The current institutional framework of agricultural research in Africa south of the Sahara (SSA) has been shaped by more than a century of agricultural research activity. In colonial times, the European powers invested substantial resources in agricultural research to unlock the agricultural potential of Africa. Initially, they focused mainly on commercial export crops, such as coffee, tea, cacao, cotton, rubber, oil palm, and sugarcane. Research on local food crops and livestock only started in earnest after World War II (WWII). With the attainment of independence in the late 1950s and early 1960s, most African countries inherited an agricultural research system dominated by foreign scientists. The prospect of replacing them with national scientists presented a major challenge, because the newly independent countries lacked an academically trained cadre and, even more crucially, universities to train them. As a result, the nationalization of agricultural research required a lengthy transition for most African countries. In the early 1980s, some 20 years after independence, roughly 30 percent of the agricultural researchers employed in the region’s national agricultural research systems (NARSs) were still expatriates (Pardey, Roseboom, and Anderson 1991), but by the mid-1990s this share had fallen to negligible levels in most countries.

The nationalization process after independence often also resulted in the dismantling of established colonial linkages among agricultural research entities, including various agencies established by Great Britain, France, and Belgium, whose mandates encompassed multiple African colonies. In the first few decades following independence, most African countries were so preoccupied with the nationalization process that they had little political or other incentives to explore regional collaboration. Since the early 1970s, some of this vacuum in cross-country collaboration has been filled by international

The authors would like to thank all the individuals across Africa who contributed to the Agricultural Science and Technology Indicators database, which forms the primary source for the analysis in this chapter. In addition, the authors would like to thank the various reviewers who helped to improve this chapter at different stages.
agricultural research centers operating under the CGIAR umbrella. As part of their work, they manage multicountry research networks and programs. Interest in cross-country collaboration in agricultural research by NARSs only began in earnest in the late 1980s and early 1990s, which eventually led to the establishment of Africa’s subregional organizations (SROs) and the Forum for Agricultural Research in Africa (FARA). A major challenge of such NARS-led collaboration is the strong fragmentation of Africa’s agricultural research capacity into some 47 NARSs, which differ greatly in size, research ambition, and competency. Moreover, they are embedded in a rich diversity of agroecologies, production systems, cultures, languages, customs, levels of development, political systems, and so on. This makes finding common ground for collaboration in agricultural research and translating that into action all the more challenging.

This chapter provides an overview of the structure of agricultural research in SSA; its development through time; and its struggle with widespread, systemic constraints. It begins with an overview of the region’s NARSs, followed by a discussion of supranational agricultural research collaboration, before offering an analysis of the constraints affecting the performance of agricultural research in SSA, including (1) policies related to agriculture and agricultural research and development (R&D); (2) the organization and management of agricultural research; (3) human, financial, and physical resources; and (4) collaboration and coordination.

**National Agricultural Research Systems**

**Overview**

NARSs are the principal building blocks of Africa’s agricultural research system. Of the 47 low- and middle-income countries that constitute SSA, almost all have a NARS; however, their size and strength vary greatly.1 As of 2011—the most recent year for which comprehensive data are available through the

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1 South Sudan became independent in 2011, raising the number of low- and middle-income countries in SSA to 47. Despite being geographically located within SSA, Equatorial Guinea is excluded because the World Bank classifies it as a high-income country, because of its high oil revenues, and Mayotte and Réunion are excluded because they are French territories, not independent countries. The dataset that underlies most of the analysis in this chapter comprises 45 of the 47 SSA countries; Somalia and South Sudan are excluded because of extreme data constraints. In several African countries—such as Côte d’Ivoire, Democratic Republic of the Congo, Rwanda, Sierra Leone, Somalia, Sudan, and more recently Mali—NARSs have been forced to close down or at least significantly contract their activities for long periods of time because of civil war and military conflict.
Agricultural Science and Technology Indicators (ASTI) initiative, led by the International Food Policy Research Institute—the region’s NARSs collectively employed an estimated 14,221 full-time-equivalent (FTE) researchers, representing a fivefold increase over the 1971 total of 2,981 FTEs (Figure 2.1). A further 50,000 staff members supported these researchers (including research technicians, laborers, administrative support staff, and so on), yielding an average support-staff-per-researcher ratio of about 4:1 (calculated by authors from ASTI 2014). This ratio varies widely across individual NARSs, ranging from less than 2:1 to more than 14:1. In response to efforts to improve efficiency, the overall trend is toward declining support-staff ratios. High support-staff ratios often reflect a strong presence of labor-intensive nonresearch activities, such as seed multiplication or agricultural production activities.

NARS spending (in constant 2005 PPP dollars) grew far more slowly than research staff numbers over this period, from $853 million in 1971 to $1,693 million in 2011 (Figure 2.1), indicating a dramatic decline of financial resources per researcher over time, from $286,208 in 1971 to $119,065 in 2011. Most often, declining spending levels per researcher were the result of (1) the transition from employing relatively expensive expatriate researchers to employing less expensive local researchers (a phenomenon that largely occurred in the 1970s and 1980s), (2) minimal adjustment of salaries to

**FIGURE 2.1** Agricultural R&D spending and staffing trends in Africa south of the Sahara, 1971–2011

![Graph showing agricultural R&D spending and staffing trends from 1971 to 2011.]

*Source:* Calculated by authors based on ASTI (2014).

*Notes:* FTEs = full-time equivalents; PPP = purchasing power parity; R&D = research and development.
compensate for inflation over long time periods, (3) extreme contraction of operating costs and capital investment, and (4) declining support-staff ratios (particularly in more recent years). The combined effect of these factors has left many African NARSs with a poorly paid (and hence poorly motivated) pool of researchers who are required to conduct research with very limited resources—such as out-of-date or dysfunctional scientific equipment and lack of fundamental services.² Of course, there are exceptions, both within and across NARSs, but the overall picture is quite grim. The establishment of national agricultural research institutes/organizations (NARIs/NAROs) in the 1970s and 1980s was expected to resolve these problems by removing agricultural research from the government bureaucracy; however, these entities have remained largely dependent on government funding, and are therefore subject to many of the same constraints as before.

In relative terms, the growth in agricultural research staffing only just exceeded growth in agricultural labor. As a result, the number of agricultural researchers per 100,000 economically active agricultural population grew only modestly, from an average of 5.7 FTEs during 1981–1985 to 7.0 FTEs in 2011 (Figure 2.2).

