] However, the discovery of new crop varieties will not lead to transformation if national governments do not increase their efforts to promote the adoption of these crops through effective extension services and the support of local bureaucracies.

With the greater effects of climate change on weather patterns, irrigation has to increase substantially. Using an econometric model and data on 31 countries in sub-Saharan Africa, Fuglie and Rada find that that average yields in irrigated farms are 90 percent higher than the yields of nearby rain-fed farms.[31] You et al. estimate that internal rates of return on irrigation projects in Africa vary between 6.6 and 28.0 percent, depending on the type of irrigation and other conditions.[32] The estimates show a huge potential for irrigation in Africa. Beyond this, weather changes are increasingly unpredictable and Africa is severely hit in this regard. This means that reliance on rain-fed agriculture cannot continue and signals that Africa needs not only an increase in irrigation, but also needs to develop better mechanisms for dealing with climate variability. International organizations and national governments are working toward developing "climate-smart agriculture" to prepare the world to adapt and mitigate the effects of climate change for food security, which will certainly be of great interest to Africa's agriculture.

As soil fertility deteriorates, fertilizer use must increase. As noted earlier, fertilizers are not widely used for a variety of reasons, including market failures. Government interventions are, thus, needed to ensure availability of the right type of fertilizers, at the right price, and at the right times. Subsidies can be helpful,[33] but strong governance and farmer education are both essential for success.[34] Farmer field schools used for education and the provision of agricultural extension services are very beneficial for improving productivity and income. Furthermore, improved knowledge about the use of fertilizers lessens their potential negative impact on the environment. Davis et al. evaluate the impact of these programs in East Africa. They find an average increase of 61 percent in income, with varying degrees of success across countries.[35] In addition to fertilizers, farmers need to protect their crops from insects and pests through the careful use of insecticides and pesticides.

Market access, regulations, and governance need to improve. As shown earlier in the chapter, policy failures have prevented Africa from benefiting from the green revolution, and thus policy needs to improve for the agriculture sector to yield significant benefits. Fuglie and Rada estimate that eliminating policy distortions in agriculture would raise output by 4.7 percent.[36] Improving rural infrastructure such as roads is also crucial to raising productivity.[37] Reducing shipping time and costs would significantly reduce losses in perishable food shipping and make exporters more competitive.

As the next section will discuss, ICTs can enable and complement the above reforms.

The role of ICTs for agricultural productivity improvement

The rapid uptake of ICTs in Africa provides an important opportunity to improve the performance of agricultural value chains (AVCs) from the farm to the market. Indeed, ICTs—including mobile telephony, radios, geographic information systems (GIS), and satellite imagery technologies—have been expanding in Africa. The likely contribution from ICTs can be viewed from the perspectives of potential stakeholders along the value chain: businesses and business organizations, farmers (smallholders, commercial farms, and trade agencies), researchers, and government departments. ICTs in agriculture can also be considered based on their applications along the stages of the production cycle: pre-cultivation, crop cultivation and harvesting, and post-harvest.[38] Several potential avenues are available at each stage for applying ICTs to increase agricultural productivity. The following analysis looks at various ICT applications at each stage of the agricultural production cycle and highlights successes.

At the pre-cultivation stage, ICTs have several uses, ranging from land and crop selection to the development of crop insurance products; they can also enhance land and water management and use. In fact, ICTs can be used for facilitating the process of land registration, allocation, and use for crop selection; taking inventory; obtaining weather information on the planting calendar; and facilitating farmers' access to credit. M-PESA in Kenya is a well-known example of a mobile technology–based payment system that is increasing financial inclusion even in rural areas. ICTs can help to develop crop insurance against adverse weather shocks and crop failures. An example of this is Kilimo Salama,[39] a mobile technology–based insurance on purchased inputs (certified seed, fertilizer, and crop protection products) that protects farmers against bad weather shocks. Mobile phones are used to scan the barcode of products purchased by farmers and M-PESA is used for payout at the end of the growing season in case of bad weather. Moreover, GIS and remote sensing (RS) are increasingly being used to ensure more efficient land use and water management.[40] GIS combined with RS has been used to support the assessment of land capability, soil conditions, crop condition and yield, flood and drought risk, groundwater contamination, and pest infestation.[41] For example, Egypt has developed a soil and terrain database for the Sinai Peninsula and other regions. Satellite imagery data and GIS have also been used in Ethiopia and Mozambique to enable land registration and crop inventories. India has many applications using GIS technology to support sustainable agricultural development. One of those applications is a cropping system analysis that identifies low-productivity areas.[42]

