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Investing in Sub-Saharan African Agricultural Research: Recent Trends

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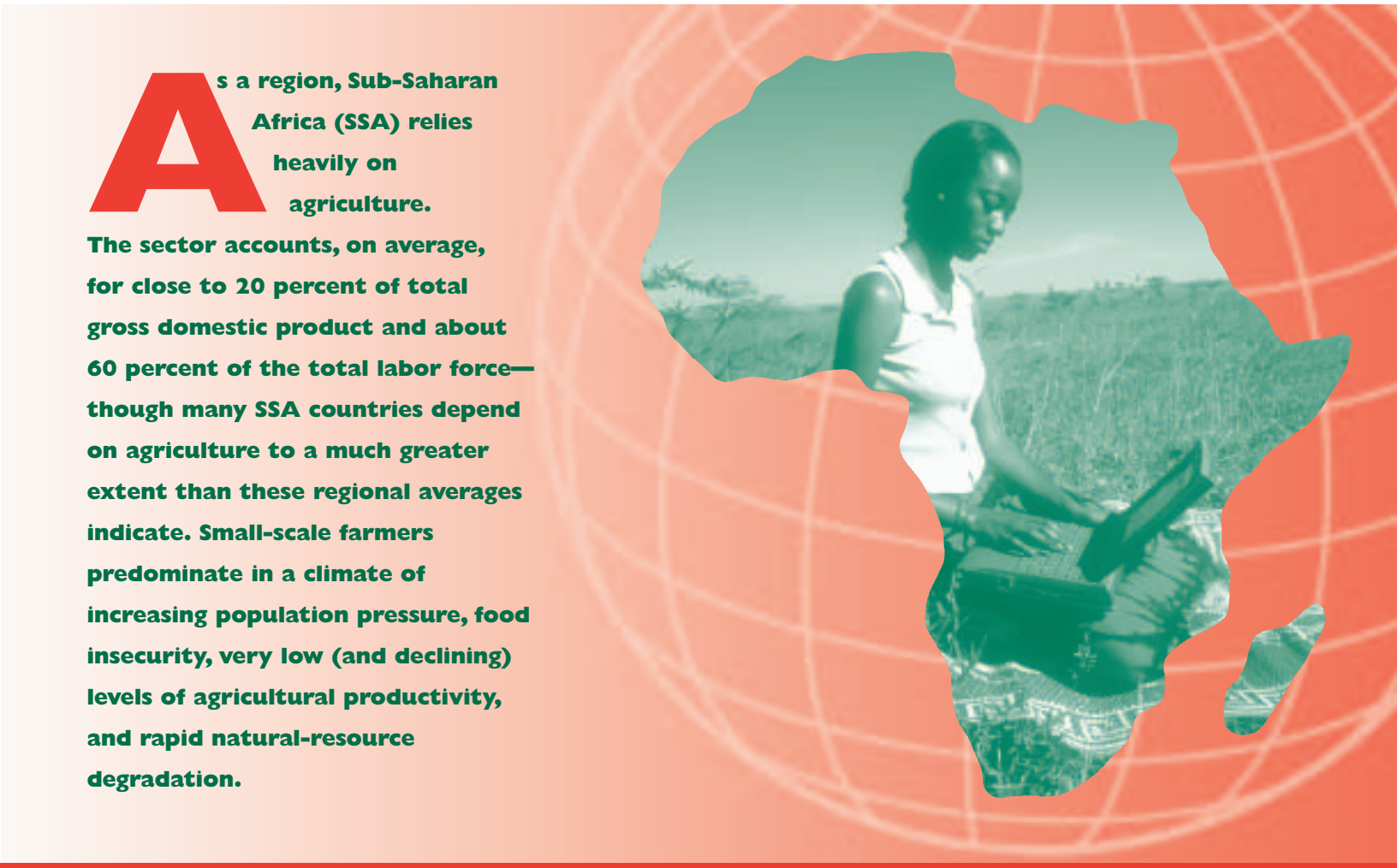

As a region, Sub-Saharan Africa (SSA) relies heavily on agriculture. The sector accounts, on average, for close to 20 percent of total gross domestic product and about 60 percent of the total labor force—though many SSA countries depend on agriculture to a much greater extent than these regional averages indicate. Small-scale farmers predominate in a climate of increasing population pressure, food insecurity, very low (and declining) levels of agricultural productivity, and rapid natural-resource degradation.

