

# SENEGAL

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*This brief reviews the major investment and institutional trends in Senegalese public agricultural research since the early 1970s, including a new set of survey data for the 1990s collected under the Agricultural Science and Technology Indicators (ASTI) initiative (IFPRI–ISNAR–CORAF/WECARD 2003).<sup>1</sup>*

## INSTITUTIONAL DEVELOPMENTS

Senegal is a semi-arid country located at the western-most point of the African continent. Although agriculture accounts for less than 20 percent of the country's GDP, it remains crucial to the country's economy given that the sector employs nearly three-quarters of the population and accounts for nearly half the country's total exports (FAO 2004). Agricultural research and development (R&D) consequently plays an important role in Senegal's pursuit for economic and social development. We identified nine agencies conducting agricultural R&D in Senegal in 2001, seven of which are included in our sample.<sup>2</sup> Combined, these seven agencies employed 159 full-time equivalent (fte) researchers and spent approximately 6 billion 1999 CFA francs—equivalent to 23 million 1993 international dollars (Table 1).<sup>3,4</sup>

The principal agricultural research agency—the Senegalese Agricultural Research Institute (ISRA)—accounted for close to three-quarters of the country's agricultural researchers and expenditures in 2001.<sup>5</sup> ISRA was established in 1974, replacing various French agricultural research agencies conducting crop research (See *A Short*

**Table 1—Composition of agricultural research expenditures and total researchers, 2001**

Type of agency	Spending		Researchers <sup>a</sup> (fte's)	Share		Agencies in sample <sup>b</sup> (number)
	1999 CFA francs (millions)	1993 international dollars		Spending (percent)	Researchers	
<i>Public agencies</i>						
ISRA	4,059.2	16.6	113.0	72.0	71.1	1
ITA <sup>c</sup>	220.2	0.9	8.5	3.9	5.3	1
Higher education <sup>d</sup>	1,035.5	4.2	29.4	18.4	18.5	3
<b>Subtotal</b>	<b>5,314.9</b>	<b>21.8</b>	<b>150.9</b>	<b>94.3</b>	<b>95.0</b>	<b>5</b>
<i>Business enterprises<sup>e</sup></i>						
Business enterprises <sup>e</sup>	323.2	1.3	8.0	5.7	5.0	2
<b>Total</b>	<b>5,638.1</b>	<b>23.1</b>	<b>158.9</b>	<b>100</b>	<b>100</b>	<b>7</b>

Sources: Compiled by authors from (IFPRI–ISNAR–CORAF/WECARD 2002-03) and Mazzucato and Ly (1994).

<sup>a</sup> Includes national and expatriate staff.

<sup>b</sup> See note 2 for details of all agencies. The agencies under the Gaston Berger University of Saint-Louis were excluded from this table and further data analysis in this brief because of data-unavailability.

<sup>c</sup> The 17 researchers at ITA spent 50 percent of their time on research, which represents 8.5 fte researchers.

<sup>d</sup> Expenditures for the higher education agencies are estimates based on the average expenditures per researcher for the government agencies. The 289 faculty staff employed in the three higher-education agencies spent between 5 and 60 percent of their time on research, resulting in 29.4 fte researchers.

<sup>e</sup> Expenditures for CSS are estimates based on the average expenditures per researcher for SODEFITEX.

## KEY TRENDS

- Total agricultural research spending and researcher numbers fell gradually from 1991 until 2001.
- Senegal's main agricultural R&D agency is the Senegalese Agricultural Research Institute (ISRA); in 2001 it accounted for nearly 75 percent of the country's research capacity, in terms of agricultural research staff and expenditures.
- In addition to government funding, ISRA depended on revenue raised through two World Bank–led initiatives in the 1990s: the Agricultural Research Project (ARP) and the Agricultural Services and Producer Organizations Project (PSAOP).
- The National Agricultural Research Fund (NARF), a competitive funding mechanism introduced as part of PSAOP in 1999, has revolutionized the way Senegalese agricultural R&D agencies are financed and has made research more demand-driven.
- Senegal's agricultural research staff are among the most highly qualified in Africa.
- The involvement of the private sector in Senegal's agricultural R&D is minimal, representing about 5 percent of agricultural research staff and spending in 2001.

