

# SUDAN

## RECENT DEVELOPMENTS IN AGRICULTURAL RESEARCH

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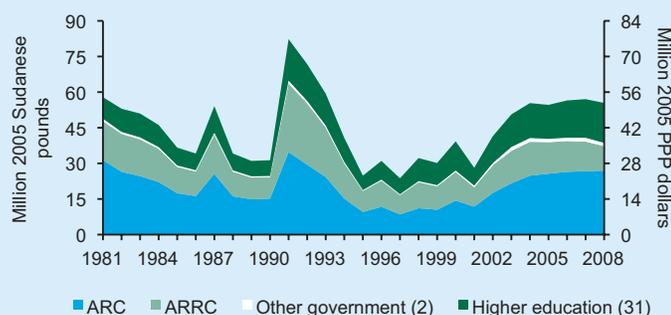
### LONG-TERM INVESTMENT AND CAPACITY PATTERNS IN AGRICULTURAL R&D

Despite remarkable, oil-driven economic growth of about 8 percent per year during 2000–10, Sudan has experienced unprecedented poverty and food insecurity over the past two decades brought about, in part, by the poor and inconsistent performance of the agricultural sector, which employs roughly 80 percent of the country's work force. Chronic civil strife and frequent droughts have had negative effects on agriculture; contradictory policies are also to blame for the current, critical situation (Faki 2006). During the 1990s, agricultural research and development (R&D) investments in Sudan declined rapidly (Beintema and Faki 2003), but this trend has reversed in more recent years due to increased recognition by the national government of the importance of agricultural R&D to agricultural development. Various reforms have led to increased R&D investments, resulting in an increase in agricultural R&D expenditures from a low of 28 million Sudanese pounds or 26 million purchasing power parity (PPP) dollars in 2001 to 55 million pounds or 52 million PPP dollars in 2008 (both in 2005 constant prices; Figure 1, Table 1).<sup>1</sup> Note that, unless otherwise stated, all dollar values quoted herein are based on PPP exchange rates, which reflect the purchasing power of currencies more effectively than standard exchange rates because they compare the prices of

### Key Trends Since 2000

- Public agricultural research and development (R&D) investments doubled during 2001–08 following increased government support, but the country's total agricultural R&D investments as a percentage of agricultural GDP remained among the lowest in Sub-Saharan Africa.
- Human resource capacity in agricultural R&D also increased steadily after the turn of the millennium, reaching 1,020 full-time equivalent (FTE) researchers in 2008.
- Agricultural R&D is largely funded by the national government; donor funding is limited.
- In the years to come, Sudan's key challenges will be maintaining high-quality research and avoiding capacity erosion as increasing numbers of experienced senior scientists trained abroad retire and are replaced with locally trained junior scientists. An important strategic objective for the Agricultural Research Corporation (ARC) and other Sudanese agricultural R&D agencies will be intensifying the intake of junior scientists and ensuring that they receive high-level training.

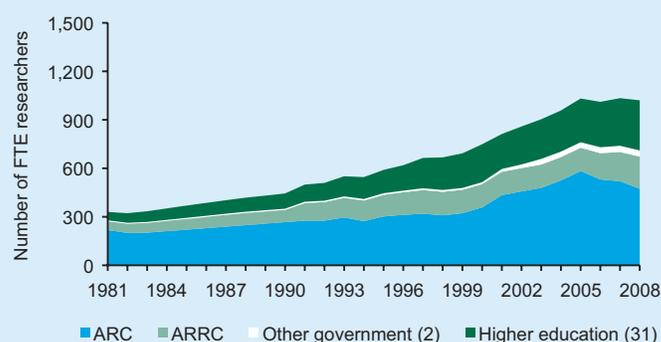
**Figure 1—Public agricultural R&D spending adjusted for inflation, 1981–2008**



Sources: ASTI-ARC 2010 and Beintema and Faki 2003.

Notes: Figures in parentheses indicate the number of agencies in each category. Financial data are presented in Sudanese pounds; the pound was introduced on January 10, 2007, equaling 100 dinars. For more information on coverage and estimation procedures, see the Sudan country page on ASTI's website at [www.asti.cgiar.org/sudan](http://www.asti.cgiar.org/sudan).

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



Sources: ASTI-ARC 2010 and Beintema and Faki 2003.