Growth in NARS spending lagged behind growth in agricultural gross domestic product (AgGDP) during most of the 1980s and 1990s. This trend

² This can include transport, electricity, computer hardware, reliable Internet access, necessary software and databases, and publications.

SOURCE: Calculated by authors based on ASTI (2014).
NOTE: FTEs = full-time equivalents.
reversed itself during the 2000s, but average spending by NARSs as a share of AgGDP during this decade was still lower than during the late 1970s and early 1980s, and also lower than the recommendation by the New Partnership for Africa’s Development (NEPAD) of an investment of at least 1 percent of AgGDP (Figure 2.3).

**Fragmentation and Interlinkages**

As indicated in the previous section, African NARSs are predominantly small; only nine employed more than 500 FTE researchers in 2011. Nonetheless, African NARSs have progressively grown in size over time in terms of researchers, given that in 1961 the overwhelming majority employed fewer than 100 FTEs (Chapter 8, this volume). Despite this growth in human resource capacity, the fragmentation of agricultural research across the region acts as a considerable constraint on effectiveness. For the most part, small countries have to deal with the same range of agricultural research issues as do large countries, but with a substantially more limited capacity. Consequently, they tend to focus on adapting existing technologies to meet local needs, rather than developing new ones. Only in rare circumstances can small countries afford to undertake such activities as plant breeding. Seeking collaboration with other countries in such situations is imperative. The problem for African countries is that most...
of their neighbors also have only limited agricultural research capacity, focusing mainly on adaptive research, so opportunities to borrow from each other are also limited.

In addition to fragmentation of agricultural research capacity across NARSs, fragmentation also occurs within NARSs. Systems typically comprise either an agricultural research department housed within a ministry of agriculture or one or more NARIs, complemented by various entities that conduct a small amount of research, such as universities and nonprofit agencies. NARIs typically operate as semiautonomous bodies that receive most of their funding from the government, but have more autonomy to set internal policy and procedures than do government departments, especially in terms of recruiting and remunerating staff and generating their own revenues. Some of the larger NARS with multiple institutes have established a council to provide coordination and oversight. Examples include South Africa’s Agricultural Research Council, the Agricultural Research Council of Nigeria (ARCN), and Ghana’s Council for Scientific and Industrial Research (CSIR).

Interlinkages within NARSs remain a problem in most countries because of a lack of effective coordination mechanisms. This internal fragmentation also complicates linkages with third parties, such as extension providers, policymakers, and farmers’ organizations. Weak linkages between agricultural research and extension have been identified by many as a key bottleneck in agricultural innovation in SSA for decades (Chapter 13, this volume), but they remain largely unresolved.3

**Institutional Composition**

Government research agencies still represent by far the largest component of NARSs in terms of the number of FTE researchers employed (72 percent of the total in 2011; Figure 2.4). The higher-education sector’s share of researchers expanded substantially in the past couple of decades from 16 percent in 1991 to 25 percent in 2011. This growth stems from the expansion of existing universities, the establishment of new universities, and the addition of new MSc and PhD programs in agricultural and related sciences (Chapters 8 and 10, this volume). While this growth of the university sector has provided NARSs with more and better qualified researchers (although most of them work only part time on research), it has also contributed to a greater

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3 In Rwanda, agricultural research and extension were merged under a single entity in 2009. The only other instance of such a merger occurred in Zimbabwe in 2001, but the two functions were again separated in 2009.
FIGURE 2.4 Institutional categories by country based on share of national agricultural researchers, 2011

Source: Calculated by authors based on ASTI (2014).
fragmentation of agricultural research capacity across entities, exacerbating challenges related to national coordination. Nigeria’s higher-education sector contributes a relatively large share of agricultural researchers to the NARSs, reflecting the adoption of the US land-grant university model (emphasizing university provision of agricultural research and extension) across the Nigerian states in the 1970s and 1980s.4

The role of privately funded and implemented agricultural research in SSA is still very limited. Private companies in SSA employ agricultural researchers on a permanent basis, but these are few (Chapter 7, this volume). A complicating factor is that private companies tend to keep information about their research efforts confidential and often have no legal obligation to report on them, with the result that information on private, intramural agricultural research tends to be incomplete. With the exception of South Africa, it is generally believed that this category of private, intramural agricultural research represents only a small fraction of the total agricultural research effort in SSA. More commonly, private companies either outsource their research to public agencies or collectively fund a specialized, nonprofit research agency through a levy or membership fee (Chapter 7, this volume).

The first type of extramural private agricultural research remains largely unnoticed because it is captured statistically under public agricultural research.5 The second type of extramural private agricultural research is captured under the nonprofit research category. On average, this category represented about 2 percent of SSA’s agricultural research capacity in 2011 (Figure 2.4). While many countries have no agencies in this category, 33 percent of FTE researchers in Mauritius fell in this category because of the dominance of the Mauritius Sugar Industry Research Institute, funded for many decades through a cess collected by the sugar industry (until 2012).6 The track record of these industry-funded, nonprofit research agencies is considerably better than that of government or university research agencies (Kangasniemi 2002). However, this success has not translated into an expansion of this model to other agricultural

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4 Swaziland’s higher-education sector stands out as contributing an exceptionally large share of agricultural researchers to its NARS, but this is mainly a reflection of the limited capacity of the agricultural research department within the Ministry of Agriculture, not an unusually high contribution by the universities.

5 It is only when detailed data on the funding of public agricultural research agencies are available that this “private” research component becomes visible.

6 In 2012 all sugar industry–related agencies financed by cesses were merged into the newly established Mauritius Cane Industry Authority operating under the Ministry of Agro-Industry and Food Security. The sugar industry of Mauritius has been heavily affected by EU sugar reform and trade policies, which ended the preferential access of Mauritius sugar to the EU market.
industries. In fact, the share of nonprofit agricultural research agencies has slightly declined since 1991, and the number of researchers employed at nonprofit agencies has changed little since 2000.