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Increasing agricultural productivity and food security will require new and improved technologies and their broad dissemination, and agricultural research and development (R&D) institutions are the channel through which this will occur. Considerable empirical evidence indicates high rates of return from agricultural R&D investments, making agricultural research a cost-effective way for governments to accelerate agricultural development. But despite the mass of evidence pointing to agricultural development as a priority, growth in agricultural research investments in SSA has stagnated over the past two decades.

INSTITUTIONAL DEVELOPMENTS IN PUBLIC AGRICULTURAL R&D

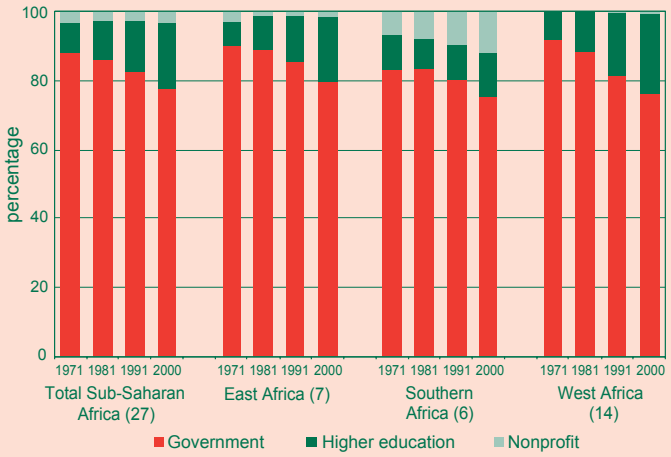
With political independence in the late 1950s and early 1960s, many African countries inherited the agricultural research infrastructure established by former colonial powers. Some countries inherited very specialized institutes that did not necessarily address their production needs, while other (often smaller) countries were unable to sustain their systems when financial resources and expatriate research staff were withdrawn. Research in the immediate postcolonial period focused mainly on export crops, and little attention was paid to the production problems of subsistence farmers. Hence, many countries were left with minimal physical, human resource, or organizational research capacity.

In the early years after independence, most countries focused on building capacity, specifically in terms of replacing expatriate staff with national researchers and enhancing research infrastructure, a process that was often hindered by political unrest and institutional instability. By the early 1980s, the focus of reform turned toward improving the effectiveness of national agricultural R&D, which involved amalgamating disparate research activities within a single agency, coordinating and developing national agricultural research plans, and improving management practices such as planning, monitoring, and evaluation. In more recent years, reforms in SSA have focused on issues such as redefining the government's role in agricultural research, decentralizing decisionmaking processes, increasing farmer/stakeholder participation, identifying new funding sources and mechanisms, and strengthening system linkages.

Nonetheless, despite significant capacity expansion in the 1970s and 1980s, agricultural research in SSA remains heavily fragmented, with more than half the region's countries employing fewer than 100 full-time equivalent (FTE) researchers each. In addition, the government still conducts the majority of agricultural research, having more than three-quarters of total agricultural R&D staff in 2000 (Figure 1). And while the number of agriculture-related universities, colleges, and schools significantly expanded over this time (the share of the higher-education sector in the continent's total agricultural R&D capacity grew from 8 percent in 1971 to 19 percent in 2000), the individual capacity of many remains very small; more than 40 percent of the 86 agricultural higher-education agencies in Nigeria and Sudan employed fewer than five FTE researchers in 2000, for example.