Note: Figures in parentheses indicate the number of agencies in each category.

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

| Type of agency              | Total spending        |             |            | Total staffing |            |
|-----------------------------|-----------------------|-------------|------------|----------------|------------|
|                             | Sudanese pounds       | PPP dollars | Shares     | Number         | Shares     |
|                             | (million 2005 prices) |             | (%)        | (FTEs)         | (%)        |
| ARC                         | 26.9                  | 25.0        | 48.6       | 473.0          | 46.4       |
| ARRC                        | 10.3                  | 9.6         | 18.6       | 199.4          | 19.5       |
| Other government (2)        | 1.4                   | 1.3         | 2.4        | 38.3           | 3.8        |
| Higher education (31)       | 16.8                  | 15.6        | 30.4       | 309.8          | 30.4       |
| <b>Subtotal public (35)</b> | <b>55.4</b>           | <b>51.5</b> | <b>100</b> | <b>1,020.5</b> | <b>100</b> |
| <b>Private (2)</b>          | <b>na</b>             | <b>na</b>   | <b>—</b>   | <b>17.0</b>    | <b>—</b>   |
| <b>Total (37)</b>           |                       |             |            | <b>1,037.5</b> |            |

Source: ASTI-ARC 2010.  
 Notes: Figures in parentheses indicate the number of agencies in each category. Financial data are presented in Sudanese pounds; the pound was introduced on January 10, 2007, equaling 100 dinars.

a broader range of local—as opposed to internationally traded—goods and services.<sup>2</sup> Agricultural R&D capacity levels in Sudan have also risen since the turn of the millennium. The country employed 1,020 full-time equivalent (FTE) researchers in 2008 compared with only 749 in 2000 (Figure 2). Sudan now has the fourth-largest pool of agricultural scientists in Sub-Saharan Africa, after Nigeria, South Africa, and Ethiopia.

The Agricultural Research Corporation (ARC) is Sudan’s principal agricultural research institute, accounting for close to half of the country’s public agricultural R&D staff and expenditures in 2008. Established in 1967, the Corporation is charged with crop and forestry research, along with cross-cutting disciplinary research on soil and water management, crop protection, agricultural engineering, plant biotechnology, food technology, genetic resources, and socioeconomics. ARC is headquartered in Wad Madani in the fertile Gezira region and operates 22 research stations, 10 research centers, and 3 research units across the country (ARC 2010). Nevertheless, close to half of ARC’s researchers are stationed in the Wad Madani/Khartoum area; relatively few researchers are permanently posted in the country’s fertile southern region or in the vast eastern and western regions (El-Siddig and Hamada 2008). In 2008, ARC employed 473 FTE research staff. In 2001, ARC was (temporarily) moved from the Ministry of Agriculture and Forestry (MAF) to the newly established Ministry of Science and Technology (MOST), which paved the way for a large influx of new scientists; however, many of ARC’s senior scientists subsequently retired, causing an overall decline in research staff levels, accompanied by a deterioration in qualification levels.

The Animal Resources Research Corporation (ARRC) under the Ministry of Animal Resources and Fisheries (MARF) was established in 1995 by amalgamating the research activities of existing public veterinary agencies. The Corporation consists of the Central Veterinary Research Laboratory, the Animal Production Research Centre, the Fisheries Research Centre, the Wildlife Research Centre, and a network of 22 regional veterinary

## ASTI Website Interaction

-  More details on institutional developments in agricultural research on Sudan are available in the 2003 country brief at [asti.cgiar.org/pdf/Sudan\\_CB11.pdf](http://asti.cgiar.org/pdf/Sudan_CB11.pdf).
-  Underlying datasets can be downloaded using ASTI’s data tool at [www.asti.cgiar.org/data](http://www.asti.cgiar.org/data).
-  This brief presents aggregated data; additional graphs with more detailed data are available at [asti.cgiar.org/sudan/datatrends](http://asti.cgiar.org/sudan/datatrends).