## ABOUT ASTI

The Agricultural Science and Technology Indicators (ASTI) initiative comprises a network of national, regional, and international agricultural R&D agencies and is managed by the International Service for National Agricultural Research (ISNAR) division of the International Food Policy Research Institute (IFPRI). The ASTI initiative compiles, processes, and makes available internationally comparable data on institutional developments and investments in public and private agricultural R&D worldwide, and analyses and reports on these trends in the form of occasional policy digests for research policy formulation and priority setting purposes.

Primary funding for the ASTI initiative was provided by the CGIAR Finance Committee/World Bank with additional support from the Australian Centre for International Agricultural Research (ACIAR), the European Union, and the U.S. Agency for International Development (USAID).

*History of Government-Based Agricultural Research* below). The institute is administered by the Ministry of Agriculture and Livestock (MAE) but has its own board of directors. In addition to a secretariat based in Dakar, ISRA encompasses five national research centers and laboratories, and four regional research centers located across the country's various agroecological zones (ISRA 2004). The institute holds a broad mandate covering crop, livestock, forestry, fisheries, and socioeconomic research, organized within 22 research programs. ISRA underwent substantial restructuring in the 1990s associated with a number of World Bank–led projects. Further, a 1997 law gave ISRA greater managerial autonomy and created a holding company through which the institute could market commercial research outputs, either independently or in partnership with the private sector (Sompo-Ceesay 2000).

One other government R&D agency—the Food Technology Institute (ITA)—was involved in agricultural R&D in 2001, accounting for about 5 percent of Senegal's total fte research staff and expenditures. Based in Dakar and founded in 1963, ITA falls under the responsibility of the Ministry of Mining, Crafts, and Industry (MMAI). ITA conducts research on the storage, conservation, and processing of agricultural products; develops new local food products; and assists in the quality control of food products (Mazzucato and Ly 1994). ITA also underwent significant restructuring in the 1990s through an institutional support project sponsored by the Canadian government from 1994 to 1998. The project reorganized and reduced ITA's management, developed a strategy to enhance demand-driven research, and provided management training (ITA 2003; Gage et al. 2001).

The three higher-education agencies involved in agricultural research accounted for close to 20 percent of Senegal's total financial and human resources in agricultural research in 2001. These activities were carried out by 29 fte researchers employed at the National Advanced School of Agriculture (ENSA), based in Thiès, and the Faculty of Science and Technology and the Earth Sciences Institute (IST), both within the Dakar-based Cheikh Anta Diop University (UCAD). ENSA and UCAD play a significant role in agricultural research in Senegal, conducting crop, livestock, natural resource, and socioeconomic research.

Agricultural R&D performed by the private sector in Senegal is minimal. We identified two private enterprises directly conducting agricultural research in Senegal and accounting for roughly 5 percent of the country's total agricultural researchers and research spending. The Textile Fiber Development Company (SODEFITEX), founded in 1974, undertakes limited cotton research, and in 2001 employed 3 fte researchers. The Senegalese Sugar Company (CSS), founded in 1970, conducts limited sugar research, and in 2001 employed 5 fte researchers. Many of the larger private companies outsource their research to ISRA, ITA, and the higher-education agencies. ISRA, for instance, develops new crop varieties and studies the effects of new products for various agrochemical and seed companies. ISRA also works closely with SODEFITEX and CSS.

Cooperation between ISRA, ITA, the higher-education sector, and the private sector has been significantly enhanced since the establishment of the National Agricultural Research Fund (NARF), a competitive funding mechanism introduced as part of the first phase of the World Bank project, Agricultural Services and Producer Organizations (PSAOP-I). At a regional and international level, ISRA collaborates closely with the West Africa Rice Development Association (WARDA), the International Institute of Tropical Agriculture (IITA), the International Livestock Research Institute (ILRI), the World Agroforestry Centre (ICRAF), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the Sahel Institute (INSAH), the Semi-Arid Food Grain Research and Development (SAFGRAD) project, and various European and North American universities. Cooperation includes training and the supply of germplasm samples. ITA's international scientific partners include the West and Central African Millet Research Network (ROCAFREMI), the Food and Agriculture Organization of the United Nations (FAO), the Walloon Center of Industrial Biology (CWBI), and the International Atomic Energy Agency (AIEA). Senegal's higher-education agencies collaborate closely with the Center of International Agricultural Research Cooperation for Development (CIRAD) and the Research Institute for Development (IRD) (both from France), the Council for the Development of Social Science Research in Africa (CODESRIA), and various American, French, German, and Italian universities (Durand and Weesie 2002).