**Supranational Agricultural Research Collaboration**

The colonial research infrastructure built by Great Britain, France, Portugal, and Belgium during the first half of the 20th century was typically headquartered in Europe and (1) oversaw agricultural research across colonies not only in Africa, but also in other parts of the world; (2) provided backup support for the work in the colonies; and (3) managed a corps of European agricultural scientists who rotated among the various colonies and headquarters. Funding for agricultural research was mainly derived from the colonies themselves (for example, through levies on agricultural export commodities), although in later years (in particular after WWII) metropolitan investment in African agricultural research became more important. Federal agricultural research agencies spanning multiple African colonies were introduced by France in the 1920s and 1930s (and reinforced after WWII) and by Great Britain in the 1940s and 1950s. Examples of federal agricultural research agencies established during the colonial time by Great Britain are the East African Agriculture and Forestry Research Organization, the Tea Research Institute of East Africa, the West African Cocoa Research Institute, and the West African Rice Research Institute. In the case of France, the chain of tropical commodity institutes headquartered in France operated in the field through research centers and stations with either local or multicountry mandates. Nearly all of these federal agricultural research entities eventually lost their supranational mandate after independence and were disbanded or integrated into the NARS of the host country.

The first wave of such post-independence collaboration came in the form of regional agricultural research networks that emerged during the 1980s and 1990s, often operating under the auspices of CGIAR centers or other external agents, such as the Food and Agriculture Organization of the United Nations (FAO), France’s CIRAD, or Canada’s International Development Research Centre (IDRC) (Roseboom, Pardey, and Beintema 1998). Characteristic of this period was that the drive for this new supranational collaboration came mainly from outside and not so much from within. This often resulted in a top-down approach, with the external agent in charge and the national partners as relatively passive participants (so-called central source networks in contrast to collaborative networks).
Subregional Organizations

It took a while for the “internal drive” toward supranational collaboration in agricultural research in SSA to emerge, very much supported by development partners. Important in this process has been the establishment of three SROs:

1. **Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA).** CCARDESA’s predecessor, the Southern African Centre for Cooperation in Agricultural Research (SACCAR), was established in 1984 by the Southern African Development Community (SADC), which currently comprises Angola, Botswana, Democratic Republic of the Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe. Unfortunately, SACCAR was phased out between 1997 and 2001. Some of SACCAR’s tasks were continued by SADC’s Food, Agriculture and Natural Resources Directorate (SADC–FANR), but at a substantially lower level of activity and within a restrictive administrative setting. A plan to re-establish a semiautonomous SRO for the subregion was developed in 2007/08 (SADC 2008a, 2008b) and approved by the SADC Council in 2010. CCARDESA operates under the SADC secretariat, but is financially and administratively autonomous. It officially commenced operation in August 2011, but is still in its initial stages of development. CCARDESA is intended to address relevant agricultural R&D issues by (1) coordinating the implementation of regional agricultural R&D programs; (2) facilitating collaboration among NARS stakeholders; (3) promoting public–private partnerships in regional agricultural R&D; and (4) improving the generation, dissemination, and adoption of agricultural technologies in the subregion through collective efforts, training, and capacity building.

2. **West and Central African Council for Agricultural Research and Development (CORAF/WECARD).** Established in 1987, CORAF/WECARD initially only covered French-speaking African countries and was dominated by French advisors. In some ways, it tried to maintain the French colonial agricultural research structures. For the first few years the secretariat was based in Paris; it was only transferred to Dakar, Senegal, in 1990. That year it was also decided to include the subregion’s English- and Portuguese-speaking countries, which eventually occurred

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7 This section is largely based on Roseboom (2011).

CORAF/WECARD underwent a major restructuring in 2007/08, when it adopted a programmatic approach comprising eight programs: (1) livestock, fisheries, and aquaculture; (2) staple crops; (3) nonstaple crops; (4) natural resource management; (5) biotechnology and biosafety; (6) policy, markets, and trade; (7) capacity strengthening and coordination; and (8) knowledge management. While the last two programs do not conduct research, they support the others in the effective delivery and dissemination of research results. Budget constraints meant that it took several years before all eight programs became operational.

3. Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). Established in 1994, ASARECA currently has 11 member countries: Burundi, Democratic Republic of the Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, South Sudan, Tanzania, and Uganda. ASARECA’s program structure is almost identical to CORAF/WECARD’s, comprising (1) staple crops, (2) high-value nonstaple crops, (3) livestock and fisheries, (4) agrobiodiversity and biotechnology, (5) natural resource management and biodiversity, (6) policy analysis and advocacy, and (7) knowledge management and upscaling. In contrast to CORAF/WECARD, capacity strengthening is no longer separate, but is instead integrated across the programs.

Initially, the SROs only aimed to coordinate the work of the different regional agricultural research networks and programs within their mandated areas. By the late 1990s, however, they started to develop their own subregional agricultural research strategies. This was a first clear sign that the SROs and their members were starting to take charge of the supranational agricultural research agenda in their subregions. From merely coordinating regional agricultural research networks, the SROs have assumed the following five

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8 Madagascar and Tanzania are members of both CCARDESA and ASARECA, and the Democratic Republic of the Congo is a member of all three SROs. Comoros, Djibouti, São Tomé and Príncipe, Somalia, and Réunion do not belong to any of the SROs; South Sudan joined ASARECA in December 2011.
functions over the past decade: (1) advocacy and policy formulation, (2) capacity strengthening, (3) knowledge management and information exchange, (4) coordination of agricultural research in each subregion, and (5) promotion of supranational agricultural research activities in selected priority areas. The fifth function is usually seen by the SROs as the one with the biggest growth potential.

The SROs have no research capacity of their own; they focus on mobilizing their NARS members to conduct agricultural research that is of regional interest through commissioned or competitive agricultural research grant schemes (CARGs). In the case of competitive bidding, the SROs are experiencing difficulty in keeping the instrument focused on supranational research priorities, as national researchers have a tendency to see these regional competitive funding schemes as an opportunity to fund their own national research priorities. Stronger upfront priority setting (that is, defining the supranational research agenda) and far more specific calls for proposals are needed to keep the instrument focused on supranational research priorities. In addition to CARGs, the SROs are promoting the development of national agricultural research centers of excellence that conduct research of supranational relevance (see the section on regional agricultural productivity programs below).

ASARECA and CORAF/WECARD have adopted important institutional innovations over the past decade, which have also influenced the establishment of CCARDESA: (1) the introduction of CARGs for joint research activities, (2) the adoption of a programmatic approach, and (3) the introduction of a multidonor trust fund (MDTF) managed by the World Bank.