While nonprofit institutions, by definition, are not directly controlled by national governments, they are often linked to producer organizations and thereby receive most of their funding through taxes levied on production or exports; examples include agencies conducting research on tea (Kenya, Malawi, Tanzania), coffee (Kenya, Tanzania, Uganda), cotton (Zambia), and sugar (Mauritius, South Africa). Other types of nonprofit institutions (independent of producer organizations) have been established in a number of countries, such as Madagascar and Togo, but nonprofit institutions still play a limited role in agricultural research in the region. In 2000 they accounted for only 3 percent of SSA's total agricultural research capacity (measured by number of FTE researchers).

FIGURE 1 Total Public Agricultural Research Staff by Institutional Category, 1971–2000



Source: N. M. Beintema and G. J. Stads, *Agricultural R&D in Africa: An Era of Stagnating Growth* (IFPRI, forthcoming).

Notes: Figures in parentheses indicate the number of countries. The 7 East African countries are Burundi, Eritrea, Ethiopia, Kenya, Sudan, Tanzania, and Uganda; the 6 Southern African countries are Botswana, Madagascar, Malawi, Mauritius, South Africa, and Zambia; the 14 West African countries are Benin, Burkina Faso, Republic of Congo, Côte d'Ivoire, Gabon, Gambia, Ghana, Guinea, Mali, Mauritania, Niger, Nigeria, Senegal, and Togo. Prior to 1991, data were not available for 6, mainly small, countries and were estimated using the trends for the other countries in the respective subregions. Data for West Africa, excluding Nigeria, are for 2001.

HUMAN AND FINANCIAL RESOURCES IN PUBLIC AGRICULTURAL R&D

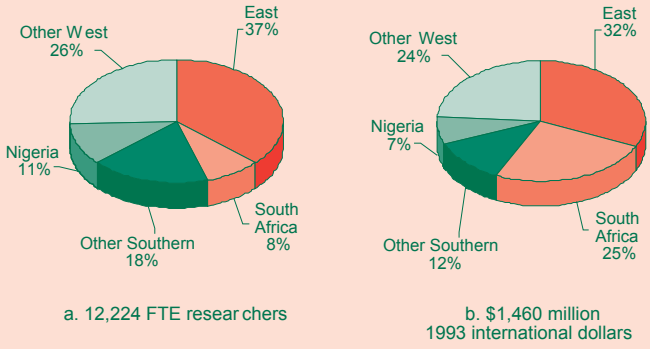
In 2000, the total number of FTE researchers working in public agricultural research agencies in SSA was well over 12,000 (Figure 2a), with equal shares active in East and West Africa (37 percent each) and the remainder in Southern Africa (26 percent). About 40 percent of this total capacity was located in 5 of the 48 countries: Nigeria and South Africa had the largest capacities (1,352 and 1,029 FTE researchers, respectively), followed by Kenya, Sudan, and Ethiopia—all three located in East Africa. That same year, spending on R&D totaled close to $1.5 billion in 1993 international dollars (Figure 2b). The spread of total spending over the three subregions differed from the allocation of total SSA research staff. About 37 percent of financial resources were spent in Southern Africa (including South Africa, which alone accounted for a quarter of total spending). The subregion's share of spending considerably surpassed its share of researchers. Although Nigeria employed the highest total number of FTE researchers in SSA (11 percent), its share of spending was only 7 percent, highlighting the more limited resources available to Nigerian researchers compared with their counterparts in South Africa, for example.

Time-series data on public agricultural research staff and spending were available (or could be estimated) for 27 SSA countries, accounting for a combined 74 percent of the region's total agricultural research capacity in 2000. Between 1971 and 2000, total numbers of agricultural research staff increased threefold (at an average of 4.0 percent per year), but the majority of this growth occurred in the 1970s and 1980s (Figure 3a). Along with these increased numbers, the level of formal training also rose. In 1971, only 45 percent of the FTE researchers had postgraduate-level training; by 1991 that share had grown to 65 percent, and by 2000 it was 75 percent, with a quarter of researchers holding doctoral degrees.