## A Short History of Government-Based Agricultural Research

Agricultural research in Senegal began with the creation of an experimental garden in the town of Hann in 1903. In the 1920s and 1930s, research capacity developed focusing mainly on groundnuts, millet, sorghum, and cowpeas. Senegal played a central role in terms of agricultural R&D in colonial times because Dakar was the center of French West Africa. Regional cooperation within French West Africa was intensified substantially after World War II, and the French station at Bambey conducted research on food and cash crops for the entire Sudano-Sahelian zone.

At independence in 1960, Senegal inherited the existing (substantial) French research infrastructure. Lack of trained national researchers forced Senegal to rely on the French colonial research institutes, such as the Study and Research Group for Tropical Agricultural Development (GERDAT), and consequently the structure of Senegal's national agricultural research system changed very little until 1975. France and Senegal agreed to jointly finance research, with France supplying the researchers and Senegal the agricultural laborers.

In 1973, the General Delegation of Scientific and Technical Research (DGRST) was established. It was the first organization to oversee all agricultural research institutes, including the French ones. In November 1974, DGRST established the Senegalese Agricultural Research Institute (ISRA), which took over the control of research activities previously conducted by the French institutes. The Food Technology Institute (ITA) was the only agricultural research agency to remain administratively independent from ISRA.

After several reorganizations, ISRA is now part of the Ministry of Agriculture and Livestock, and is by far the most important agricultural research organization in Senegal, accounting for over 70 percent of the country's FTE researchers. ITA is the only other government agency currently conducting agricultural research in Senegal.

Sources: Mazzucato and Ly (1994).

## HUMAN AND FINANCIAL RESOURCES IN AGRICULTURAL R&D

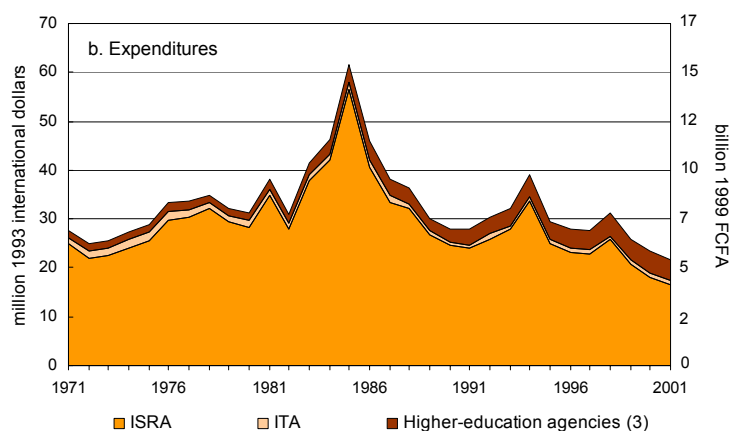
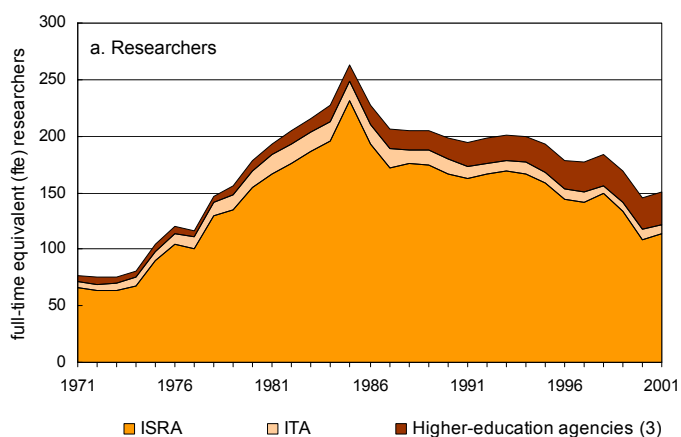
### Overall Trends

Total agricultural researcher numbers in Senegal grew on average by 10.2 percent per year during 1971–85 but fell by 2.5 percent annually thereafter (Figure 1a).<sup>6</sup> This reduction was the result of research staff cuts at ISRA in 1987, and 1990 as a result of restructuring and a proportional increase in ITA's nonresearch activities, such as extension, training, and meat quality control (Mazzucato and Ly 1994). In recent years, total researcher numbers have fallen even further. Despite improvements to the salary structure introduced in the late 1990s, many researchers have left ISRA for careers with private companies or international organizations (Gage et al. 2001). The introduction of an incentive program in 2002, providing additional benefits to researchers, appears to have reversed this trend somewhat, though the longer term effects remain to be seen.