At the crop cultivation and harvesting stage, ICTs also have other uses. ICTs can generate valuable information on land preparation and sowing, crop health, input management—particularly the choice and use of fertilizer—and pest and water management. ICTs can also be used to get information to farmers, particularly smallholder farmers who could otherwise be out of reach. In 2011, the GSMA mAgri Programme, in partnership with the Bill & Melinda Gates Foundation, launched the mFarmer initiative to support the development of mobile agricultural value-added services (Agri VAS) in four countries: India, Kenya, Mali, and Tanzania. The Agri VAS, developed by mobile network operators, is designed to offer information on crop cultivation and market prices to farmers.[43]

As in previous examples, at the post-harvest stage ICTs can provide market information that is crucial to improving market efficiency. A lack of sufficient information—including information on prices and market conditions—along with price information asymmetries make it difficult for farmers to get fair prices for their crops. The uncertainty this causes can also discourage attempts to invest more in inputs and technologies. Efforts are being made on the continent to deal with information generation and dissemination issues within the context of commodity exchanges. For example, the Esoko Ghana commodity exchange (EGCI),[44] operational since 2005, publishes a weekly cash price index of commodities. Esoko has expanded in a dozen countries and provides price and knowledge data to farmers via mobile text messages. An even better known commodity market is the Ethiopia Commodity Exchange (ECX), which addresses the huge market inefficiency that prevented commodity buyers from interacting directly with sellers, and vice versa. Information was also asymmetrical on prices and product quality. The ECX disseminates information on products' grades and prices and facilitates the coordination of buyers and sellers as well as the enforcement of contracts. All farmers in the country, including smallholder farmer cooperatives representing 2.4 million of farmers, are members of the ECX. They have access to price information, which is provided through a call center. Addressing the information asymmetry about the prices of crops in different markets has allowed farmers to have more marketing options and more bargaining power, and to increase their income by 10 to 30 percent.[45]

Other potential contributions of ICTs in agricultural productivity improvement include the traceability of food and animals, which is important for participating in global value chains. Traceability entails displaying the lot number and the production facility name on each case of the product and recording this information on invoices and bills of lading. Data can be recorded and transmitted via different ICT platforms.[46] Recently an application that monitors cattle

and provides valuable information, called iCow, was launched in Kenya. A related application is vetAfrica, which provides veterinary information. In addition, common information systems platforms linking all stakeholders are being set up in several countries as a way to share information and decrease maintenance costs. One example is Kenya's M-Kilimo, which comprises a database containing farmers' information (land size, crop, language, etc.). Farmers can call to report problems and ask questions. Specific responses are tailored to the farmer whose information is already available in the system. Government extension services also use this system to provide farmers with customized solutions.

Another recent scientific and technological innovation in the field of biotechnology and genetic engineering is having a profound impact on global agriculture. Below the potential of this technology for transforming African agriculture is considered.

Opportunities and challenges of genetically modified (GM) crops

The adoption of GM crops in Africa remains limited. In 2014, the AfDB and the International Food Policy Research Institute (IFPRI) published a report titled *GM Agricultural Technologies for Africa: A State of Affairs.*[47] The study examined the current status, issues, constraints, and opportunities presented by GM technologies in Africa. It noted that, although the use of GM crops is increasing in other developing countries, its adoption is very limited in Africa: only four countries (Burkina Faso, Egypt, South Africa, and Sudan) are currently farming some GM crops (cotton and maize). Some other countries—such as Ghana, Kenya, Malawi, Mozambique, Nigeria, and Uganda—are piloting a variety of GM crops (banana, cassava, cowpeas, etc.).

With the continent's rapid population growth and the intensification of the effects of climate change on weather patterns, high-yield GM crops that are resistant to weather shocks represent an opportunity for Africa to address food insecurity. A majority of scientists argue that GM crops are safe to consume, and they also reduce insecticide use, greenhouse gas emissions, and soil-damaging tillage while enhancing farmers' income and farm production without increasing the cultivated area.[48] A meta-analysis of 147 impact studies found that the adoption of GM crops (soybean, maize, and cotton) has, on average, "reduced chemical pesticide use by 37%, increased crop yields by 22%, and increased farmer profits by 68%."[49] A recent survey of members of the American Association for the Advancement of Science found that 89 percent of scientists argue that GM crops are safe to eat.[50] Despite the positive effects, there is still a debate on the safety of GM foods and a resistance to GM crops, especially from Europe. This debate has influenced perceptions in Africa and given way to extensive misinformation. For instance, in the midst of a famine in 2002, Zambia refused food aid that contained GM crops based on precautionary principles.[51]

The positive benefits of GM crops do not mean, however, that they are a panacea for food security in the world. Food security depends not only on production output but also on distribution and availability at the right price. Moreover, yields of GM crops depend on farming conditions, and their benefits may not outweigh their costs under poor conditions. Other farming practices may increase yields as much as GM crops do. Another worry is that the seeds are controlled by a small number of multinationals, which means that farmers will always be dependent on purchased seeds. Adverse consequences of GM crops on biodiversity and gene flow need further research.[52]

The 2014 AfDB-IFPRI report highlights the conditions necessary to increase Africa's adoption of GM crops.[53] These conditions include increased funding for research and development to enhance biotechnology capacity and genetic modification. Regulatory systems also need to boost their capacity to inform decision makers. More outreach and better communication will ensure that Africans are well informed about the risks and benefits of GM crops.

