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RECENT DEVELOPMENTS IN PUBLIC AGRICULTURAL RESEARCH

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LONG-TERM INVESTMENT AND CAPACITY PATTERNS IN PUBLIC AGRICULTURAL R&D

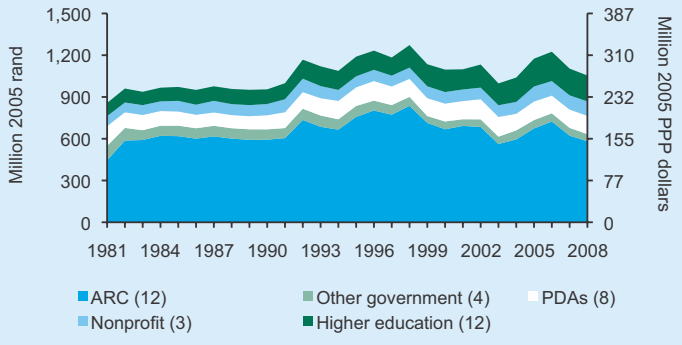
Since the early 1990s, yearly spending on public agricultural research and development (R&D) in South Africa has varied considerably. In 2008 the country spent 1 billion rand or 272 million PPP dollars on agricultural R&D, both in 2005 constant prices (Figure 1; Table 1).[1] Unless otherwise stated, all dollar values in this note are expressed in purchasing power parity (PPP) prices.[2] PPPs reflect the purchasing power of currencies more effectively than do standard exchange rates because they compare the prices of a broader range of local—as opposed to internationally traded—goods and services. Agricultural R&D spending was relatively constant during the 1980s and began to rise from 1991 onward. Levels fluctuated substantially from 1997 due to a change in government funding formulas; instead of a core funding dispensation, the government began to allocate parliamentary grants to the Science Councils on a competitive basis.

Total public agricultural R&D capacity increased from the early 1980s, peaking at 1,091 full-time equivalent (FTE) researchers in 1996. Numbers declined by one-third between 1997 and 2004, rebounding only slightly thereafter to reach 784 FTE researchers in 2008 (Figure 2). Trends varied considerably

Key Trends Since 2000

- Public agricultural research and development (R&D) expenditures in South Africa fluctuated considerably between 2000 and 2008, largely due to shifts in government funding to the country's main agricultural research agency, the Agricultural Research Council (ARC).
- National agricultural researcher numbers declined by one-third during 1997–2004, with most of the attrition involving government agencies, particularly ARC. Within ARC, departures were highest among those qualified to the BSc level.
- Despite the decline, government agencies still account for the vast majority of the country's agricultural R&D spending and staffing (around 75 percent). Nonprofit and higher education agencies experienced limited growth since 2000.
- Government contributions continue to be the primary source of funding for agricultural R&D, supplemented by the sale of goods and services and support from producer/commodity organizations. Donor contributions are minimal by comparison with other funding sources.

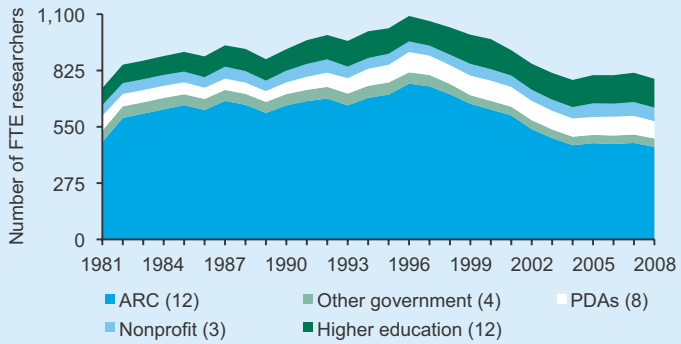
Figure 1—Public agricultural R&D spending adjusted for inflation, 1981–2008



Sources: Calculated by authors from ASTI–UP–ARC 2009–10; Liebenberg, Beintema, and Kirsten 2004; ARC 2010; DEAT 2010; DoA 2009; and RSA 2010.