Prior to the creation of ISRA, agricultural research in the government sector was managed and largely conducted by the French tropical research institutes, resulting in a preponderance of French researchers in the system. The majority of Senegalese staff were employed as technicians. Training of national staff became a priority when ISRA took over the management of research (Mazzucato and Ly 1994). In 1981, expatriate researchers still accounted for over half the total research staff at ISRA; 10 years later, the expatriate share had fallen to less than a third; and by 2001 the expatriate researcher share was only 8 percent. The majority of expatriate researchers were employed by French agencies; ITA employed only 0.5 fte expatriate researcher in 2001.

Total agricultural R&D expenditures in Senegal followed an erratic overall trend from 1971 to 2001, declining by an average of 1.6 percent per year (Figure 1b). In the late 1970s and early 1980s, the funding base to Senegal's government sector agencies broadened to include many new international donors, including the Belgian and Canadian governments and the United States Agency for International Development (USAID). The World Bank–led Agricultural Research Project (ARP) in particular, which ran from 1981 until 1989, produced a strong increase in research expenditures (peaking at \$62 million in

Figure 1—Public agricultural R&D trends, 1971-2001



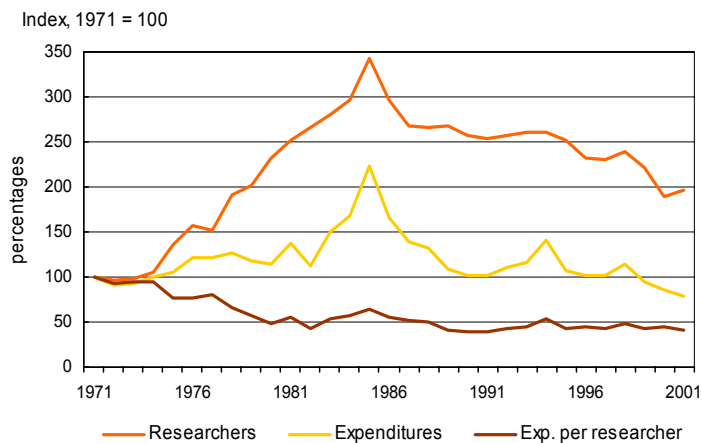
Sources: Compiled by authors from ASTI survey data (IFPRI-ISNAR-CORAF/WECARD 2002-03) and Mazzucato and Ly (1994).

Notes: Figures in parentheses indicate the number of agencies in each category. Expenditures for the higher-education agencies are estimates based on the average expenditures per researcher for the government agencies. Personnel and expenditures for the French tropical agricultural research institutes were included for the period 1971-74 under "other government". Underlying data are available on the ASTI website (<http://www.asti.cgiar.org>).

1985). Research expenditures dropped sharply from the late 1980s onward because many donor-funded projects ended and ITA shifted its focus toward nonresearch-related activities (Mazzucato and Ly 1994). The temporary peak in the early 1990s correlates with the relatively high World Bank funding levels accompanying the second Agricultural Research Project (ARP-II).

Average expenditures per researcher in Senegal declined rapidly during the 1970s and 1980s, mainly because of the replacement of expatriate researchers with (cheaper) national research staff. Senegal's expenditures per researcher more or less stabilized between 1991 and 2001 (Figure 2); in 2001 they totaled \$144,000—much higher than the corresponding levels in neighboring countries like Mali (\$92,000) and Mauritania (\$91,000) (Stads and Kouriba 2004; Stads et al. 2004).

Figure 2—Trends in public expenditures, researchers, and expenditures per researcher, 1971-2001

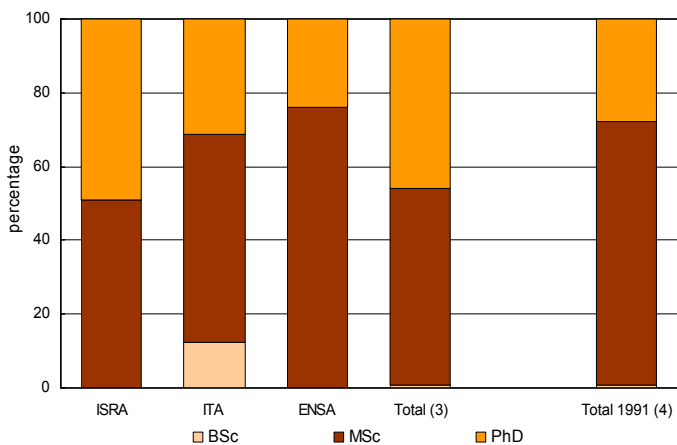


Source: Figure 1.