The next section explores how land reforms can address the issue of land access and distribution in Africa to improve agricultural productivity.

Land reform for higher productivity and inclusion

Africa has the highest area of arable uncultivated land (202 million hectares) in the world, yet most farms occupy less than 2 hectares.[54] This situation is a result of poor land governance and ownership that is based mostly on customary laws, which together have resulted in unequal distribution of land and uncertainty of tenure. With the introduction of land markets, land inequality and landlessness are growing in some countries, such as Côte d'Ivoire, Kenya, and Liberia, and in the Southern African region. From the 1998 household survey for Côte d'Ivoire, it is estimated that 5.56 percent of women own land versus 7.14 percent of men, and large land surfaces are concentrated in the hands of public employees.[55] The customary laws that often prevent women from ownership are a constraint to inclusive growth. Byamugisha sees land reforms as a pathway to shared prosperity in Africa.[56]

Land reforms that clearly define property rights, ensure the security of land tenure, and enable land to be used as collateral and to be allocated more efficiently will be necessary in many African countries. Land allocation under customary laws often lacks the security of tenure and prevents owners from using their assets as collateral to access finance for purchasing inputs. Moreover, highly productive farmers may lack sufficient land to expand their production. Depending on the country, land reforms have to

address access to land and distribution of land. Some countries, such as Cameroon, are using GIS systems to first register land before implementing redistribution mechanisms. The reforms should also ensure some form of tenure security that allows farmers to leverage their assets.

Land reforms in African countries where colonial systems have resulted in high levels of inequality have succeeded to varying degrees. In some countries, mostly in Southern Africa, colonial systems expropriated large portions of land from the majority of the population for the benefit of a minority. Most of these countries undertook land reforms to redistribute land and address inequality, but failed. Zimbabwe tried land expropriation from white farmers to redistribute the land to black farmers. This has largely failed because the reforms transformed the country from a food basket and exporter to a food importer. The South African reforms that attempted to avoid those mistakes through a market-based and negotiated approach have, so far, failed to redistribute large areas of land as a result of an inefficient system and insufficient implementation of land transfer, which has left the country with high levels of land inequality and, according to the government, 50 percent of land transfer projects have failed.[57] Using a similar market approach, Namibia has been more successful in reallocating land. Over the last two decades, 8 percent of agricultural land has been transferred to black farmers in South Africa, while Namibia has reallocated 27 percent of its farm land.[58] One big difference in the two systems is that Namibia does not recognize ancestral land rights, and the state has the right of first refusal in any land sale in the country. Byamugisha holds out the land reforms in Malawi as a model of success for other countries to emulate.[59] The model is based on voluntary redistribution of large corporate estates to poor farmer groups with community-based land rights. The farmer groups are provided with funds to buy agricultural inputs in order to use their newly acquired land or diversify their production. The process has, thus far, helped 15,000 households, representing about 0.5 percent of total households, to gain land ownership. However, this success has yet to eliminate land misallocation in the country.

Land redistribution policies should, however, not prevent market mechanisms from supporting the development of commercial large-scale farming. Adamopoulos and Restuccia found that the 1988 land reform in the Philippines, which imposed a ceiling on land holdings and restricted the transfer of distributed land, reduced farm size by 34 percent, and led to a decrease in agricultural productivity by 17 percent.[60] The effect of land misallocation is also found in Malawi. Restuccia and Santaeulalia-Llopis use micro data from the Malawi Integrated Survey on Agriculture collected by the World Bank in 2010–11 to study the link between land allocation and farm productivity.[61] They found that farm size was unrelated to farm productivity and capital, implying a misallocation of land. Overall, 78.3 percent of farmers in Malawi operate on less than 1 hectare and only 0.3 percent of the farms are larger than 5 hectares. The average plot size is 0.83 hectares. Land markets are practically nonexistent in the country, and most of the land is transferred through customary rights. This customary-based ownership and transfer system creates a misallocation of land, preventing more productive farmers from acquiring larger plots. An efficient redistribution of farm land would increase aggregate productivity by a factor of 3.6. This very large increase calls for the establishment of a land market in Malawi.