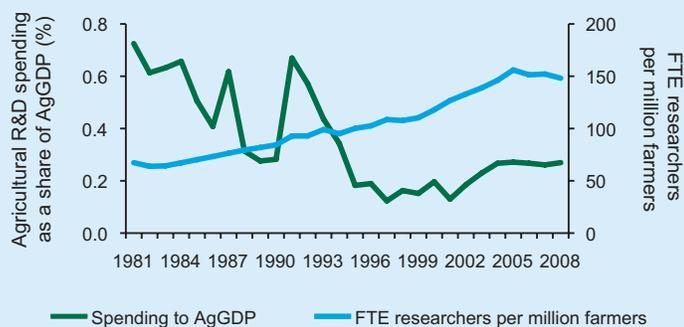
[www.asti.cgiar.org/sudan](http://www.asti.cgiar.org/sudan)

laboratories and animal production research stations. ARRC is principally charged with identifying diseases and epidemics that constrain animal health, production, and export; developing disease control mechanisms; improving animal production research (including fisheries); and conducting research on wildlife within their ecosystems. In 2008, ARRC employed 199 FTE research staff, up from 144 in 2000. Like ARC, ARRC was temporarily moved from MARF to MOST for the period 2001–10 (see the next section for details).

Two other government agencies—the Hydrology Research Station (HRS) and the National Centre for Research (NCR)—conduct agricultural research activities, accounting for a combined 4 percent share of Sudan’s total public agricultural R&D capacity in 2008. HRS investigates conveyance systems of irrigation water, along with issues of weed control and siltation in the irrigation canals of the Gezira Scheme. Four units within NCR conduct agricultural research: the Environment and Natural Resources Research Institute, the Medicinal and Aromatic Plants Research Institute, the Biotechnology and Genetic Engineering Corporation, and the Arid and Dry Lands Research Institute. In 2008, HRS and NCR employed 12 and 26 FTE researchers in agriculture, respectively.

Thirty-one higher education agencies were identified that conduct agricultural R&D in Sudan. Combined, these agencies employed 310 agricultural R&D staff in 2008 in FTEs, or 30 percent of the country’s agricultural R&D staff. The largest agencies in this category are the Faculty of Agriculture (53 FTEs in 2008) and the Faculty of Veterinary Medicine (36 FTEs), both under the University of Khartoum, and the Faculty of Agricultural Sciences (30 FTEs) under the University of Gezira. The remaining higher education agencies each employed 16 FTEs or fewer. Many agencies in this category were only established in the 1990s with the expansion of the higher education sector and the associated spread of institutions across the country in response to the national government’s 1995 subdivision of the country into 26 rather than nine states (Beintema and Faki 2003). The overall quality of agricultural re-

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



Sources: Calculated by authors from ASTI–ARC 2010, Beintema and Faki 2003, FAO 2009, and World Bank 2009.

Notes: 2008 data for ARC are for researchers only and exclude 1, 10, and 148 technicians with PhD, MSc, and BSc degrees, respectively.

search conducted at these new faculties is generally poor, based on underfunding and a total lack of research management structures.

Agricultural R&D performed by the private sector in Sudan is minimal. Many of the larger companies outsource their research to ARC, ARRC, and the universities. For example, the Sudan Cotton Company (representing cotton farmers) contracts ARC and the University of Khartoum to conduct its research. ARC also carries out fertilizer and pesticide tests on behalf of a number of chemical companies, but these activities are limited. The only private companies identified as carrying out their own R&D are the Kenana Sugarcane Company (KSC) and the Guneid Sugar Company (GSC), both of which conduct applied research to promote and maintain high sugarcane yields and reduce production costs, but even these programs are well coordinated with ARC. In 2008, KSC and GSC were estimated to employ 13 and 4 FTE researchers, respectively.

In 2008, 38 percent of Sudan’s agricultural research staff was female (ASTI–ARC 2010), which was well above the African average and a significant improvement over the 1991 share of 12 percent (Beintema, Pardey, and Roseboom 1995). The higher education agencies employed relatively fewer female researchers (30 percent) compared with ARC (34 percent), ARRC (48 percent), and the other government agencies (42 percent). Although gender equality can be said to exist at the MSc and BSc qualification levels, women are still underrepresented when it comes to PhD qualifications, although this gap appears to be closing somewhat. As of 2010, around 70 percent of the students at the agricultural faculties of the University of Khartoum and the University of Gezira were female. In 2008, on average, Sudan employed 1.3 technicians, 0.5 administrative support staff, and 2.5 other support staff for every agricultural FTE researcher (ASTI–ARC 2010). This ratio was higher for ARC than for the other government and higher education agencies. Of note, close to 20 percent of the 853 technicians employed at ARC held BSc, MSc, or PhD degrees.