Notes: Figures in parentheses indicate the number of agencies in each category. Dates represent fiscal years (April to March). Data for other government agencies are based on estimates from Treasury records (RSA 2010). For more information on coverage and estimation procedures, see the South Africa country page on ASTI's website at asti.cgiar.org/south-africa.

Figure 2—Public agricultural research staff in full-time equivalents, 1981–2008



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Notes: Figures in parentheses indicate the number of agencies in each category. Dates represent fiscal years (April to March).

Table 1—Overview of public agricultural R&D spending and research staff levels, 2008

Type of agency	Total spending			Total staffing	
	Rand	PPP dollars	Shares	Number	Shares
	(million 2005 prices)		(%)	(FTEs)	(%)
Government					
ARC (12)	582.3	150.4	55.2	452.0	57.6
Other government (4)	50.9	13.2	4.8	41.3	5.3
PDAs (8)	131.4	33.9	12.5	84.5	10.8
Nonprofit (3)	103.6	26.8	9.8	66.0	8.4
Higher education (12)	186.0	48.0	17.6	140.6	17.9
Total (39)	**1,054.2**	**272.3**	**100**	**784.3**	**100**

Sources: Compiled by authors from ASTI-UP-ARC 2009-10; Liebenberg, Beintema, and Kirsten 2004; ARC 2010; CeSTII 2008; DEAT 2010; DoA 2009; NMMU 2010; NWU 2010; RSA 2010; UFS 2010; UL 2010; UP 2010; UNISA 2010; Univen 2010; and Unizulu 2010.

Notes: Figures in parentheses indicate the number of agencies in each category. Dates represent the fiscal year (April 2008 to March 2009). Data for other government agencies are based on estimates from Treasury records (RSA 2010).

across agencies, with some experiencing uneven growth and others, principally the government agencies, experiencing significant contraction from the 1990s onward.

South Africa's main agricultural research agency, the Agricultural Research Council (ARC), now comprises 11 research institutes and a coordinating office. Three research institutes focus on grain and industrial crops—the Grain Crops Institute (CGI), Small Grains Institute (SGI), and Institute for Industrial Crops (IIC); three institutes focus on horticulture—the Vegetable and Ornamental Plant Institute (VOPI), Institute for Tropical and Subtropical Crops (ITSC), and Infruitech-Nietvoorbij (NIETV); two institutes (the largest in terms of agricultural FTE researchers) focus on livestock—the Animal Products Institute (API) and Onderstepoort Veterinary Institute (OVI); and three institutes focus on natural resources and engineering—the Plant Protection Research Institute (PPRI), Institute for Agricultural Engineering (IAE), and Institute for Soil, Climate, and Water (ICSW). As stated, OVI and API are the largest agencies in terms of human resource capacity, employing 70 and 64 FTE researchers in 2008, respectively. The smallest institutes are IAE and IIC, employing 11 and 14 FTE researchers in 2008, respectively. The remaining agencies employed 22–59 FTE researchers in 2008. ARC accounted for over half the country's agricultural R&D spending and research capacity in 2008, which is a much smaller share than in the 1990s. From the mid-1990s until 2008, the net decline in total number of FTE researchers at ARC amounted to around 300, mainly as a result of the ongoing structural transformation of the council and disrupted funding mechanisms at the commodity organizations (Liebenberg, Pardey, and Khan 2010). Total staff further declined by 19 since 2008. Departures were initially encouraged by offers of voluntary severance in an effort to reduce the size of government, but from 2001, staff attrition (mostly of BSc-qualified researchers) was prompted by dissatisfaction over restructuring initiatives.

Four other national agencies conduct agricultural research in South Africa: Grootfontein Agricultural Development Institute (GADI); the Chief Directorate of Research, Antarctica, and Islands in Marine and Coastal Management (MCM); the Division of Food Biological and Chemical Technologies of the Council for Scientific and Industrial Research (CSIR); and the Forestry and Forest Products Research Centre (FFP), a joint venture between CSIR and the University of KwaZulu-Natal. These four agencies accounted for an estimated 5 percent of the country's agricultural research capacity and investment in 2008, amounting to 41 FTE researchers and 51 million rand (or 13 million PPP dollars, both in 2005 constant prices). Investment and capacity levels remained relatively stable since 2000.