**Forum for Agricultural Research in Africa**

In addition to the three SROs, FARA was established in 2001 to promote and coordinate supranational collaboration in agricultural research across Africa (including North Africa). FARA took over from the Special Program for African Agricultural Research (SPAAR), which was first conceived by the World Bank and other donors at a CGIAR meeting in Tokyo in 1985. SPAAR, which was primarily a donor instrument, became operational in 1987 and was hosted by the World Bank until 2001. FARA very much differs from SPAAR, however, in terms of ownership: SPAAR was controlled by donors, whereas FARA is controlled by the SROs and NARSs. The mandates of FARA and the SROs strongly overlap, requiring coordination and a clear division of labor based on the “subsidiarity” principle, which dictates that responsibility should be adopted at the lowest level possible. The idea is that FARA should take on responsibilities only that are better dealt with collectively than
by the SROs individually. In practice, however, this principle is logistically challenging and creates political friction, not least because the SROs are at different levels of development.

What FARA and the SROs have in common is their dependence on donor funding, which is unsustainable in the long run. Mobilizing more funding from within the region should be high on the agendas of both FARA and the SROs in the coming years. Moreover, high dependency on donor funding leaves FARA and the SROs vulnerable to the capriciousness of donor policies. Despite substantial efforts by FARA and the SROs to comply with donor requirements, such as the adoption of a programmatic approach and greater accountability, the amount of donor funding that has come forward in recent years has been substantially below expectations (Table 2.1).

**TABLE 2.1 Expenditures by the Forum for Agricultural Research in Africa and the subregional organizations, 2006–2011**

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<td>Forum for Agricultural Research in Africa (FARA)</td>
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<tr>
<td>Secretariat</td>
<td>2.3</td>
<td>3.3</td>
<td>4.3</td>
<td>3.7</td>
<td>5.5</td>
<td>7.3</td>
<td>na</td>
</tr>
<tr>
<td>Programs</td>
<td>3.0</td>
<td>5.5</td>
<td>7.8</td>
<td>12.8</td>
<td>14.7</td>
<td>11.6</td>
<td>na</td>
</tr>
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<td>Secretariat</td>
<td>0.2</td>
<td>0.4</td>
<td>1.0</td>
<td>1.4</td>
<td>1.6</td>
<td>2.1</td>
<td>2.5</td>
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<td>12.6</td>
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<td>13.5</td>
<td>12.3</td>
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<td>Secretariat</td>
<td>0.4</td>
<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
<td>1.0</td>
<td>na</td>
<td>1.4</td>
</tr>
<tr>
<td>Programs</td>
<td>0.5</td>
<td>0.8</td>
<td>0.9</td>
<td>1.9</td>
<td>7.8</td>
<td>na</td>
<td>4.8</td>
</tr>
</tbody>
</table>

*Source:* Compiled by authors from ASARECA (various years), CORAF/WECARD (various years), and FARA (various years).

*Notes:* CCARDESA is not included in the table because it only began operating in 2011. Between the demise of its predecessor, the Southern African Centre for Cooperation in Agricultural Research (SACCAR) in the late 1990s and CCARDESA’s 2011 establishment, the Food, Agriculture and Natural Resources of SADC (SADC-FANR) took on some of SACCAR’s Directorate former activities. Although no specific data were available for SADC-FANR, it is estimated to have spent about US$3–$5 million per year on agricultural research. The projected yearly budget for CCARDESA is about $11 million by 2016, of which $1.3 million is allocated to the secretariat and the rest for its programs. na = data were not available.

Regional Agricultural Productivity Programs

As previously discussed, the effectiveness of African agricultural research is seriously constrained because of the high level of fragmentation of research capacity across countries. As a result, most African countries have very limited capacity in any scientific or technological domain, which both
constrains the attainment of national research goals—because resources are spread too thinly over a broad range of topics—and encourages duplication of effort with countries often pursuing the same, rather limited, research agenda. The concept of supranational collaboration is an attempt to improve the effectiveness of agricultural research by pooling resources and talent so that participating countries can jointly pursue a more ambitious research agenda of common interest. One approach to this, as discussed above, is through the CARGs for supranational agricultural research projects operated by the SROs. The current limitation of these schemes is their complete dependence on donor funding in the absence of mechanisms to collect a regional tax or levy to finance such schemes (which itself would pose administrative and coordination challenges).

An alternative approach being piloted through regional agricultural productivity programs is to convert selected national agricultural research programs into initiatives with a supranational mandate, such that the host country becomes a “center of excellence” (that is, specialization) on the target commodity or topic. The funding for these programs is provided by the government hosting the program, in full knowledge that substantial benefits from the research may—and desirably will—spill over into neighboring countries, but this is purposefully designed to be a reciprocal process. By cooperating, countries aim to share both the costs and the results of the research conducted, thereby leveraging their resources on the one hand, and reducing wasteful duplication on the other. This mechanism of mutual interdependence has the added advantage of circumventing the need for a regional tax or levy, whose collection requires a yet to be realized level of economic and political integration among African nations. Since 2007, this approach has been implemented through regional agricultural productivity programs facilitated by the World Bank through a series of loans to national governments, but depending strongly on the coordination capacity of the SROs to bring the various partners together.

The programs have been established as program loans that can be adapted both horizontally (that is, to include more countries) and vertically (that is, through potential extensions after the completion of the first phase). Key in all three programs is the investment in the development of national centers of excellence to promote supranational collaboration. Particularly in the case of West Africa, a substantial component of the investment actively targets the promotion of research spillovers to the other participating NARSs, by training researchers and conducting joint research projects between the center of excellence and the satellite research agencies (Table 2.2).
It is still too early to assess the impacts of these programs and of the approach in general. Nevertheless, the assumption that this type of mutual interdependence will work is not without risk. If one of the partners pulls out or fails to deliver, the whole constellation of mutual interdependence may collapse. For the moment, the programs receive ample funding through World Bank loans, but once this stops there is no guarantee that countries will continue their collaboration. Moreover, the model assumes spillover potential that in practice may not materialize because of differences in agroecologies, market development, consumer preferences, and so on.