Total public spending as a percentage of agricultural output (AgGDP)—a commonly used indicator of comparative agricultural R&D spending across countries—fell rapidly in the 1990s but has grown in more recent years with the government’s commitment to agriculture. In 2008, the country invested \$0.27 for every \$100

## ASTI Website Interaction

-  A list of the 4 government and 31 higher education agencies included in this brief is available at [asti.cgiar.org/sudan/agencies](http://asti.cgiar.org/sudan/agencies).
-  Detailed definitions of PPPs, FTEs, and other methodologies employed by ASTI are available at [asti.cgiar.org/methodology](http://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/sudan/datacoverage](http://asti.cgiar.org/sudan/datacoverage).
-  More relevant resources on agricultural R&D in Sudan are available at [asti.cgiar.org/sudan](http://asti.cgiar.org/sudan).

[www.asti.cgiar.org/sudan](http://www.asti.cgiar.org/sudan)

of agricultural output (Figure 3), which is well below the ratios recorded in neighboring Kenya (1.43) and Uganda (1.24), but equal to the ratio recorded in Ethiopia (0.27). In contrast, the number of agricultural FTE researchers per million farmers more than doubled during 1981–2008, from 67 to 148, indicating that agricultural researcher numbers grew more rapidly than did the number of farmers.

## INSTITUTIONAL STRUCTURE AND POLICY ENVIRONMENT

The institutional structure of agricultural R&D in Sudan has changed little since the turn of the millennium. ARC and ARRC continue to dominate the country’s agricultural R&D system, although the relative contribution of the higher education sector has gradually increased over the past two decades in terms of expenditures and staffing. Some important changes have taken place, however, to research coordination. As previously mentioned, MOST was established in 2001, taking over administrative responsibility for the country’s (agricultural and nonagricultural) R&D agencies. ARC, ARRC, and NRC were all transferred to MOST, but in light of low (and falling) agricultural productivity in the past decade, along with weak linkages between agricultural research under MOST and extension, which had remained under MAF, the research agencies were returned to their original supervising ministries in 2010 to ensure functional relationships with other relevant departments and stakeholders.

In addition, a series of strategies has been developed in efforts to boost agricultural production and combat poverty and food insecurity. An agricultural development program was launched under the country’s 2007–11 Five-Year Strategic Plan to improve the agricultural sector’s overall performance and to meet targets under the Millennium Development Goals. The specific

objectives of the Agricultural Revival Program (ARP), which will initially operate from 2008 until 2011, are to achieve sustainable agricultural development, reduce poverty, and attain more even distribution of social and economic welfare by reinvesting oil revenues in the agricultural sector as a means of avoiding the occurrence of “Dutch Disease.”<sup>3</sup> The Plan addresses the need to increase productivity, expand area, and diversify the commodities produced. Although the abovementioned initiatives are definitive signs of the government’s commitment to agriculture and agricultural science and technology, Sudan requires significant agricultural development and consequently faces major challenges.

With the 2005 signing of the Comprehensive Peace Agreement (CPA) between the Government of Sudan and the Southern Sudan People’s Liberation Movement/Army (SPLM/A), the organization of agricultural R&D in southern Sudan was transferred to the Southern Sudan Agricultural Research and Technology Organization (SSARTO). SSARTO is intended to become a centre of excellence, generating and disseminating improved technologies to farmers and extension agents in Southern Sudan. Consequently, SSARTO’s mission is to contribute to improving the livelihoods of the inhabitants of Southern Sudan by promoting agriculture and forestry development, while at the same time conserving the natural resource base. A team of seven ARC scientists from Southern Sudan is currently developing an agricultural research strategy. It is also hoped that ARC’s capacity for professional and graduate training can be harnessed to support the growth of a new generation of SSARTO scientists.