Nine provincial departments of agriculture (PDAs) were established in 1994 from six of the seven former agroecological-focused agricultural development institutes and the agricultural administrations of the former homeland and independent states. The mandate of the resulting PDAs includes conducting research on issues and challenges relevant to their respective provinces. However, the individual capacity of each department has changed significantly over time. The reorganization had different effects on the provinces ranging from limited changes to large reorganizations that seriously disrupted the department's research capacity (DoA 2009). The department focusing on the Western Cape is now the country's strongest in terms of research capacity and productivity—employing 31 FTEs in 2008—in part because it escaped major restructuring, compared with most other departments whose provincial boundaries do not match the former agroecological boundaries. Furthermore, the Western Cape produces a unique mix of commodities, including horticulture and wine, and the department is strongly supported by its provincial government (DoA 2009). Seven other PDAs conduct agricultural research, but their capacities vary considerably, from 16 FTE researchers in the Eastern Cape to 3 FTE researchers in Kwazulu-Natal. A ninth department in Gauteng Province outsources all of its research needs to ARC. In 2008, the provincial departments accounted for a combined 11 percent of national agricultural research capacity and 12 percent of national agricultural research investment. Investment fluctuated

ASTI Website Interaction

- More details on institutional developments in agricultural research in South Africa are available in the 2004 country brief at http://www.asti.cgiar.org/pdf/SouthAfrica_CB14.pdf.
- Underlying datasets can be downloaded using ASTI's data tool at www.asti.cgiar.org/data.
- A list of the 24 government, 3 nonprofit, and 12 higher education agencies included in this brief is available at asti.cgiar.org/south-africa/agencies.

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somewhat, but in 2008 was at a similar level as in 2000, around 130 million rand (33 million PPP dollars, in constant 2005 prices). However, their combined research capacity decreased from 100 FTEs in 2000 to 85 FTEs in 2008.

The nonprofit sector in South Africa accounted for 10 percent of agricultural R&D expenditures and 8 percent of research staffing in 2008. The main nonprofit institution is the South African Sugarcane Research Institute (SASRI), a division of the South African Sugar Association (SASA). SASRI, which employed 38 FTE researchers in 2008, is funded through a levy on sugar production, conducts research responding to industry needs, and has strong linkages with other sugar research agencies around the world. Two other nonprofit institutions—the Institute for Commercial Forestry Research (ICFR) hosted by the University of Natal and the Oceanographic Research Institute (ORI)—employed 13 and 15 FTE researchers, respectively, in 2008.

Agricultural research capacity at the higher education sector increased from the early 1990s, but very limited growth occurred during 2000–08. By 2008, the sector accounted for about 18 percent of the country's public agricultural R&D staffing and expenditures. The higher education sector includes 12 departments, schools, and faculties of agriculture and related sciences. The Faculty of Natural and Agricultural Sciences at the University of the Free State and Stellenbosch University's Faculty of AgriSciences employed 33 and 21 FTE researchers in 2008, respectively. The University of Pretoria's Faculty of Natural and Agricultural Sciences and Faculty of Veterinary Science employed 25 and 20 FTE researchers, respectively. The remaining 8 higher education agencies employed fewer than 15 FTE researchers each. Universities are increasingly relying on part-time and contract appointments to fulfill their research mandates, in part a reflection of the general uncertainty and limits of research funding and the greater flexibility of their human resource policies that allow specialized skills to be secured for research initiatives.

ASTI Website Interaction

- Detailed definitions of PPPs, FTEs, and other methodologies employed by ASTI are available at asti.cgiar.org/methodology.
- The data in this brief are predominantly derived from surveys. Some data are from secondary sources or were estimated. More information on data coverage is available at asti.cgiar.org/south-africa/datacoverage.
- More relevant resources on agricultural R&D in South Africa are available at asti.cgiar.org/south-africa.