Most of the growth in public agricultural research spending in SSA took place in the 1960s when real (inflation-adjusted) spending increased by an annual average of 6.8 percent. During 1971–2000, real public agricultural R&D spending for our 27-country sample grew more slowly, at an average annual rate of 1.4 percent (Figure 3b). Although expenditure growth appears to have been more evenly distributed over time than growth in researcher numbers, the annual growth rate declined from 2.0 percent in the 1970s to only 0.8 percent in the 1990s. As a consequence, average spending per scientist declined by about half between 1971 and 2000, though for many countries the decline was more extreme.

These regional averages mask considerable differences among the sample countries. Burundi and Côte d'Ivoire, for example, experienced strong declines in total FTE researcher

FIGURE 2 Total Public Agricultural Research Staff and Spending in Sub-Saharan Africa, 2000



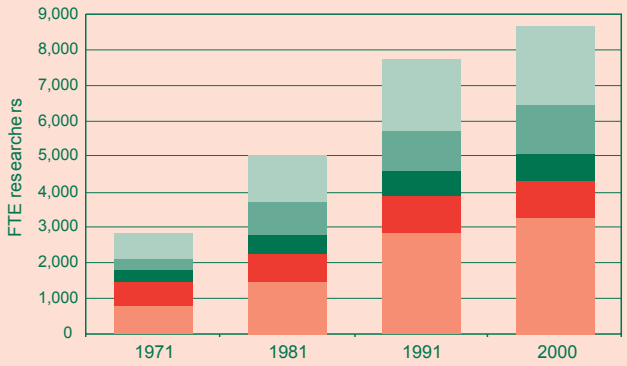
a. 12,224 FTE researchers

b. $1,460 million 1993 international dollars

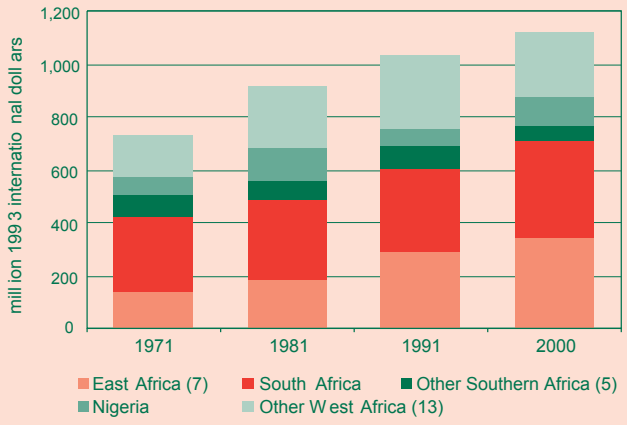
Source: See Figure 1.
Notes: The total includes all 48 Sub-Saharan African countries. The research capacity of 21 countries has been estimated in line with their share of total agricultural output. Financial data were converted to 1993 international dollars by deflating current local currency units with local GDP deflator (base year 1993) and then converted to international dollars using a 1993 purchasing power parity (PPP) index. Data for Other West Africa, with the exception of Nigeria, are for 2001.

FIGURE 3 Trends in Public Agricultural Research Staff and Spending for 27 Countries, 1971–2000

a. Total agricultural researchers

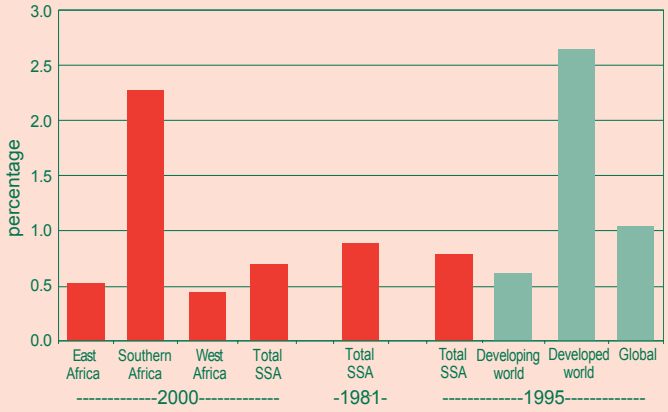


b. Total agricultural R&D spending



Source and notes: See Figures 1 and 2.