Going forward, it will be crucial to harness the complementarity between smallholder and large-scale farming to reduce the overreliance on smallholders and expand much-needed commercial large-scale farming. Although a fringe of the latter offers mixed results about the complementarity between large-scale farming and smallholders, recent analyses suggest that there is room to harness such complementarity whereby large-scale farming can achieve better productivity.[62] Successful transformation of agriculture will require a recognition that, as stated by Collier and Dercon, "smallholders are heterogeneous in potential and there is scope for large scale farmers as commercial enterprises, often in interaction with smaller scale farmers using institutional frameworks that encourage vertical integration and scale economies in processing and marketing."[63] If well regulated, large-scale farming could have positive spillover effects on smallholders including job creation, income generation, and the transfer of knowledge and know-how. The out-grower scheme model, where smallholder farmers supply products for a larger firm under pre-agreed mutually beneficial conditions, could be a potential mechanism to ensure such mutual benefits. This complementarity will be explored in the context of value chains, discussed in the next section.

ENHANCING THE INTEGRATION INTO AGRICULTURAL VALUE CHAINS (AVCS)

Increased globalization has created both challenges and opportunities for Africa's agriculture; these notably arise from the continent's greater integration into AVCs. Thanks to globalization, African products can now reach larger markets. However, to take advantage of this potential, African farmers need to deliver higher-quality products at competitive prices and integrate international distribution channels by satisfying the norms and standards set out by their trading partners.[64] This is a serious challenge for smallholder farmers, who supply up to 80 percent of the food in sub-Saharan Africa,[65] but who need to enhance their capacity to meet international standards.

Greater integration into AVCs is expected to boost benefits to small-scale farmers and facilitate the creation of agribusinesses for increased value addition in exported goods. The participation of small-scale farmers in AVCs will enable them to harness the interdependence among the different actors in the value chain, namely the suppliers of inputs and seeds, the farmers, the businesses providing technical support for the farmers such as agricultural machinery, the financiers, the wholesale producers of farm products, the processors, and associated sellers.[66] Consequently, participation in AVCs will facilitate small-scale farmers' access to inputs, financing, and end-markets at the local, national, regional, and international levels, thereby enabling them to have a greater voice in the value chain and enhancing their economic returns. This will, in turn, facilitate the creation of modern integrated agribusiness value chain economies based on specialization.[67] Participation in such AVCs will enable firms to "move up" into higher-value activities, capture a greater share of value in global markets, and thus enhance the sector's competitiveness.[68]

The discussion that follows will explore the potential of value chains to enhance Africa's agricultural competitiveness. It reviews Africa's global positioning as well as its potential integration into the global AVCs, which are both necessary for creating a conducive environment. The AfDB has made significant efforts to enhance the continent's integration into AVCs, as discussed later in this chapter.

Africa's positioning and potential within global and regional value chains

Even though Africa's integration within global AVCs is limited, it offers scope for greater integration within the traditional cash-crop production chain. Africa's general participation in regional and global value chain trade is discussed elsewhere in this *Report* (see Chapter 2.3). Participation in AVCs is even more challenging because international norms and standards keep evolving and are difficult to satisfy. Africa is a large global supplier of traditional cash crops (coffee, cotton, cocoa, sugar, tea, and tobacco) as raw material, which accounts for about 50 percent of Africa's total agricultural exports.[69] These tend to be producer-driven chains with limited scope for functional upgrading, given the tight control by lead producers with higher-value activities—such as processing and manufacturing—that are carried out outside Africa.[70] Nonetheless, some scope exists for product differentiation and quality upgrading within the cash-crop production chains. In fact, product differentiation presents various opportunities for increasing agricultural income from cash crops, through branding and grading specialty coffee and establishing grading systems, for example, as well as by segregating different qualities for export.[71]

The production of non-traditional crops, however, offers more scope for greater integration within the global AVCs. African economies have progressively diversified from the traditional cash crops and are increasingly engaged in the production and global sale of crops such as fruits, vegetables, fish, and flowers that belong to buyer-driven value chains. This has, in part, been the result of the proliferation of supermarkets seeking to consolidate their supply networks in order to exert more control over production processes.[72] Indeed, with Africa's greater urbanization and growing middle class, rising consumption creates more demand for local products.[73] Functional upgrading can occur in such value chains as retailers seek "ready-to-sell" products more and more, thereby advancing processing and packaging activities further along the value chain.[74]

Regional value chains offer great promise in facilitating the integration of Africa's agriculture into global value chains and need to be supported. Meeting the standards required for integrating into global value chains will be a gradual process for Africa's agriculture exporters. In the interim, gains can be made from integrating into regional value chains. Indeed, the agriculture sectors of some African countries—especially Kenya and South Africa, which are major regional exporters of processed food—are increasingly being integrated into regional value chains. For instance, the Kenya fresh vegetable (especially green beans) and dairy export industries grew considerably in size and value-added in the 2000s and are now leading producers in Africa. This success is the result of the sound implementation of new processes and operations by private Kenyan businesses, as well as the support of the public sector. Given the nature of the smallholder-based agriculture in Africa, support will need to be provided to small-scale farmers to be better organized so as to enhance their productivity and ensure the timely off-take of produce from farm to markets. Indeed, the United Nations Economic Commission for Africa (UNECA) underlines the need to support small-scale producers through national and regional cooperatives or other farmer organizations in order to facilitate their access to inputs, financial services, and markets and to enable them to defend their interests in the value chain.[75]

Five keys to a conducive environment for greater AVC integration

This section presents five keys to creating an environment conducive to fostering greater AVC integration.