www.asti.cgiar.org/south-africa

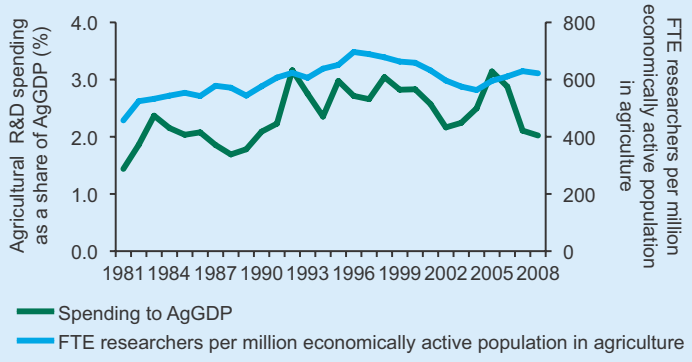
Many private companies conduct agricultural R&D in South Africa, including Monsanto and Pannar. Most of these are subsidiaries of larger multinational companies that focus on seed and fertilizer research. A recent study identified 51 private companies conducting some type of agricultural R&D in South Africa, accounting for 322 million rand (in current 2008 prices) and an estimated 164 researchers, in headcounts not FTEs, in 2008 (Kirsten, Stander, and Haankuku 2010).

Female researchers constituted 42 percent of ARC's total agricultural research staffing in 2008 (ASTI–UP–ARC 2009–10). This represents a decrease in absolute numbers since 2000, but a relative increase in the share of women employed (based on higher attrition of male researchers).

In 2008, for every researcher, ARC employed 1.9 technicians, 0.9 administrative staff, and 1.6 other support staff (ASTI–UP–ARC 2009–10). Absolute support staff numbers at ARC decreased between 2000 and 2008 (Liebenberg, Beintema, and Kirsten 2004), but the ratio of support staff to researchers increased because of the higher decline in the number of researchers. Of note, about 11 percent of technicians held either MSc or BSc degrees (see the section on staff qualifications for more information).

An often-used indicator of agricultural R&D spending across countries is the research intensity ratio, in this case, total public agricultural R&D spending as a percentage of agricultural output (AgGDP). In South Africa, this ratio fluctuated considerably, reflecting erratic trends in both agricultural expenditures and AgGDP (Figure 3). In 2008, for every $100 of agricultural output, South Africa invested $2.02 in agricultural R&D, which is one of the lowest ratios reported by the country since the 1980s. Hence, levels of investment have not kept pace with AgGDP growth or with the government's 3 percent target for agricultural research investment (1 percent of GDP for science research overall). Nevertheless, South Africa's investment level is high compared with most other Sub-Saharan African countries, reflecting a well-established research system despite recent spending and staffing declines. For comparison, 2008 intensity ratios in Ghana, Uganda, and Kenya were $0.94, $1.24, and $1.43, respectively, and 2006 ratios in Brazil and Argentina were $1.68 and $1.27, respectively (Stads, Ruiz, and De Greef 2010). South Africa's investment levels

Figure 3—Intensity of public agricultural research spending and capacity, 1981–2008



Sources: Calculated by authors from Figures 1 and 2; World Bank 2010; FAO 2009.

Note: Dates represent fiscal years (April to March).

are significantly lower than developed countries like the United States ($4.00 in 2007) and Australia ($3.10 in 2007) (Alston, et al. 2010; Mullen 2010).

In terms of agricultural FTE researchers per million economically active population in agriculture, South Africa had one of the highest ratios in Sub-Saharan Africa, at 622 researchers in 2008.

INSTITUTIONAL STRUCTURE AND POLICY ENVIRONMENT

The Department of Science and Technology (DST) is responsible for all science and technology research policy in South Africa. Under the latest national R&D strategy, DST and the relevant line ministries/departments share responsibility for sector-specific science councils. Under this strategy DST is primarily responsible for basic research capacity, while the line departments take responsibility for applied research functions related to their services. Operationally, the Department of Agriculture, Forestry and Fisheries (DAFF), under the Ministry of the same name, oversees ARC. Established in 2003, the National Agricultural Research Forum (NARF) serves as a mechanism to inform policy direction and assisted in developing the 2007 Agricultural Research and Development Strategy; nevertheless, it has been dormant since that time because it does not play a role in policy implementation. As such, the strategy objectives of improving coordination and increasing the ability to leverage additional funding has not yet been achieved.