## Human Resources

In 2001, 99 percent of the 122 fte researchers in a sample consisting of ISRA, ITA, and ENSA were trained to the postgraduate level. A significant 46 percent held PhD degrees, positioning Senegal's researchers among the most highly qualified in West Africa (Figure 3). Researchers at ISRA were more highly educated than their counterparts at ITA and ENSA, and ITA was the only agency employing researchers without postgraduate training (that is, researchers with only BSc degrees). Education levels increased significantly between 1991 and 2001. The share of researchers with PhDs was higher in 2001 than in 1991 at all three agencies. Five ISRA researchers were trained to the PhD level and 10 to the MSc level under USAID's Natural Resources-Based Agricultural Research Project (NRBAR) between 1992 and 1998. The World Bank also funded limited researcher and technician training under ARP-II over the same period, primarily relating to research planning and programming (World Bank 1997). In addition, under PSAOP-I, four ISRA researchers received MSc degrees and five researchers received PhD degrees.

**Figure 3—Educational attainment of researchers, 1991 and 2001**

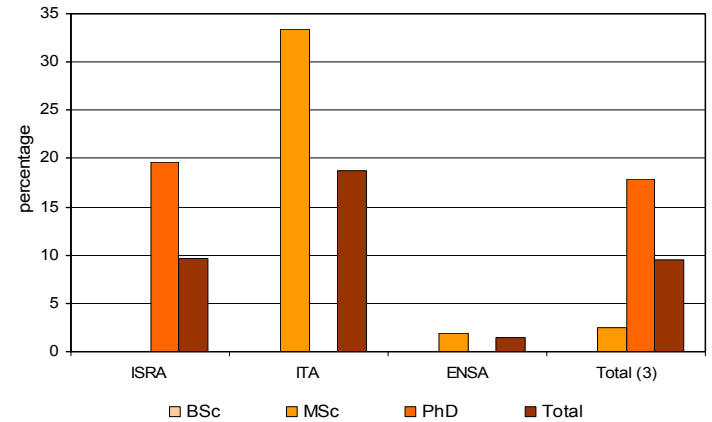


Source: Compiled by authors from ASTI survey data (IFPRI-INSAR-CORAF/WECARD 2002-03).

Notes: Figures in parentheses indicate the number of agencies in each category. Data exclude expatriate researchers.

Based on a three-agency sample for 2001, 10 percent of all researchers were female (Figure 4). ITA had the largest proportion of female researchers, at 19 percent, followed by ISRA with 10 percent, and ENSA with 2 percent. ITA's female researcher share fell by more than 10 percentage points during 1992–2001, while ISRA's share remained unchanged (Mazzucato and Ly 1994). In terms of qualifications, 18 percent of the PhD researchers and 3 percent of the MSc researchers in our 2001 sample were female.

**Figure 4—Share of female researchers, 2001**

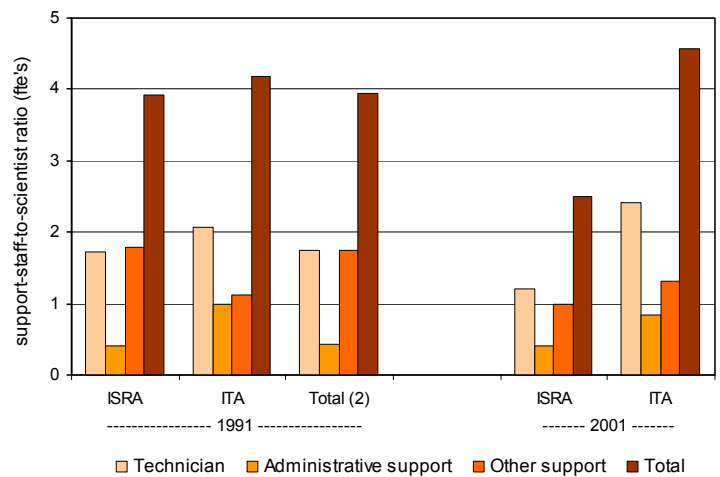


Source: Compiled by authors from ASTI survey data (IFPRI-INSAR-CORAF/WECARD 2002–03).