FIGURE 4 Agricultural Research Intensity Ratios Over Time and Compared Globally



Source: See Figure 1.
Note: Data for West Africa, with the exception of Nigeria, are for 2001.

numbers in the 1990s (due to civil war in Burundi and the departure of expatriate staff from Côte d'Ivoire with the nationalization of its agricultural R&D system). In contrast, total researcher numbers increased by more than two-thirds in Botswana and Ethiopia over the same period because of intensified government investment in agricultural R&D in combination with large World Bank–funded projects. About half the sample countries experienced negative annual growth in total agricultural R&D spending during the 1990s. Rates in Burundi, the Republic of Congo, and Sudan fell below the negative 10 percent mark, for example. Declines resulted from political unrest (Burundi and Sudan) or the completion of large donor-funded projects (Burkina Faso, Guinea, Madagascar, Niger, Togo, and Zambia). In contrast, total spending in Nigeria—which had one of the lowest spending-per-scientist levels in SSA—grew by an annual average of 6.3 percent in the 1990s. This was a combined result of increased agricultural research staff numbers (mainly in the higher-education sector) and a substantial rise in civil service salaries in 2000. Spending in South Africa also grew between 1991 and 2000, but the increase occurred in the first half of the decade, after which spending contracted considerably due to reductions in federal and provincial government funding for agricultural research. Excluding Nigeria and South Africa, total public agricultural R&D spending in SSA actually declined by 0.2 percent per year in the 1990s.

INTENSITY RATIOS

Total public spending as a percentage of agricultural output (agricultural GDP) is a common research investment indicator that helps place a country's agricultural R&D spending in an internationally comparable context. In 2000, Africa invested $0.70 for every $100 of agricultural output (in international dollars)—lower than the 1981 level of $0.95 (Figure 4). Ratios ranged from 0.20 percent or lower in The Gambia, Niger, and Sudan to over 3.00 percent in Botswana, Mauritius, and South Africa. In 1995, the latest year for which global data are available, SSA's average agricultural research intensity ratio was slightly higher, at 0.79 percent—greater than the average ratio for the developing world (0.62 percent) but lower than the global average (1.04 percent).

There is no official recommendation on preferred intensity ratios for agricultural R&D investments. In the early 1980s the World Bank set a 2 percent target, which has been widely quoted since. Others, however, have found an intensity ratio of 1 percent to be a more realistic objective, but few countries in SSA have achieved even this lower target.

FUNDING PUBLIC AGRICULTURAL R&D

Agricultural research in SSA, as in many developing-country regions, became increasingly dependent on donor funding toward 2000; yet the share of donor contributions in total funding declined in the last half of the 1990s—at least for the 23 countries in our funding sample. Such declines resulted in part from the termination of a large number of World Bank projects in support of agricultural R&D or the agricultural sector at large. Donor contributions (including World Bank loans) accounted for an average of 35 percent of funding to principal agricultural research agencies in 2000. Five years earlier, close to half the agricultural research funding of the 20 countries for which time-series data were available was derived from donor contributions (Figure 5).