Among the ARC institutes, three research agencies focusing on livestock were merged to create API in 2006, but the institutional structures of the other national government, nonprofit, and higher education agencies have not changed significantly since 2000.

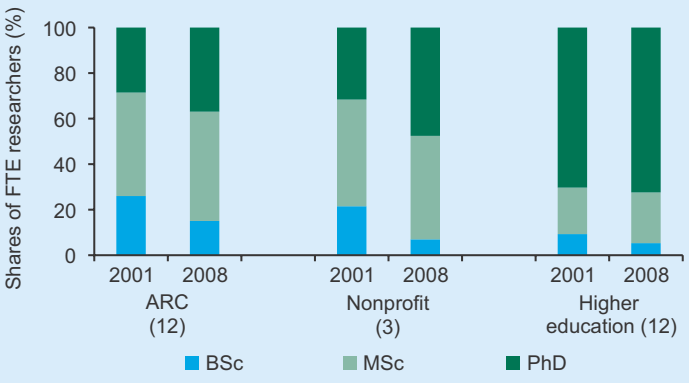
Collaboration with regional and international research agencies continues to expand. Many collaborative projects are implemented jointly between government or higher education agencies and the centers of the Consultative Group on International Agricultural Research (CGIAR), including the International Center for Tropical Agriculture (CIAT), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Maize and Wheat Improvement Center (CIMMYT), and Bioversity International. South African agencies also collaborate with universities in neighboring African countries, as well as in the United States and Europe. At a regional level, South Africa is a member of the Southern African Development Community (SADC) and participates in regional research programs such as the Southern Africa Root Crops Research Network (SARRNET). Collaboration among national agencies is common as well, as the government agencies often engage in various types of collaborative projects with universities and private firms.

RESEARCH STAFF QUALIFICATIONS AND TRAINING

An increasing share of the agricultural research staff at ARC has been trained to the postgraduate level. In 2008, 37 percent of researchers held PhD degrees and 48 percent held MSc degrees (Figure 4). The shift in shares reflects the accelerated decline of staff qualified to the BSc level since the 1990s. In absolute terms, degree-qualified staff numbers declined across all levels, but the highest decline was among staff qualified to the BSc level only; as a result, 2008 levels of BSc-qualified staff were half those recorded in 2001. Many of ARC's junior researchers left to accept positions in the higher education or private sectors, often in a nonresearch capacity. Despite an overall decline in numbers of female researchers, the decline of those qualified to the BSc and MSc levels was not as severe as for male researchers, and the number of female researchers with PhD degrees at ARC actually increased. Consequently, shares of female researchers at all degrees levels increased, achieving parity with male researchers at the BSc level, and nearing parity with male researchers at the MSc level.

ARC employs a significant number of FTE technicians with degree qualifications, but technicians are not officially counted

Figure 4—Research staff trends by degree (in FTEs), 2001 and 2008



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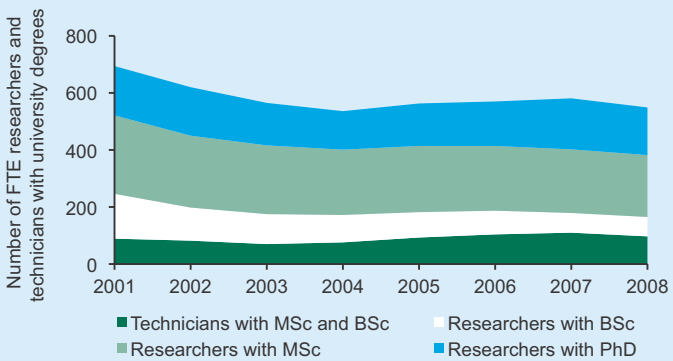
Notes: Figures in parentheses indicate the number of agencies in each category. The PDAs and other government agencies were excluded due to lack of data. Dates represent fiscal years (April to March). Data are for researchers only and therefore exclude 11 MSc-qualified and 86 BSc-qualified technicians (in FTEs), respectively (see Figure 5).

Figure 5—Full-time equivalent researcher and technician trends at ARC, 2001–08



Source: Calculated by authors from ASTI–UP–ARC 2009–10.