First, the need to address poor domestic productive capacity and infrastructure in order to enhance Africa's effective participation in value chains cannot be overemphasized. Africa is endowed with vast resources, but its low domestic productive capacity and poor infrastructure, as well as a focus on low-value-added activities, are holding back the continent's effective participation in value chains. Indeed,

Africa's considerable endowments in natural resources and its competitive wages, as well as the significant potential of domestic and regional markets, have been well documented.[76] However, domestic productive capacity, in the form of skills and capital to produce on a large scale and meet required standards, is limited. The performance of the agriculture sector is also hampered by inadequate infrastructure, including unreliable energy, an ineffective urban-rural road network, inefficient ports, and a business and regulatory environment that overall is not conducive to doing business in agriculture make trade more costly. For instance, Bah and Fang show that, on average, Africa's firms lose 25 percent of their output as a result of the poor business environment.[77] A 2009 report by the US international trade commission also shows that poor infrastructure (especially land and maritime transport and energy) is putting African exporters at a competitive disadvantage by increasing costs and compromising the quality of exports.[78] Addressing these shortcomings will be crucial for Africa's beneficial participation in AVCs.

Second, farmers need to be provided with appropriate financing schemes so they can make necessary investments and meet required standards for integration into global value chains. Limited access to finance hinders local farmers from undertaking the requisite investments to increase productive capacity and meet the quality requirements of integration into both regional and global value chains.[79] Aforementioned efforts at land reform, enabling farmers to have security of tenure, will need to be complemented by efforts to ensure that farmers are well organized through cooperatives, farmers' unions, and associations to enhance their bargaining power, allowing them to obtain better financing terms. Improved organizational capacity on the part of farmers will also enable them to cooperate in working to meet the standards required for integration of value chains. Better access to financial facilities will need to be complemented by financial literacy training to avoid the over-indebtedness that accompanied the green revolution in Asia.

Third, efforts should be made to encourage the connection of small-scale farmers with large commercial farmers through mutually beneficial *contract farming* (also called *out-grower schemes*), thus enhancing the sector's inclusiveness. As large-scale farmers become better connected with AVCs, agribusiness initiatives will increasingly seek value additions to agriculture products and there will be a reduction in the export of raw material. In supporting these agribusiness initiatives, special attention should be given to out-grower schemes because they not only assist farmers to meet required production standards within the global value chain, but they also guarantee supply to leading firms. Contract farming usually involves a large agribusiness firm entering into contract with smallholder farmers, providing farmers with inputs on credit and extension in return for a guaranteed delivery of products.[80] Box 3 discusses the AfDB's role in

Box 3: The AfDB's role in supporting the transformation of Africa's agriculture for inclusive growth

The AfDB Group has a long experience, going back to the late 1990s, of supporting African countries in developing their agriculture sectors. The AfDB views agriculture as key to the socioeconomic development of the continent. Between 2006 and 2014, the AfDB committed 198 operations in agriculture and agribusiness, amounting to a total of US$6.33 billion. Prior to 2000, the AfDB endorsed the Integrated Rural Development approach to agriculture. In 2000, the AfDB adopted a new strategic framework embodied in the Agriculture and Rural Development Policy, which focused on addressing the critical bottlenecks of agricultural development, namely: high population growth rates, the poor state of infrastructure, declining trends in agricultural prices, persistent political instability, reliance on rain-fed agriculture, high post-harvest losses, the complex land tenure system, limited human and institutional capacity, and inaccessibility to credit. From 2010, the AfDB's operations in agriculture were guided by its Agriculture Sector Strategy (AgSS), covering the period 2010–14, with its principal objective being to guide the AfDB's operations to contribute to greater agricultural productivity, food security, and poverty reduction. Below are two examples of inclusive agribusiness projects supported by the AfDB.

The Maryland Oil Palm Plantation Project (MOPP) is a US$203 million agribusiness project. The AfDB approved US$20 million for this project in 2013. MOPP entailed a 15,000 hectare greenfield palm oil plantation and milling project in Liberia. The nucleus plantation constituted 9,000 hectares, while 6,000 hectares were to be cultivated by local farmers in an out-grower scheme involving 600 farmers. These farmers are expected to receive financing for their inputs from MOPP, which they will repay once their product is sold. Access to modern inputs such as improved seed varieties and fertilizers, extension services, and access to finance is expected to improve the livelihood of these farmers.