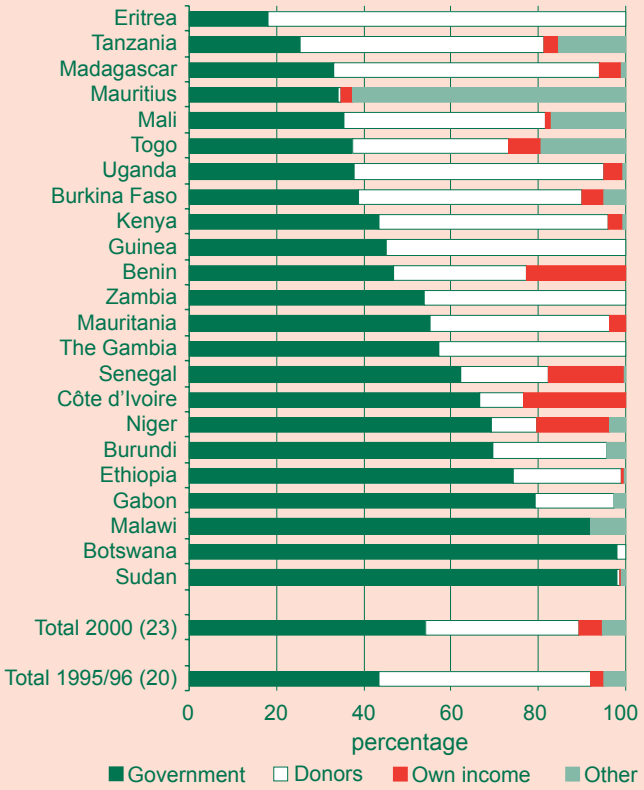
Once again, the average masks great variation across countries. In 2000, donor funding accounted for more than half of the agricultural R&D funding in 7 of the 23 sample countries. Eritrea, in particular, was highly dependent on donor contributions. Its principal agricultural research agencies received more than three-quarters of their funding from donors. In contrast, donor funding was quite insignificant in Botswana, Malawi, Mauritius, and Sudan (less than 5 percent). From the mid-1990s to 2000, one-third of the 20 time-series countries experienced declines of 10 percentage points or more in donors' share of total agricultural R&D funding, while donor dependency increased by at least 10 percentage points for four countries. Of note, donor funding fell from over 50 percent of total funding to 10 percent or less for Malawi, Niger, and Sudan, as a result of the completion of major projects funded by World Bank loans or contributions from the Food and Agriculture Organization of the United Nations (FAO).

Funding from sources other than government or donors, such as internally generated revenues, was relatively small, representing 11 percent of total funding in 2000 with the exception of Benin and Côte d'Ivoire. The principal agricultural

research agencies in these two countries generated significant shares of total funding from research contracts, commercialization of agricultural products, and dissemination of research results. In the case of Côte d'Ivoire, the World Bank's second National Agricultural Services Support Project (PNASA II) had an important commercialization component, stipulating that 35 percent of the annual budget of the National Agricultural Research Center (CNRA) was to be self-generated through mechanisms such as commodity sales.

Only limited funding information was available for the largest agricultural research systems—Nigeria and South Africa—hence these were excluded from Figure 5. The majority of agricultural research in Nigeria is currently funded by the government, but in the 1990s considerable funding was provided through a World Bank loan as part of the National Agricultural Research Project (NARP). Funding for agricultural research in South Africa comes primarily from the government, commodity trusts, levies from producer organizations, and private-sector enterprises; unlike in most other countries in SSA, agricultural research receives very limited donor funding.

FIGURE 5 Sources of Funding by Country, 1995/96 and 2000



Source: See Figure 1.
Notes: Funding sources are for the main agricultural research agencies only. Combined, these agencies accounted for 76 percent of total spending for the 23-country sample in 2000. The total for 1995/96 excludes Benin, Côte d'Ivoire, and Gabon. Data for West Africa, with the exception of Nigeria, are for 2001.

THE PRIVATE SECTOR

Agricultural research conducted by the private sector has grown in recent years, especially in the developed world. Nevertheless, the role of the private sector in the developing world is still small and will likely remain so, given weak funding incentives for private research. In addition, many of the private-sector activities in developing countries focus solely on the provision of input technologies or technological services for agricultural production, but most of the technologies are produced in the developed world.