## DEGREE LEVELS AND TRAINING OF RESEARCH STAFF

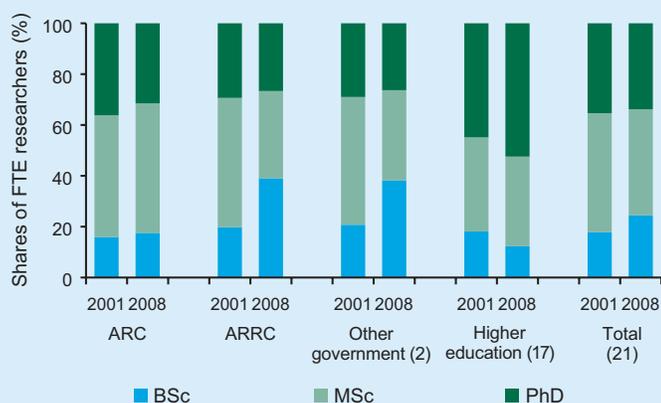
In 2008, three-quarters of agricultural researchers employed in Sudan were trained to the postgraduate level, with 34 percent holding PhD degrees and 42 percent holding MSc degrees (Figure 4). Consistent with developing countries around the world, the higher education sector reported a higher share of researchers with PhD degrees (52 percent) compared with ARC (32 percent), ARRC (27 percent), and the two other government

agencies (a combined 26 percent). Average degree qualifications of ARC staff have consistently deteriorated since the 1980s, when the share of PhD-qualified researchers reached well over 50 percent. Until the early 1980s, the vast majority of ARC and ARRC scientists received MSc or PhD degrees from foreign universities, fully sponsored by the Sudanese government. As more and more Sudanese universities have begun to offer MSc and PhD programs in agricultural sciences, the younger generation of Sudan’s agricultural scientists has increasingly been trained locally. Nevertheless, the quality of Sudanese PhD programs is widely perceived as inferior to overseas programs. Foreign-trained scientists have had more intellectually stimulating opportunities in terms of conference attendance, professional networking, and avenues for publication compared with their locally trained colleagues. As increasing numbers of foreign trained senior scientists retire, the overall quality of Sudan’s research staff and outputs is believed to be deteriorating. Loss of experienced, well-qualified researchers accompanied by their slow replacement constitutes an important future challenge. In 2006, ARC lost 42 PhD-qualified senior scientists when the official retirement age of 60 years was enforced by the government. The total number of PhD-qualified staff continued to fall thereafter as more researchers reached 60 or took advantage of more lucrative opportunities at universities or international organizations. In 2009, ARC employed 134 PhD-qualified scientists in FTEs, down from 196 FTEs four years earlier. Many more senior scientists are scheduled to retire in the coming years, so a key strategic objective for ARC will be more intensive recruitment of new scientists accompanied by high-quality training and attractive salary packages.

Currently, most MSc and PhD training at ARC occurs locally. The Corporation predominantly hires young BSc-qualified research assistants and supports their educational training. External training is limited to foreign scholarships sought independently by researchers. Many local universities accept postgraduate-level ARC and ARRC staff as students. One interesting development is the 2004 establishment of the Sudan Academy of Science (SAS) as a Federal Union of different research institutes and centers. SAS emphasizes the pooling of human and institutional resources available within the Ministry of Science and Technology (MOST) so as to provide quality training and research in various scientific disciplines. SAS is a wholly postgraduate institution, offering a wealth of masters, doctorate, and professional development programs in the areas of agriculture, animal sciences, energy, environment, engineering, management, and public relations. Each research center or institution is represented in SAS by a coordinating council that acts as an academic arm of that institution or center. Despite the recent move back to their original ministries, the Agricultural Research Coordinating Council (ARCC) and the Animal Resources Research Coordinating Council (ARRCC) remain under SAS. Eighty ARC employees were awarded MSc degrees and 14 were awarded PhD degrees from SAS between 2004 and mid-2010.

Traditionally, the German Academic Exchange Service (DAAD) has been the main provider of scholarships to agricultural scientists in Sudan. Each year, 12 Sudanese agricultural scientists are invited to apply for PhD grants at German universities. DAAD also sponsors local training. Ten scholarships for PhD training at the University of Gezira are issued each year. As of June 2010, ARC staff were undertaking training in Germany (3 researchers), China

**Figure 4—Degree level of researchers by institutional category, 2001 and 2008**



Source: ASTI-ARC 2010.

Notes: Figures in parentheses indicate the number of agencies included in each category. Fourteen higher education agencies were excluded from the sample because of data unavailability.