Approved by the AfDB in 2009, ***Agri-Vie*** is a US$100 million private equity fund focusing on small- and medium-sized enterprises in the agribusiness and food sectors. The fund closed in 2010 with 65 percent of the commitments coming from development finance institutions and the rest from the private sector (life insurance, foundations). Agri-Vie has a proactive and collaborative relationship with investees and provides training and technology transfer to out-grower farmers. In terms of results, Agri-Vie has a continuous focus on driving selected impacts per investee in the following sectors: governance (reporting, policies, and controls), workers (employment, training, and development), and community relations and environment (environmental management practices). In terms of development outcomes, by the end of 2012, Agri-Vie Fund had impacted more than 890 small- and medium-sized enterprises, 2,900 farmers, and 312 non-farmer micro-enterprises. One of the feedbacks from the managers of Agri-Vie Fund is that investment in African food and agribusiness remains robust, which is an encouraging sign.

(Cont'd.)

Box 3: The AfDB's role in supporting the transformation of Africa's agriculture for inclusive growth *(cont'd.)*

Going forward, the new AfDB Agriculture Sector Strategy (AgSS) (2015–2019) will seek to build on previous AfDB work in agriculture by bringing the agriculture sector and agribusiness to the front of Africa's structural transformation agenda. The AfDB's interventions within the framework of the AgSS for 2015–19 will be guided by two pillars: (1) agricultural infrastructure and (2) natural resource management.[1] The AgSS will embrace a value-chain approach and support innovative technologies to foster the development of value chains within the agriculture sector and its commercialization. It will promote agricultural commodity exchanges and improve access to finance for agricultural small- and medium-sized enterprises. It will also help to improve capacity building by providing specific vocational training to farmers and agricultural product dealers, for example. It will leverage mobile information services, allowing farmers to collect valuable data. It will promote best practices for investments in land, ensuring that private investments benefit rural communities. It will also pay greater attention to increasing gender mainstreaming in the AfDB's operations and programs.[2] The key features of the AgSS for 2015–19 are highlighted below.

1. **Infrastructure in agriculture:** Supporting regional member countries to develop their infrastructure systems in the agriculture sector, including improving rural infrastructure, rural electrification, irrigation, water management, and leveraging information technology systems for agriculture development;
2. **Agribusiness and innovation:** Supporting the development of agribusiness and innovation, which includes commercializing agriculture by developing the agro-industry and value chains; implementing measures to enhance agricultural trade, including promoting commodity exchange markets in the agriculture sector; and developing low-cost technologies for primary processing that retains essential nutrients; and
3. **Resilience and natural resource management:** Promoting resilience and the sustainable management of natural resources, including managing the environmental impact of agriculture activities.

Notes

1 AfDB 2015, forthcoming.

2 AfDB 2015, forthcoming.

Sources: AfDB, 2010; AfDB 2015, forthcoming. Compiled from the AfDB investment portfolio.

supporting the transformation of Africa's agriculture for inclusive growth. It provides some examples of inclusive AfDB projects in the agribusiness sector, including through private equity.

Fourth, ICTs play a key role in fostering greater integration into value chains. As noted earlier, ICTs can reduce information asymmetry and improve market efficiencies throughout the different phases of the production process as well as in the post-harvest period. These information asymmetries extend beyond the local market into regional and global markets. ICTs can be employed to improve the marketing of agricultural products into regional and global markets, while at the same time being used to receive market information in a timely manner.

Last, state intervention is crucial in supporting greater value chain integration. In the majority of poor development outcomes, coordination failure is one of the main culprits. As previously discussed, better integration into AVCs can be attained by organizing smallholder farmers in cooperatives and groups. African governments can play a vital role in facilitating the formation of those networks. Services can be leveraged for this purpose and provide information on how to better integrate AVCs. Governments should also invest more in infrastructure to improve the business climate, as its current state represents a significant competitive disadvantage for African exporters. International organizations can also help to correct coordination failures by bringing different stakeholders together and by boosting inclusive investments in the agriculture sector (see Box 4).

RECOMMENDATIONS AND CONCLUSIONS

This chapter recalls the main factors that make agriculture in Africa one of the least productive globally while the rest of the world, particularly Asia, greatly benefited from the green revolution. The chapter also discusses the ingredients needed for a more competitive agriculture sector that will lead to faster structural transformation processes across Africa.