**CGIAR’s Contribution**

The CGIAR Consortium comprises a group of 15 international agricultural research centers that address global development challenges and are funded by a large group of bilateral and multilateral donors. In 2012, the Consortium’s global turnover reached US$756 million, of which more than half was spent

<table>
<thead>
<tr>
<th>Project/phase</th>
<th>Approval date</th>
<th>Participating countries</th>
<th>Centers of excellence, specialization, or leadership</th>
<th>Budget (US$)</th>
</tr>
</thead>
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<tr>
<td><strong>A. East Africa Agricultural Productivity Program</strong></td>
<td></td>
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<tr>
<td>Phase 1</td>
<td>June 2009</td>
<td>Ethiopia, Kenya, Tanzania</td>
<td>Wheat, dairy, and rice</td>
<td>90 million</td>
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<tr>
<td>Phase 1a</td>
<td>November 2009</td>
<td>Uganda</td>
<td>Cassava</td>
<td>30 million</td>
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<tr>
<td>Phase 1b</td>
<td>Contemplated but not implemented</td>
<td>Other East African countries</td>
<td></td>
<td></td>
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<tr>
<td><strong>B. West Africa Agricultural Productivity Program</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Phase 1a</td>
<td>March 2007</td>
<td>Ghana, Mali, Senegal</td>
<td>Roots and tubers, irrigated rice, and drought-tolerant cereals</td>
<td>49.4 million</td>
</tr>
<tr>
<td>Phase 1b</td>
<td>September 2010</td>
<td>Burkina Faso, Côte d’Ivoire, Nigeria</td>
<td>Onions, mangoes, bananas and plantains, and fisheries</td>
<td>122.2 million</td>
</tr>
<tr>
<td>Phase 1c</td>
<td>March 2011</td>
<td>Benin, Guinea, Liberia, Niger, Sierra Leone, The Gambia, and Togo</td>
<td>Maize, livestock, and mangrove rice</td>
<td>118 million</td>
</tr>
<tr>
<td>Phase 2a</td>
<td>May 2012</td>
<td>Ghana, Senegal (Mali dropped out at the last moment due to war)</td>
<td>Roots and tubers, and irrigated rice</td>
<td>131.8 million</td>
</tr>
<tr>
<td><strong>C. Agricultural Productivity Program for Southern Africa</strong></td>
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<td></td>
</tr>
<tr>
<td>Phase 1</td>
<td>March 2013</td>
<td>Malawi, Mozambique, Zambia</td>
<td>Maize, rice, and food legumes</td>
<td>94.6 million</td>
</tr>
</tbody>
</table>

**Sources:** Compiled by authors; Roseboom (2011).
on SSA (Figure 2.5). CGIAR investment has shifted toward SSA in the past two decades; SSA’s share of total CGIAR spending increased from 40 percent in 1992, to 43 percent in 2002, to about 50 percent in more recent years. SSA receives more support from CGIAR than any other region, although not all CGIAR centers are equally active there. Four centers are headquartered in SSA, and two of them—AfricaRice and the International Institute of Tropical Agriculture (IITA)—focus exclusively on SSA. At the other end of the spectrum are the Center for International Forestry Research and the International Rice Research Institute, which spend only 5 and 7 percent of their resources, respectively, on SSA (Table 2.3). The number of people employed by CGIAR centers focusing on SSA totaled an estimated 763 international staff members and 4,384 local staff members in 2012 (CGIAR 2012).

Compared with African NARSs, CGIAR centers are well funded; however, from the African perspective, they are largely donor-driven, top-down agencies with weak accountability toward local counterparts. Moreover, coordination among the different CGIAR centers and programs is also quite weak, leading to duplication and sometimes outright competition (CGIAR 2005). Much has been done in recent years to improve collaboration among CGIAR centers, as well as between them and their local SSA counterparts through consultations and joint priority setting. For example, CGIAR developed two region-specific medium-term plans in 2005/06 (one for West and

**FIGURE 2.5** CGIAR expenditures in Africa south of the Sahara, 2000–2011

![Graph showing CGIAR expenditures in SSA from 2000 to 2012](image-url)

*Source:* Calculated by authors based on CGIAR (2000–2012, various years).

*Note:* SSA = Africa south of the Sahara.
Central Africa and one for East and Southern Africa), thereby unifying the different activities of CGIAR centers within these regions (Mokwunye 2010). A renewed effort to improve the overall coordination of agricultural research activities in SSA among CGIAR centers, SROs, and NARSs was launched in 2010, known as the Dublin Process. A great deal of potential overlap exists between the CGIAR agenda and the emerging supranational NARS agenda (Chapters 14 and 15, this volume). The best outcome would be for these organizations to collaborate to their mutual benefit, given that CGIAR has the scientific capacity, but NARSs have the political legitimacy.

### TABLE 2.3 CGIAR center staff focused on Africa south of the Sahara, 2012

<table>
<thead>
<tr>
<th>CGIAR center</th>
<th>Share SSA (%)</th>
<th>Total number CGIAR staff (head counts)</th>
<th>Estimated CGIAR staff in SSA (head counts)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>International</td>
<td>Local</td>
</tr>
<tr>
<td>Africa Rice Center (AfricaRice)(^a)</td>
<td>100</td>
<td>51</td>
<td>224</td>
</tr>
<tr>
<td>Bioversity International</td>
<td>36</td>
<td>62</td>
<td>148</td>
</tr>
<tr>
<td>International Center for Tropical Agriculture</td>
<td>43</td>
<td>88</td>
<td>744</td>
</tr>
<tr>
<td>Center for International Forestry Research</td>
<td>37</td>
<td>73</td>
<td>133</td>
</tr>
<tr>
<td>International Maize and Wheat Improvement Center</td>
<td>51</td>
<td>191</td>
<td>811</td>
</tr>
<tr>
<td>International Potato Center</td>
<td>63</td>
<td>88</td>
<td>744</td>
</tr>
<tr>
<td>International Center for Agricultural Research in the Dry Areas</td>
<td>13</td>
<td>89</td>
<td>324</td>
</tr>
<tr>
<td>International Crops Research Institute for the Semi-Arid Tropics</td>
<td>49</td>
<td>76</td>
<td>1,162</td>
</tr>
<tr>
<td>International Food Policy Research Institute</td>
<td>50</td>
<td>149</td>
<td>328</td>
</tr>
<tr>
<td>International Institute of Tropical Agriculture(^a)</td>
<td>100</td>
<td>116</td>
<td>958</td>
</tr>
<tr>
<td>International Livestock Research Institute(^a)</td>
<td>61</td>
<td>108</td>
<td>485</td>
</tr>
<tr>
<td>International Rice Research Institute</td>
<td>29</td>
<td>129</td>
<td>1,127</td>
</tr>
<tr>
<td>International Water Management Institute</td>
<td>60</td>
<td>113</td>
<td>202</td>
</tr>
<tr>
<td>World Agroforestry Centre(^a)</td>
<td>62</td>
<td>60</td>
<td>393</td>
</tr>
<tr>
<td>WorldFish</td>
<td>47</td>
<td>53</td>
<td>290</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>1,446</td>
<td>8,073</td>
</tr>
</tbody>
</table>