Note: Dates represent fiscal years (April to March).

as researchers. In 2008, ARC employed 11 FTE technicians with MSc degrees and 86 with BSc degrees (Figure 5). In contrast with the general decline in FTE researcher numbers at ARC, this represented a slight increase over 2001 levels.

In the nonprofit sector, the number of researchers holding PhD degrees almost doubled between 2001 and 2008. Nonprofit agencies have a slightly larger share of researchers qualified to the PhD level compared with ARC, but during 2001–08 these agencies experienced a similar contraction in the level of staff qualified to the BSc level.

Universities worldwide generally have a higher share of PhD-qualified staff, and this holds true in South Africa: three-quarters of all FTE researchers in the higher education sector held PhD degrees in 2008 and 20 percent held MSc degrees. The number of researchers with BSc degrees also declined in the higher education sector between 2001 and 2008.

Numbers of agricultural researchers are comparatively even across age groups in South Africa. In 2007, about half of all researchers were under 40 years old, whereas a quarter were over 50 years old (ASTI–AWARD 2008).

Funding for researcher training in South Africa originates from various sources. A government-funded scheme established in 2003 by the Department of Agriculture and ARC provides some opportunities. Industries also fund training within specific disciplines considered to be a priority. Other training opportunities can arise through project funding, Fulbright fellowships, or from provincial governments and producer organizations.

INVESTMENT TRENDS

Expenditures

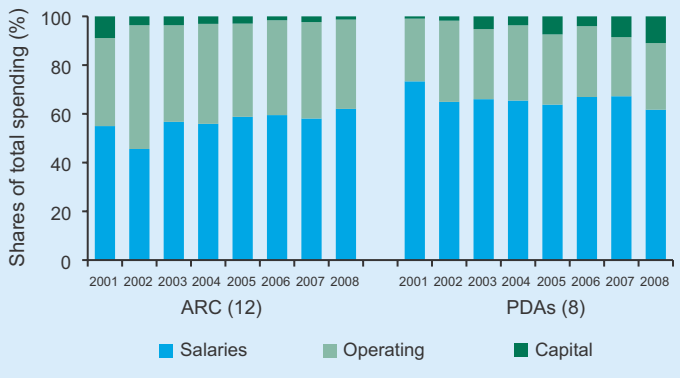
The allocation of research budgets across salaries, operating costs, and capital investments affects the efficiency of agricultural R&D, and therefore detailed cost-category data were collected from government agencies as part of this study. At ARC, salaries accounted for 62 percent of total 2008 expenditures, while operating costs accounted for 37 percent and capital investments accounted for only 1 percent (Figure 6). The share of capital costs represented a significant decrease since 2001, stemming from ARC's new policy of leasing rather than purchasing equipment and vehicles. Salary levels (and overall shares) tend to be much higher among provincial government agencies, but in 2008 average cost-category shares were similar to those reported by ARC: 62 percent for salaries, 27 percent for operating costs, and 11 percent for capital investments. Results within individual provincial departments differed significantly, however, and in some provinces shares of operating costs fluctuated widely, falling as low as 18 percent in some years.

Funding Sources

Agricultural R&D agencies in South Africa are primarily funded by the government through parliamentary grants, supplemented by internal revenues generated from the sale of goods and services, support from producer organizations, and contributions from donors. In 2007, the government provided 66 percent of ARC's funding; 13 percent was derived from the sale of goods and services, 5 percent was derived from producer/commodity organizations, 1 percent represented contributions from donors, and 15 percent was raised through other sources such as interest received on investments and deferred income (Figure 7). Government funding declined in the 1990s, reaching 55 percent of total funding to ARC in 2001, but 2008 data indicate a slight upswing in more recent years. As mentioned, funding for the Science Councils changed from a formula based core funding dispensation to a competitively allocated parliamentary grant, increasing the volatility of government funding.