(5 researchers), Japan (3 researchers), and Turkey and Malaysia (1 researcher each). More than 20 ARRC researchers leave for training abroad each year, notably in Germany, Japan, China, South Korea, Malaysia, and Turkey. During 2007–10, 27 scientists from the University of Khartoum’s Faculty of Agriculture received scholarships for PhD training at German, Turkish, Japanese, and Italian universities.

Unlike many other countries in Sub-Saharan Africa, Sudan is not afflicted with the problem of an aging pool of agricultural scientists. The average age of researchers at ARC and ARRC is around 40 and 45 years, respectively, and most research assistants are well under 35 years.

## INVESTMENT TRENDS

### Cost Categories

The allocation of research budgets across salaries, operating costs, and capital investments affects the efficiency of agricultural R&D, so detailed cost category data were collected from the government agencies as part of this study. At ARC during 2001–08, salaries accounted for 82 percent of total expenditures, operating costs for 12 percent, and capital investments for 6 percent (Figure 5). In more recent years, the share of capital investments has risen gradually as government funding has increased. Cost category shares at ARRC were somewhat different for the shorter, 2005–08 period, with salaries dominating at 70 percent, operating costs accounting for 24 percent, and capital costs amounting to 6 percent of all expenditures.

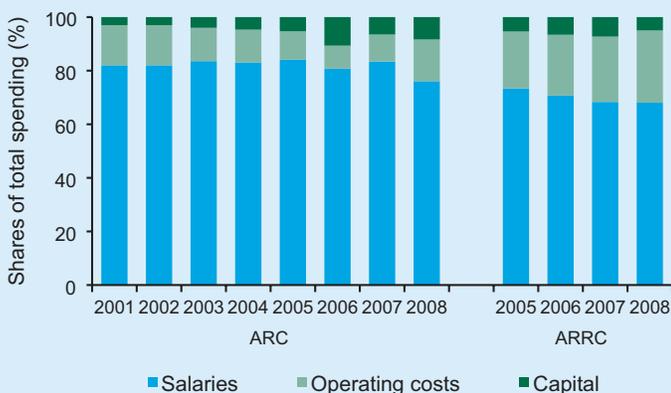
Researcher salaries at both ARC and ARRC are 100 percent funded by the national government. The transition from MAF/MARF to MOST in 2001 prompted a salary increase at both corporations; a further salary increase of 50 percent for junior staff and 10–50 percent for senior staff was effected in 2004, increasing ARC’s and ARRC’s attractiveness as employers. Before the start of each budget year, ARC and ARRC submit revenue estimates for recurrent expenditures, research costs, and capital investments to the Ministry of Finance. ARC and ARRC used to receive only about a quarter of their requested revenues, but in more recent years, this share has risen to 70 percent, which is the main reason for the overall spending increase.

## Funding Sources

Agricultural R&D funding in Sudan is almost entirely financed by the national government. During 2005–08, the government accounted for more than 98 percent of ARC’s total funding, with donors and development banks accounting for the remainder (Figure 6). This situation sharply contrasts the 1990s, when ARC received significant funding from the European Union, the governments of the Netherlands and Italy, the International Fund for Agricultural Development (IFAD), and the World Bank (Beintema and Faki 2003). When the United States imposed a trade embargo against Sudan in November 1997, donor support to agricultural R&D from many (western) donors and development banks effectively ceased. This had an obvious negative effect on overall R&D investment levels, but it also further isolated Sudan from global scientific developments. The situation has recently improved, however. The European Union has begun to release funding for crisis areas again, and the German Organization for Technical Cooperation has intensified its assistance. Nevertheless, total donor funding to Sudanese agricultural R&D remains negligible compared with many of the country’s neighbors. The limited donor funding reported by ARC was primarily derived from the centers of the Consultative Group on International Agricultural Research (CGIAR), including the International Center for Agricultural Research in the Dry Areas (ICARDA) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Other donors include the Food and Agriculture Organization of the United Nations (FAO), the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA), and the Islamic Development Bank (IDB).