Agriculture remains an important source of income for the majority of Africans and represents a large share of economic output in most countries in the continent. The sector consists primarily of small-scale farmers who cultivate a large variety of low-yield crops on small plots of non-irrigated land, using a minimal amount of fertilizers and pesticides. These characteristics make the sector very unproductive, leading to food insecurity and large imports of staple foods. The continent has not benefited from the green revolution that started in the 1960s, and that essentially focused on Asia and Latin America. The African continent was left behind for several reasons: (1) the development of high-yield crops focused on irrigated rice and maize, crops not very suited for African soils and ecological systems; (2) market failures and infrastructure deficits have constrained the availability and access to productivity-enhancing inputs as well as the commercialization of agricultural production in Africa; and (3) policy and institutional factors, characterized by the inefficient involvement of governments that resulted in distorted prices of both agricultural inputs and outputs as well as in low levels of technological innovation and adoption. In contrast to Africa, Asian governments have been heavily involved in the drive to revolutionize their agriculture sectors.

In order to foster Africa's green revolution, it is essential to address the factors above and simultaneously take into account the specificities of African conditions, including the continent's variety of soils and appropriate crops. This will involve increased international and national research to develop and promote high-yield crops suitable for Africa. While international research efforts have greatly increased in recent years, national governments are failing to reach their target of devoting 10 percent of national spending to agriculture as agreed under the terms of the NEPAD-CAADP. Increased national spending should support better water management to intensify irrigation, reduce the continent's dependence on rain-fed agriculture, and increase resilience to climate change. Moreover, governments need to put in a place a sound regulatory and institutional framework to minimize distortions and take advantage of new opportunities provided by the development of science and technology. Innovations in ICTs have several agricultural applications involving different stakeholders at different stages in the production cycle. Diffusion of market information, production knowledge, and geographical information are among the top applications that are being increasingly used in Africa but whose usage could be further enhanced. Since the large majority of scientists believe that GM crops are safe to eat, the technology has the potential to revolutionize Africa's agriculture. Improved yield and resistance to pests can increase farmers' income. However, skills in biotechnology are needed for a wide-scale adoption across the continent, as well as regulatory systems that ensure health and environmental safety and provide accurate information to farmers and customers.

Taking full advantage of these technologies will require a number of countries to improve their land governance systems. Land access based on customary rights that disadvantage women, unequal distribution, and the absence of land markets are preventing the most efficient farmers from the opportunity to increase their production scale. Moreover, insecure land tenure limits farmers' ability to use their land as collateral and thus to access credit markets. Land reforms accompanied with the development of financial instruments suited to the agricultural production cycle will improve the adoption of technology and expand the use of intermediate inputs.

Finally the chapter acknowledges the potential of Africa's agriculture and proposes mechanisms by which it can benefit from integration with regional and global markets. Indeed, integration in AVCs will help small-scale farmers adopt better production processes and garner higher prices for their produce. It also provides them with the opportunity to be linked with large-scale agribusinesses and diversify to higher-value crops, such as fruits, vegetables, fish, and flowers. However, meeting the high-quality standards in world markets is not easy, particularly for small-scale farmers. Thus regional AVCs can provide a stepping-stone that allows farmers to improve their production and marketing processes. This requires small-scale farmers to be better organized, for example in farmers' organizations, and to link up with large-scale agribusinesses through out-grower schemes that establish production contracts between agribusinesses and small-scale farmers. Indeed, this has been promoted by the AfDB as a way to enhance inclusiveness as the sector increases the share of large-scale commercial farming. Strong support from

Box 4: Grow Africa's approach to developing responsible, sustainable, and inclusive private-sector investment

Since its inception in 2011, Grow Africa—a partnership platform created to catalyze investment and growth in African agriculture, founded by the African Union Commission, the NEPAD Agency, and the World Economic Forum—has established itself as a trusted platform for increasing responsible, sustainable, and inclusive private-sector investment in Africa's agriculture. The network collectively works to ensure that investment commitments made by international and domestic companies in partnership with national governments are converted into investment on the ground. These investments are expected to increase farmers' income and create local jobs.

One of the most important aspects of the Grow Africa Secretariat's work is using its convening power at the highest levels to support the development of strong, effective multi-stakeholder structures to enable the public and private sectors to work together to drive investments forward. The creation of a better coordination between private-sector agricultural companies and the public sector is a significant step toward accelerating the execution of investment commitments and bringing them to scale.

Better coordination and alignment is required among different private-sector players, agribusinesses, and smallholder suppliers. Grow Africa is active in exploring, incubating, and disseminating best practice in innovative models for ensuring sustainable supply chains involving smallholder farmers. Agricultural corridors and agri-processing zones that coordinate investments into geographically targeted value-chain clusters can significantly speed up the implementation time for the individual investments within these geographic areas.

To further these efforts and locate them on the global stage, in 2015, the World Economic Forum is introducing a Global Challenge Initiative on Agriculture and Food Security—one of ten institutional initiatives addressing major issues of global concern.[1] The initiative builds on the work of the New Vision for Agriculture,[2] and is intended to strengthen leadership commitment and catalyze country-led action partnerships, such as Grow Africa.