In 2000, private firms in our 27-country sample invested $26 million (in 1993 international dollars) in agricultural R&D, representing only 2 percent of total public and private research investments that year (Table 1). South Africa, with $16 million, accounted for close to two-thirds of agricultural

Table 1—Public and Private Agricultural Research Investments, 2000

Region/country	Total spending			Shares	
	Public	Private	Total	Public	Private
	(million 1993 international dollars)			*(percentage)*	
East Africa (7)	341.4	5.4	346.8	98.4	1.6
South Africa	365.6	15.6	381.2	95.9	4.1
Other Southern Africa (5)	62.4	2.8	65.2	95.7	4.3
Nigeria	106.0	–	106.0	100.0	–
Other West Africa (13)	209.3	1.8	211.1	99.1	0.9
Total (27)	**1,084.7**	**25.6**	**1,110.3**	**97.7**	**2.3**

Source: See Figure 1.
Notes: Figures in parentheses indicate the number of countries. A number of private companies in some countries were excluded because they chose not to share their financial and human resource data. In the case of South Africa, we estimated the share of these omitted companies at about one-third of South Africa's private-sector agricultural R&D spending. Data for West Africa, with the exception of Nigeria, are for 2001.

research conducted by the private sector. The private sector does, however, play a stronger role in funding agricultural research, as opposed to actually conducting the research. Many private companies contract government and higher-education agencies to perform research on their behalf.

For reasons of confidentiality, many private companies are reluctant to provide information on their resources and investments in agricultural research. In addition, private research activities in SSA are often small scale and ad hoc, making it difficult to capture accurate information. Were data for all the private agencies in SSA included, the private-sector share in overall agricultural research investments would be slightly higher, but seemingly not substantially so.

CONCLUSION

Agricultural research capacity is an important factor in building food security and economic stability in Africa. Furthermore, new and better-targeted technologies are essential to this process, and a well-developed and well-supported agricultural research system is a prerequisite not only for the design of these technologies but also for their dissemination and adoption.

In 2000, R&D spending in SSA totaled nearly $1.5 billion (in 1993 international dollars), but funding has become increasingly scarce, irregular, and donor-dependent. These circumstances are often accompanied by poor national science and technology (S&T) policies and inefficient and ineffective agricultural research management. Institutional reforms and sound S&T policies are needed to improve the efficiency and effectiveness of agricultural research in Africa. Donor-supported projects have helped to build capacity in many countries, but these advances will quickly be eroded with the withdrawal of donor funding if other sources are not consolidated and further developed. While there is no universally recognized standard for the optimal size of agricultural R&D investments in Africa, a recent report of the InterAcademy Council (IAC) recommends doubling Africa's agricultural research intensity ratio (agricultural R&D investments as a percentage of agricultural GDP) to 1.5 by 2015. In view of the low, and often declining, level of agricultural R&D investments in SSA, both in real terms and as a ratio of agricultural output, attaining this goal will be extremely challenging.

For further reading: S. Chema, E. Gilbert, and J. Roseboom, *A Review of the Key Issues and Recent Experiences in Reforming Agricultural Research in Africa*, Research Report No. 24 (The Hague: International Service for National Agricultural Research, 2003); IAC (InterAcademy Council), *Realizing the Promise and Potential of African Agriculture: Science and Technology Strategies for Improving Agricultural Productivity and Food Security in Africa* (Amsterdam, 2004); P. G. Pardey and N. M. Beintema, *Slow Magic: Agricultural R&D a Century after Mendel,* IFPRI Food Policy Report (Washington, D.C.: IFPRI, 2001); P. G. Pardey, J. Roseboom, and N. M. Beintema, "Investments in African Agricultural Research," *World Development* 25, no. 3 (1997): 409–23.

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This brief draws directly on a dataset for the 1990s developed through a comprehensive 27-country survey during 2000–03 in collaboration with many local partners. The brief is based on a forthcoming IFPRI report and a series of country briefs that are (or soon will be) available on the Agricultural Science and Technology Indicators (ASTI) website at http://www.asti.cgiar.org. Note that this brief focuses only on SSA because of lack of available data for North Africa. New surveys have been implemented, however, in Egypt, Morocco, and Tunisia.

The ASTI initiative comprises a network of national, regional, and international agricultural R&D agencies and was managed jointly by IFPRI and ISNAR until recently. The initiative, which now resides within IFPRI, compiles, processes, and makes available internationally comparable data on institutional developments and investments in public and private agricultural R&D worldwide and analyzes and reports on these trends in the form of occasional policy digests for research policy formulation and priority-setting purposes.

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