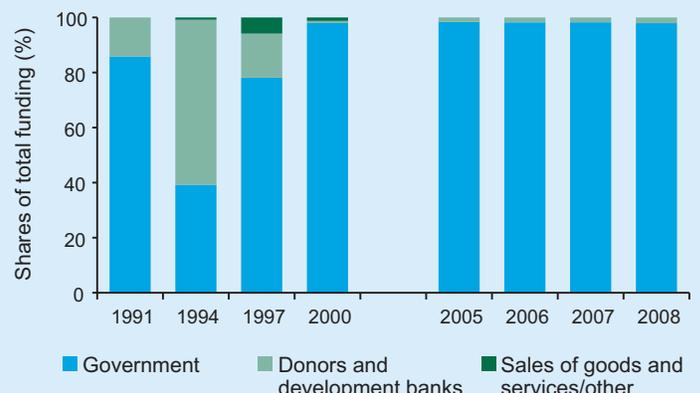
Although exact amounts were not available, ARRC also receives the bulk of its funding from the Sudanese government. Even though the Corporation generates significant internal funding through the sale of bacterial and viral vaccines, these funds are channeled back to the Treasury. In addition, ARRC reported ad hoc funding from FAO, IDB, ASARECA, the International Atomic Energy Agency (IAEA), the Government of India, and the European Union. Most of these funds were allocated to surveillance of epidemics and to equipment and training.

Figure 5— ARC’s and ARRC’s cost category shares, 2001–08



Source: ASTI–ARC 2010.

Figure 6—ARC’s funding sources, 1991–2008



Sources: ASTI–ARC 2010 and Beintema and Faki 2003.

Agricultural R&D activities at the higher education agencies are chiefly financed by Sudan's Ministry of Higher Education and Research. The University of Khartoum has traditionally been the main recipient of agricultural R&D funding from this ministry; however, with the establishment of an increasing number of smaller agricultural faculties across the country, the Faculty of Agriculture of the University of Khartoum has seen its annual R&D budget progressively shrink. By 2009, funding from the Ministry had completely ceased, and the faculty was obliged to fund its R&D activities through graduate student fees or through the 75 collaborative R&D programs it conducts with private companies. Research activities at the University of Gezira are entirely financed by the Ministry of Higher Education and Research. During 2010–12, a US\$12.3 million loan issued by IDB in support of the University of Gezira's agricultural and health sectors will finance activities like the construction of a central library, central laboratories for the Faculties of Agriculture and Animal Production, a tissue culture laboratory, a hospital for veterinary science, and training for technicians and some professional staff.

## RESEARCH ALLOCATION

The allocation of resources across various lines of research is a significant policy decision, so detailed survey information was collected on the number of FTE researchers working in specific commodity and thematic areas. In 2008, 28 percent of Sudan's agricultural researchers were involved in crop research (Figure 7). Livestock research accounted for 25 percent, and forestry and natural resources research for 8 percent each. The remaining researchers concentrated on postharvest, socioeconomic, fisheries, and water and irrigation research, or other matters.

Horticultural crops are the most researched crops in Sudan, accounting for 10 percent of the country's total crop and livestock research (Table 2). Sorghum accounted for 7 percent, and cotton, legumes, oil crops, and wheat for 5 percent each. Sudan's research on rainfed crops is relatively understaffed compared with research on irrigated crops (Faki, Gumma, and Ismail 1995). The country's

livestock researchers concentrated primarily on sheep and goats (20 percent), poultry (10 percent), and beef (10 percent).

## CONCLUSION

Large-scale oil production and ensuing economic growth led to widespread neglect of Sudan's agricultural sector for much of the 1990s and early 2000s. This, in combination with a donor embargo on development assistance from 1997, caused agricultural R&D investments to drop precipitously during this period. It was not until very recently that the national government launched a number of reforms to revive the country's agricultural sector. These reforms have had a positive effect on agricultural R&D investment levels, which more than doubled during 2001–08. In 2008, the country as a whole invested 55 million Sudanese pounds or 52 million dollars on agricultural R&D (both amounts in 2005 PPP prices). But despite this remarkable growth, Sudan's public agricultural R&D spending as a share of the country's AgGDP remains among Africa's lowest.