Meanwhile, funding raised through the sale of goods and services and from producer or commodity organizations declined during 2000–07. Commodity Control Boards were phased out in 1997, eliminating the collection of levies for research and other functions. Commodity and producer organizations now receive their income from trust funds derived from the reserve funds of the former control boards and from newly implemented voluntary levies primarily used to promote the industry. The trustees allocate a share of this income to research. In 2009, research-specific levies were introduced on small grains

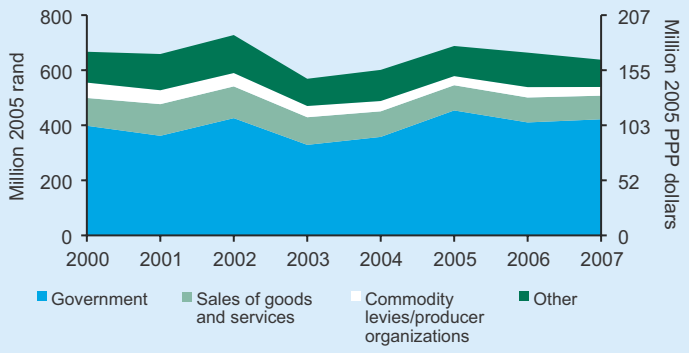
Figure 6—Cost category shares of ARC, 2001–08



Sources: Calculated by authors from ASTI–UP–ARC 2009–10, ARC 2010, and RSA 2010.

Notes: Figures in parentheses indicate the number of agencies in each category. Dates represent fiscal years (April to March).

Figure 7—Funding sources of ARC, 2000-07



Sources: Calculated by authors from ASTI–UP–ARC 2009–10 and ARC 2010.

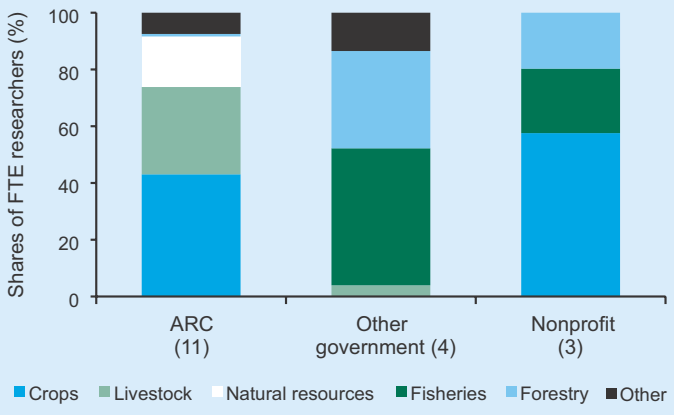
Note: Dates represent fiscal years (April to March).

and livestock; the resulting income was allocated to ARC (80 percent) and the universities (20 percent). Additional funding arrangements, such as a research levy on the sales of agricultural produce, were envisaged in the 2007 national agricultural R&D strategy, but as of 2010, none of these alternatives had been implemented.

Donor funding is minimal in South Africa compared with many other African countries, accounting on average for around 1 percent of total funding. This share has begun to grow slowly. However, donor funding may include contracts for South African researchers working on issues for neighboring countries, rather than on issues of national relevance.

Provincial research departments continue to be funded by provincial legislatures, with support from donors, nongovernmental organizations, and producer/commodity organizations. ARC also contributes technical support to the PDAs. Nonprofit agencies are funded by the private sector. SASRI, as a private institute, is funded through a levy on sugar production. Research at the universities is funded by private companies, donors, and producer/commodity organizations. University researchers also have access to competitive funds from the National Research Foundation and an innovation fund, but these are not specific to agriculture. Universities also receive a subsidy per publication in accredited journals from the Department of Higher Education. The national government allocates funding to "national asset facilities," which are research facilities of national relevance, such as reference collections and genebanks. Agencies can also be designated as Centers of Excellence by DST and receive dedicated funding for a line of research.

Figure 8—Research focus by major commodity area, 2008



Source: Calculated by authors from ASTI–UP–ARC 2009–10.

Notes: Figures in parentheses indicate the number of agencies in each category. The ARC sample excludes the coordinating office. The provincial government and higher education agencies conduct crop and livestock research but had to be excluded due to lack of data.