**Source:** Calculated by authors based on CGIAR (2012).

**Note:** \(^a\) These centers are headquartered in SSA. SSA = Africa south of the Sahara
Collaboration with International Partners

In addition to the multilateral agricultural research efforts by CGIAR’s centers, bilateral collaboration with overseas research partners constitutes a substantial contribution to African agricultural research. Initially, such collaboration was predominantly with the former colonial powers as a carry-over of the pre-independence research structures (for example, the origins of the French CIRAD and the UK Natural Resources Institute (NRI) can be traced back to colonial times); however, other developed countries, such as the governments of the United States, Canada, Australia, Japan, and various European countries have increasingly offered scientific collaboration programs on a bilateral basis, whereby advanced research agencies and universities provide some of their time and resources to address agricultural research problems of specific relevance to SSA. Often such collaboration is combined with capacity-building activities.

Collaborative research support programs (CRSPs), recently rebranded Feed the Future Innovation Labs, funded fully or partly by the US Agency for International Development (USAID), are a good example. Initiated in 1977, this successful scheme mobilizes the capacities of US land-grant universities (in collaboration with counterpart agencies in developing countries) to address issues of food security, human health, agricultural growth, trade expansion, and sustainable use of natural resources in the developing world. Currently, 10 thematic CRSPs are in operation, each mobilizing multiple US universities and counterpart agencies in developing countries. Of the 19 countries currently targeted by CRSPs, 12 are in SSA. In Europe, many national governments as well as the European Union offer funding opportunities to agricultural research agencies and universities in Europe to conduct collaborative research with overseas partners in developing countries. The Platform for African–European Partnership on Agricultural Research for Development (PAEPARD), hosted by FARA, has the specific mandate to strengthen agricultural research collaboration between Europe and Africa, and make it more demand driven.

More recently, also “South–South” collaboration in agriculture has begun to shape up, including collaboration in agricultural research and technology transfer; the two most prominent of these collaborators are Brazil and China (Chapter 6, this volume). As part of their foreign policies, both countries began to offer support in agricultural research and technology transfer to African countries in 2006.9 In the case of Brazil, this mainly takes the form of collabo-

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9 See Scoones, Cabral, and Tugendhat (2013) for a more in-depth discussion of the contributions of China and Brazil to African agriculture.
rative research and scientific capacity-building projects funded by the Brazilian Cooperation Agency (ABC) and implemented by the Brazilian Agricultural Research Corporation (Embrapa). About 25 of these projects were operating across 15 African countries in 2011, some involving multiple countries (Embrapa 2011). China’s contribution is mainly through agricultural technology demonstration centers, 15 of which have been established across SSA in the past few years; another 10 are in the planning phases (FAC 2013). Under this model, the recipient country provides the land, and China provides the infrastructure and operating expenses for the first three years (including the costs of Chinese experts to train local counterparts). After this start-up phase, the centers are expected to be run as commercial, self-supporting demonstration farms.

**Key Constraints Affecting Agricultural Research**

The following four key constraints have been distilled from the literature as holding back the performance of agricultural research in SSA, each of which is discussed in more detail in the subsequent sections (FARA 2006a, 2013a, 2013b; USAID 2013): (1) inadequate policies; (2) weak organization and management; (3) insufficient financial, human, and physical resources; and (4) poor collaboration and coordination.

**Policy Constraints**

Structural macroeconomic reform dominated the policy agenda of SSA during the 1980s and 1990s, liberating the economy from excessive, and often inappropriate, government intervention. In retrospect, this emphasis on macroeconomic reform was often at the expense of more specific policies, including agricultural (innovation) policies. Around the turn of the 21st century, the realization emerged that the right macroeconomic context was crucial, but it was not enough to eradicate poverty. The launching of the United Nations Millennium Development Goals (MDGs) was a turning point, introducing a far more qualified approach to economic growth. For example, the poverty reduction strategies that African countries developed together with the World Bank in the early 2000s all addressed the need to improve agricultural policies. However, less than half of them addressed the need to invest in agricultural innovation. Moreover, the emphasis was mostly on extension and advisory services—only 4 of 24 African poverty reduction strategies explicitly mentioned the need to invest in agricultural research (Roseboom, Beintema, and Mitra 2003).

Another important policy initiative that has helped to move agriculture back to the top of Africa’s development policy agenda is the Comprehensive
Africa Agriculture Development Programme (CAADP), launched by the African heads of state in 2004 (NEPAD 2003; Chapter 1, this volume). After an initial slow start, CAADP has assumed a leading role in strengthening agricultural policies and investment plans across Africa in recent years. Agricultural innovation is very much part of CAADP’s agenda, as is reflected in the fact that agricultural research, technology dissemination, and adoption constitute one of the program’s four key thematic pillars. FARA was asked to be Africa’s lead agent on this theme, and to this end developed a Framework for African Agricultural Productivity (FAAP) in 2004. This framework argued for a substantial increase in investment in agricultural research, extension, and education, and an institutional reform agenda putting farmers at the center of agricultural innovation (FARA 2006b). Moreover, FAAP proposed the development of subregional agricultural productivity programs and, in particular, lobbied for additional investment in agricultural research addressing subregional priorities. FAAP is being implemented by FARA in close collaboration with the SROs, subregional economic communities,10 national governments, international organizations, and donors.

Of the 28 national agricultural investment plans that have been developed as part of CAADP to date, only a few have allocated significant resources to agricultural research, extension, and education. As with the MDG poverty strategies, other priorities seem to attract more funding. Policymakers should not only direct more funding to agricultural research, but also help allocate those resources most wisely at various levels (individual research programs and organizations, countries, subregions, regionally, and worldwide). In addition, donors prioritize where they want to place their support for agricultural research. It all results in a complex patchwork of priority setting and decision-making in efforts to steer the allocation of resources (Table 2.4).