Notes

1 Information about this global challenge is available at http://www.weforum.org/projects/group/agriculture-and-food-security.

2 Information about the New Vision for Agriculture Initiative is available at http://www3.weforum.org/docs/WEF_CO_NVA_Overview.pdf.

Source: Grow Africa Secretariat.

governments and international organizations will minimize coordination failures among stakeholders and ensure that increased integration into AVCs benefits small-scale farmers, particularly women who represent a significant share in the agricultural employment breakdown.

NOTES

1 Equatorial Guinea is not included in the Country Profiles of this *Report* because it did not have sufficient data to be included in the Global Competitiveness Index.

2 AfDB 2014.

3 The *green revolution* refers to the drastic rise in the productivity of global agriculture as a result of chemical advances and the development of high-yield crops, thus making it possible to produce much larger quantities of food and feed the growing population.

4 AfDB 2014.

5 UNDP 2014.

6 See de Janvry and Saddoulet 1996; Gallup et al. 1997; Timmer 1997; Bourguignon and Morrisson 1998; Thirtle et al. 2003; Salami et al. 2010.

7 According to the International Fund for Agricultural Development (IFAD 2010), 70 percent of the poor live in rural areas and are engaged in agriculture. At the same time, the share of urban poor is increasing rapidly with the high rate of urbanization and the slow job creation in African cities.

8 See Berthold et al. 2014 for a survey of the literature on labor reallocation across sectors.

9 Bah 2011.

10 See Bah 2013 for the case of European countries.

11 AfDB 2013. The AfDB's long-term strategy is available at http://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/AfDB_Strategy_for_2013%E2%80%932022_-_At_the_Center_of_Africa%E2%80%99s_Transformation.pdf.

12 World Bank 2008.

13 Mondal, no date.

14 Hazell 2009.

15 Nin-Pratt and McBride 2014; World Bank 2008.

16 Nin-Pratt and McBride 2014; World Bank 2008.

17 Nin-Pratt and McBride 2014.

18 Kayizzi-Mugerwa 1998.

19 Voortman 2013.

20 Gollin and Rogerson 2010.

21 Voortman 2013.

22 FAO 2015.

23 Svendsen et al. 2009.

24 World Bank 2008.

25 NEPAD 2013.

26 It is not clear what type of productivity (land, labor, or total factor productivity) the program is targeting.

27 Nin-Pratt et al. 2012. This estimate is based on the accounting approach.

28 Ludena 2005, cited by FARA 2006.

29 Hazell 2009, p. 23.

30 Fuglie and Rada 2013.

31 Fuglie and Rada 2013.

32 You et al. 2011. Other conditions that affect the internal rates of return on irrigation projects are institutional, agronomic, human, and environmental ones.

33 Africa Progress Panel 2010.

34 Fuglie and Rada 2013.

35 Davis et al. 2010.

36 Fuglie and Rada 2013.

37 Gollin and Rogerson 2010.

38 Deloitte 2012.

39 See https://kilimosalama.wordpress.com/.

40 Remote sensing (RS) is the use of aerial sensor technologies to detect and classify objects on Earth with the help of propagated signals (e.g., electromagnetic radiation).

41 Wilson 2005.

42 Deloitte 2012.

43 GSMA, no date.

44 See http://www.esoko.com.

45 Adewunmi 2012.

46 World Bank 2011.

47 AfDB-IFPRI 2014.

48 Brookes and Barfoot 2014; Nuffield Council on Bioethics 2003.

49 Klümper and Qaim 2014, p. 1.

50 Entine 2015.

51 Lewin 2007.

52 Nuffield Council on Bioethics 2003.

53 AfDB-IFPRI 2014.

54 World Bank's World Development Indicators, 2015.

55 Aka 2007.

56 Byamugisha 2013.

57 The Economist 2013.

58 Moneyweb 2014.

59 Byamugisha 2013.

60 Adamopoulos and Restuccia 2014.

61 Restuccia and Santaeulalia-Llopis 2015.

62 Collier and Dercon 2009.

63 Collier and Dercon 2009, p. 3.

64 AfDB et al. 2014.

65 FAO 2012.

66 UNECA 2012.

67 AfDB 2014.

68 Gereffi et al. 2005 cited in AfDB et al. 2014.

69 Diao and Hazell 2004.

70 AfDB et al. 2014.

71 Diao and Hazell 2004.

72 Lee et al. 2012.

73 Leke et al. 2010.

74 AfDB et al. 2014.

75 UNECA 2012.

76 James 2013.

77 Bah and Fang 2015.

78 United States International Trade Commission 2009.

79 AfDB et al. 2014.

80 AfDB et al. 2014.

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