RESEARCH ALLOCATION

Given that the allocation of resources across various lines of research is a significant policy decision, detailed information was collected on the number of researchers working in specific commodity and thematic areas (in FTEs). In 2008, 43 percent of the agricultural researchers at ARC focused on crop research, 38 percent focused on livestock, 19 percent focused on natural resources, and 4 percent focused on postharvest issues (Figure 8). Areas of focus for the remaining researchers include agricultural engineering and forestry. Among the four non-ARC national government agencies, about half the researchers focused on fisheries and 34 percent focused on forestry. At the three nonprofit agencies, crop research predominated based on the size of SASRI and its focus on sugarcane (58 percent of FTEs employed at the nonprofit agencies), followed by fisheries (23 percent) and forestry (20 percent).

Commodity Focus

Fruit was the most heavily researched commodity at ARC in 2008, representing 20 percent of crop and livestock researchers. Maize was the next most-researched commodity, representing 11 percent of ARC's crop and livestock researchers (Table 2). The number of researchers focused on fruit declined between 2000 and 2008, whereas the number focused on maize increased.

Table 2—ARC's crop and livestock research focus by major item, 2000 and 2008

	2000	2008
	Shares of FTE researchers (%)	
Crop items		
Fruits	28.1	20.8
Maize	6.4	10.8
Wheat	6.6	7.8
Potatoes	2.0	3.6
Vegetables	7.2	2.2
Cotton	1.3	1.7
Tobacco	0.8	1.1
Ornamentals	1.3	1.0
Other crops	12.8	9.2
Livestock items		
Beef	12.8	20.5
Sheep and goats	6.2	4.6
Dairy	6.0	3.9
Other livestock	16.4	0.8
Total crop and livestock	**100**	**100**

Source: Calculated by authors from ASTI–UP–ARC 2009–10.

Notes: Figures in parentheses indicate the number of agencies in each category. The sample excludes the coordinating office. IAE and ISCW do not conduct crop or livestock research.

Other significant crops in 2008 include wheat and potatoes (8 and 4 percent, respectively). Vegetables were more significant in 2000, but by 2008, the number of researchers focused on vegetables had declined by three-quarters. Looking at livestock, beef was the primary focus (20 percent of ARC's crop and livestock researchers), followed by sheep and goats, and dairy (shares of 4–5 percent each).

CONCLUSION

In 2008, South Africa's public agricultural research agencies spent 1 billion rand or 272 million PPP dollars on agricultural R&D (both in 2005 constant prices) and employed 784 FTE research staff. From a regional perspective, South Africa ranks second after Nigeria in terms of agricultural R&D investment and capacity levels. Although investment levels remain high compared with other African countries, South Africa is not meeting its agricultural research investment target of 3 percent of AgGDP. In 2008, for every $100 of agricultural output, South Africa invested $2.02 in agricultural R&D, one of the country's lowest ratios since the 1980s.

While the ARC institutes continue to be primarily funded by the government through parliamentary grants, this funding can fluctuate considerably. Other sources of funding such as the sales of goods and services and support from commodity/producer organizations have declined, in part due to new mechanisms of levy collection and distribution. While contributions from donors have grown since 2000, the overall amounts are still quite small compared with other sources of funding.

ARC institutes lost ground from the mid-1990s until 2008, primarily due to fluctuating funding levels and staff dissatisfaction stemming from institutional restructuring. As a result, ARC lost over 300 FTE researchers during this time. Staff departures at ARC occurred at all degree levels but primarily by researchers holding BScs. Although this trend is partly a natural consequence of the shift toward a more competitive research environment and to increased involvement in agricultural research by the country's higher education sector (which attracted staff away from ARC), it nonetheless has possible implications for ARC's future as older staff head into retirement.

The capacity of the provincial governments also declined between 2000 and 2008, and restructuring was again a factor to some degree in that it disrupted operations. As stated, overall research capacity in the higher education sector grew, although the universities are increasingly turning to part-time and contract staff for their research activities, rather than hiring permanent staff.

NOTES

[1] This study focuses on public investment in agricultural R&D in South Africa; for more detailed information on the private sector, see Kirsten, Stander, and Haankuku (2010).

[2] Financial data are also available in current local currencies or constant 2005 U.S. dollars via ASTI's Data Tool, accessible at www.asti.cgiar.org/data.

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