The higher the level of aggregation of the strategy or plan, the more abstract the document usually becomes, and the less concrete it is in terms of setting priorities and allocating resources. These documents (which are often impressive in terms of content and length) are useful for consensus building but lack real buy-in and backing through funding; hence, follow-up on their implementation is usually weak. Going down the list of aggregation, the subregional agricultural productivity programs are the first to be backed by substantial funding (that is, World Bank loans to national governments). These

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10 These include the Common Market for Eastern and Southern Africa, East Africa Community, Economic Community of Central African States, Economic Community of West African States, and SADC.
TABLE 2.4 Steering Africa’s agricultural research agenda

<table>
<thead>
<tr>
<th>Level</th>
<th>Strategy/planning documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td><em>International Assessment of Agricultural Knowledge, Science and Technology for Development</em> (McIntyre et al. 2009): Assessment initiated by the World Bank and FAO, involving broad consultations across the world; the final version of the report was not supported by Australia, Canada, or the United States because of opinions in the report on biotechnology.</td>
</tr>
</tbody>
</table>
| Regional      | *Science Agenda for Agriculture in Africa* (FARA 2013b): Initiated by the participants of the Dublin Process and facilitated by FARA; an independent panel organized various consultations and formulated the agenda.  
*Framework for African Agricultural Productivity* (FARA 2006b): Initiated by FARA under the umbrella of CAADP; the first version focused on crops, with livestock added later.  
*Realizing the Promise and Potential of African Agriculture* (IAC 2004): Initiated by then UN Secretary General Kofi Anan and facilitated by the InterAcademy Council; an international study panel assisted by consultants organized various consultations to formulate this strategy. |
| Subregional   | *SRO strategies/operating plans* (ASARECA 2006, 2013; CORAF/WECARD 2007; CCARDESA 2013): The SROs have adopted a programmatic approach and have prioritized commodities/themes of focus; SROs do not have their own research capacity, but instead mobilize their members to execute the identified research priorities through commissioned or competitive research grants, although the volume of funding available has been limited and rather volatile to date.  
*East, West, and Southern Africa agricultural productivity programs* (EAAPP/WAAPP/APPSA): Developed by the World Bank in close collaboration with the respective SROs and the participating countries. |
| National      | Very few countries have developed a *national agricultural research strategy* encompassing all the entities constituting its NARS; the NARI/NARO strategy usually acts as a substitute. One exception is Uganda’s NARO, which is the apex body for the NARS. Some countries (Ghana, Nigeria, and South Africa) have an (agricultural) research council that oversees a range of agricultural research institutes, but even these councils do not cover the entire NARS. The growing importance of universities requires improved coordination—for example, by promoting joint research planning and projects—between government and higher-education agencies, whose research agendas usually strongly overlap. |
| Organizational| Organizations need *strategy documents* that articulate both their mission and pathway to achieving that mission within a time horizon of 5–10 years, with revisions if needed. A strategy is often accompanied by a *master/operating plan* detailing what is needed to implement the mission, including infrastructure and equipment, staffing, organizational structure, internal management processes, and governance issues. |
| Programmatic  | *Programmatic planning documents* set out research objectives and priorities (usually in the form of projects) that will be undertaken within a time horizon of 3–5 years, often revised yearly through the addition of another year. A widespread problem across African agricultural research organizations is weak adherence to planning processes. It is not uncommon for research program plans to be nonexistent or out of date, and where plans do exist, there is usually great discrepancy between what is planned and what is actually implemented. Lack of funding usually plays a major factor. |

*Source:* Authors.

*Notes:* ASARECA = Association for Strengthening Agricultural Research in Eastern and Central Africa; CAADP = Comprehensive Africa Agriculture Development Programme; CCARDESA = Centre for Coordination of Agricultural Research and Development for Southern Africa; CORAF/WECARD = West and Central African Council for Agricultural Research and Development; IAC = InterAcademy Council; FAO = Food and Agriculture Organization of the United Nations; FARA = Forum for Agricultural Research in Africa; NARI = national agricultural research institute; NARO = National Agricultural Research Organization (Uganda); NARS = national agricultural research system; SRO = subregional organization.
subregional programs have prioritized only a selected number of commodities (Table 2.2).

A major weakness of African agricultural research is poor strategizing and planning at the research program level. This usually goes hand in hand with weak monitoring and evaluation (M&E) of research activities. Strengthening the planning capacity at the research program level is crucial for all strategizing and planning higher up in the system to be effective (Chapter 12, this volume).

CGIAR centers do not fit logically within the hierarchy presented in Table 2.4; they have their own research strategies and plans, which add to the complexity of the patchwork. Some centers operate only within Africa, while others operate on a more global scale. In addition, the most recent CGIAR reorganization in 2010 transformed CGIAR from a loose conglomerate of individual centers into a stronger integrated entity (Chapter 15, this volume).

**Weak Organization and Management**

An assessment of African NARSs by FARA in 2005 (FARA 2006a) revealed that 54 percent of the agricultural research agencies surveyed in SSA lacked a long-term strategic plan. Of those that had a strategic plan, about a quarter had no implementation plan. Moreover, 38 percent of the respondents rated their capacity to undertake research priority setting, program planning, and M&E as inadequate.

Based in part on this assessment, FARA and the SROs initiated the program Strengthening the Capacity for Agricultural Research and Development in Africa (SCARDA) in 2007. In preparation, a more in-depth assessment of the 12 focal institutes that participated in the pilot phase of the program was undertaken in 2007/08. Organization and management topics that were most frequently mentioned as a weakness included research planning and priority setting, M&E, financial management, human resource management, and mobilization of funding. SCARDA offered various training opportunities addressing (some of) these issues (Annor-Frempong, Roseboom, and Ojijo 2012), but the program has been dormant since the completion of the pilot phase in 2010, with the exception of some subregional activities. More investment in this line of capacity building is definitely warranted. An important lesson learned from SCARDA and similar initiatives is that management processes require permanent maintenance. Many African agricultural research organizations have received the necessary assistance with strategic planning, priority setting, financial management, M&E, and so on in the past, but they often fail to maintain and update such processes.
Since the 1970s, the World Bank has played an important and dominant role in the development of agricultural research in SSA. Three distinctive waves of World Bank investment can be identified:

1. During the 1970s, 1980s, and 1990s, the World Bank strongly supported the creation of national agricultural research organizations or institutes, which usually required major investments in infrastructure and human resources, as well as in the design of the new organizational governance structure.