Public agricultural R&D capacity levels have also shown a steady increase since the turn of the millennium, reaching 1,020 researchers in 2008. The higher education sector in particular has intensified its agricultural R&D activities over the past two decades. Despite overall capacity increases, average degree levels of ARC staff have consistently deteriorated since the 1980s. During 2004–09, the Corporation lost more than 60 PhD-qualified researchers, mainly due to retirement. These senior, foreign-trained scientists have typically been replaced with locally trained,

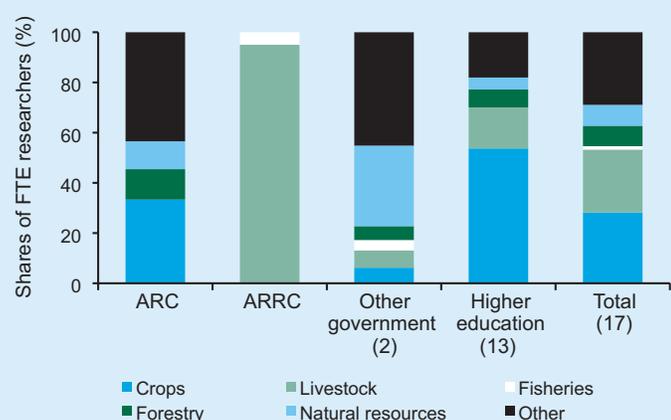
**Table 2—Crop and livestock research focus by major item, 2008**

|                                 | ARC                           | AARC       | Other government (2) | Higher education (11) | Total 2008 (12) |
|---------------------------------|-------------------------------|------------|----------------------|-----------------------|-----------------|
| <b>Crop items</b>               | Shares of FTE researchers (%) |            |                      |                       |                 |
| Horticulture crops              | 18.5                          | —          | —                    | 16.8                  | 10.3            |
| Sorghum                         | 13.8                          | —          | 21.1                 | 9.3                   | 7.2             |
| Cotton                          | 12.3                          | —          | —                    | 3.8                   | 5.1             |
| Legumes                         | 12.3                          | —          | —                    | 3.8                   | 5.1             |
| Oil crops                       | 9.2                           | —          | —                    | 7.9                   | 5.0             |
| Wheat                           | 9.2                           | —          | —                    | 6.6                   | 4.7             |
| Forages                         | 9.2                           | —          | —                    | —                     | 3.1             |
| Other crops                     | 15.4                          | —          | 26.3                 | 28.5                  | 12.3            |
| <b>Livestock items</b>          |                               |            |                      |                       |                 |
| Sheep and goats                 | —                             | 42.1       | 36.8                 | 8.7                   | 19.7            |
| Poultry                         | —                             | 21.1       | 15.8                 | 5.8                   | 10.2            |
| Beef                            | —                             | 21.1       | —                    | 4.2                   | 9.6             |
| Other livestock                 | —                             | 15.8       | —                    | 4.6                   | 7.6             |
| <b>Total crop and livestock</b> | <b>100</b>                    | <b>100</b> | <b>100</b>           | <b>100</b>            | <b>100</b>      |

Source: ASTI–ARC 2010.

Notes: Figures in parentheses indicate the number of agencies in each category. Eighteen higher education agencies were excluded from the sample because of data unavailability. In addition, two higher education agencies did not conduct crops or livestock research.

**Figure 7—Research focus by major commodity area, 2008**



Source: ASTI–ARC 2010.

Notes: Figures in parentheses indicate the number of agencies in each category. Eighteen higher education agencies were excluded from the sample because of data unavailability.

junior staff holding BSc and, in some cases, MSc degrees. This has created knowledge gaps and doubts as to the quality of future R&D outputs. Postgraduate training opportunities abroad are limited, and although recent initiatives have been established to introduce postgraduate training for researchers employed at ARC and ARRC, the need for intensive recruitment and high-quality training of junior scientists will continue to be an important strategic objective for Sudan's agricultural R&D sector if the country is to overcome its current capacity crisis.

## NOTES

- <sup>1</sup> Financial data are presented in Sudanese pounds, which replaced the Sudanese dinar in January 2007. The pound was introduced at a value equal to 100 dinars.
- <sup>2</sup> Financial data are also available constant 2005 U.S. dollars via ASTI's data tool, available at [www.asti.cgiar.org/data](http://www.asti.cgiar.org/data).
- <sup>3</sup> Dutch disease is an economic concept used to explain the deindustrialization of a nation's economy in response to the discovery of a natural resource that raises the value of the national currency, making agriculture and manufactured goods less competitive, with the result that import levels increase and export levels decrease.

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