2. From the mid-1990s onward, however, World Bank projects shifted their emphasis to improving the performance of existing organizations. Topics that dominated this new agenda included redefining the role of government to include greater private-sector participation and the promotion of public–private partnerships; decentralization, either geographically or to lower levels of government; stakeholder participation; new funding mechanisms, particularly competitive funding schemes; and systemwide linkages. As documented by Chema, Gilbert, and Roseboom (2003), many of the reforms introduced during this era were strongly influenced by new public management theory promoting the use of private business management concepts in a public-sector context (including competition, client orientation, production targets, and contracts).

3. The current wave of World Bank investment in agricultural research in SSA, which began in 2007, comes in the form of subregional agricultural productivity programs, as previously discussed.

Insufficient Human, Financial, and Physical Resources

The Global Forum on Agricultural Research recommends that developing countries invest at least 1.0–1.5 percent of AgGDP in agricultural research (Lele et al. 2010). Although there is no theoretical underpinning for this recommendation, the lower end of the target (1 percent) has been a widely accepted norm for public investment in agricultural research by developing countries for some time, but most African countries fall short of this target (Figure 2.3). In addition, high volatility of donor funding causes serious boom-and-bust problems (Chapter 4, this volume). Underinvestment in agricultural research is further exacerbated by the fact that the few resources available are spread too thinly over a very wide range of research topics and, hence, are not making much progress in any of them. What matters is not only the absolute volume of funding, but also how it is allocated across the different
inputs needed to implement a research program. Common imbalances are understaffing combined with low salaries and poor working conditions, which undermine staff motivation, along with insufficient capital and operating budgets to properly maintain infrastructure and equipment and support the day-to-day conduct of research. Lack of operating budgets also constrains much-needed on-farm, adaptive research trials.

Many African NARSs are currently experiencing a wave of retirement of relatively well-qualified and experienced agricultural researchers (Chapter 8, this volume) who were trained overseas in the 1970s and 1980s and were subsequently recruited into the newly established NARIs. Thereafter, recruitment was often scaled down or frozen for long periods, in part because of the structural adjustment programs of the 1990s. The growth in the number of agricultural researchers employed dropped from an average 6.3 percent per year in the 1970s, to 4.1 percent per year in the 1980s, to 1.3 percent per year in the 1990s. In 2000–2011, growth bounced back to a moderate average level of 3.5 percent per year (calculated by the authors from ASTI 2014). This slow growth has skewed the age distribution of agricultural researchers in many African NARSs, and with the current exodus of retiring researchers, significant expertise is being lost. New recruits have predominantly been educated locally, but a major concern is that the quality of that education is substandard, particularly in terms of knowledge of research methodologies and statistics. Several focal institutes that participated in the SCARDA program indicated a strong need for on-the-job training of newly recruited researchers on these particular topics (Annor-Frempong, Roseboom, and Ojijo 2012).

Relatively little is known about the adequacy of agricultural research infrastructure in SSA. The World Bank has traditionally been an important provider of funding for agricultural research infrastructure, but the agricultural productivity program model only focuses on specific commodities and issues, leaving large components of NARSs behind. With the exception of China, most bilateral donors are reluctant to invest in agricultural research infrastructure.

**Weak Coordination and Collaboration**

Another often-cited constraint to the functioning of African NARSs is the weakness of institutional linkages within and between national and supranational entities, between agricultural research and agricultural extension, and between research providers and end users. These issues are discussed in turn below.

1. **Weak linkages within and between national and supranational agricultural research entities.** Many African NARSs are weak or outright
dysfunctional at the system level. NARS coordination mechanisms (ranging from ad hoc committees to agricultural research councils) are not uncommon, but they are often constrained by lack of resources, commitment, and goals. Interestingly, cross-border linkages in agricultural research in SSA have improved significantly over the past decade as a result of the activities of FARA, the SROs, and the regional agricultural productivity programs.

2. **Weak linkages between agricultural research and extension providers.** This classic system constraint remains problematic in most African countries. A recent survey of agricultural researchers in Ghana and Nigeria revealed little interaction of researchers with agricultural extension or with other innovation actors (Ragasa, Abdullahi, and Essegbey 2011). Underinvestment in agricultural extension is perhaps even worse than in agricultural research. Moreover, political interference and frequent changes in extension modalities have added to the complexity of creating proper linkages between research and extension.

3. **Weak linkages between agricultural research providers and end users (farmers, traders, and processors).** The concept of the agricultural innovation system has introduced a far more holistic and interactive approach to agricultural innovation and has placed end users at the center (World Bank 2012). An important innovation is the introduction of innovation platforms, which incorporate all the different actors, including agricultural research and extension, to define mutual goals and facilitate collaboration and coordination (Chapter 13, this volume).

**Conclusion**

Despite substantial growth in agricultural research capacity across Africa over the past 50 years, agricultural research intensity ratios—such as agricultural researchers per 100,000 economically active agricultural population and agricultural research expenditures as a percentage of AgGDP—have been relatively weak and stagnant on average. In other words, African countries have continued to underexploit the potential of (scientific) knowledge to boost agricultural productivity. Despite CAADP’s efforts to promote stronger investment in agriculture (including agricultural research), on average, evidence does not indicate significant improvement in the relative intensity of agricultural research in the region. What matters is not only the volume of inputs invested in agricultural research, but also how these inputs are being used. Weak organization and
management continue to be widespread among African agricultural research organizations, and more capacity building in this area is warranted. Many organizations also expect that the adoption of more integrative research approaches (such as innovation platform and value-chain approaches) have the potential to improve the impact of agricultural research. This, however, requires substantial capacity building of existing and future researchers in these new research methods and approaches.

At a higher level, a topic that has attracted significant interest and support over the past decade is stronger collaboration among African NARSs in the form of joint research programs and regional centers of excellence. Such collaboration is expected to eventually lead to higher research impact. While optimizing the use of agricultural research resources is to be lauded, investments in agricultural research undoubtedly need to be drastically increased. Taking into account where an additional dollar has the biggest impact, priority should be given to investment in CGIAR, NARSs in countries with large agricultural sectors, and cross-country collaborative research. This does not mean that local adaptive research should be neglected (it is needed to exploit the benefits of more upstream research), but only that the potential returns to such research are generally lower.

References