Note: Figures in parentheses indicate the number of agencies in each category. Data exclude expatriate staff.

In 2001, the number of support staff per researcher at ISRA and ITA averaged 3.9—comprising 1.7 technicians, 0.4 administrative personnel, and 1.8 other support staff (such as laborers, guards, and drivers) (Figure 5). ITA employed relatively more technicians and administrative personnel per researcher than ISRA but fewer other support staff. The support-staff-per-researcher ratio remained relatively stable at ITA, from 4.6 in 1991 to 4.2 in 2001. The previously discussed decline of total researcher numbers at ISRA's caused average support-staff-per-scientist numbers to rise from 2.5 in 1991 to 3.9 in 2001.

**Figure 5—Support-staff-to-researcher ratios, 1991 and 2001**



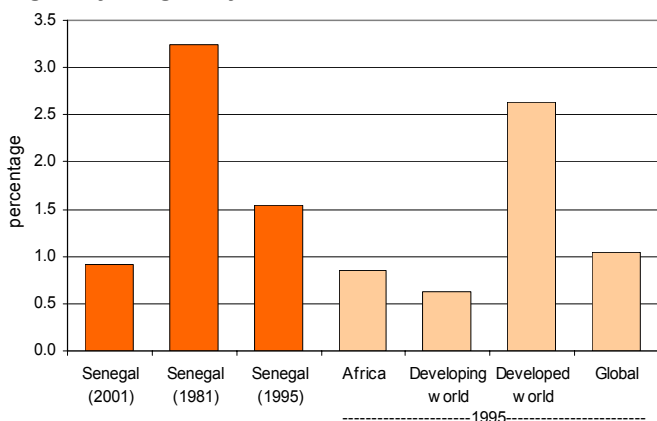
Source: Compiled by authors from ASTI survey data (IFPRI-INSAR-CORAF/WECARD 2002–03).

Notes: Figures in parentheses indicate the number of agencies in each category. Data exclude expatriate staff.

## Spending

Total public spending as a percentage of agricultural output (AgGDP) is a commonly used indicator of comparative agricultural R&D spending across countries. Senegal's research intensity ratio has traditionally been high compared with other African countries because Bambey served as the hub of the research network for Sudano-Sahelian West Africa in colonial times, and Senegal consequently inherited an unusually large agricultural research infrastructure and capacity at independence. Nevertheless, Senegal's research intensity ratio declined steadily throughout the 1980s and 1990s. In 1981, the country still invested \$3.24 for every \$100 of agricultural output (Figure 6). During 1990-2000, Senegal's research intensity ratio remained well above the 1.00 mark, but by 2001 this ratio had reached the value of 0.91. Senegal's 1995 ratio, at 1.54, was much higher than the corresponding ratios for Africa (0.85) and the developing world (0.62).

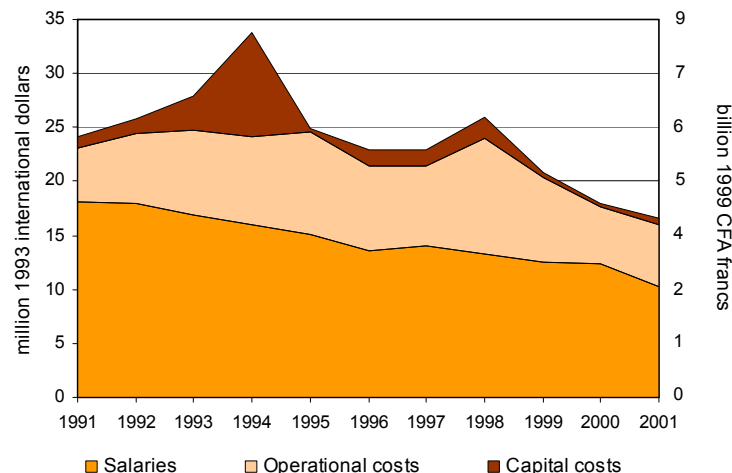
**Figure 6—Senegal's public agricultural research intensity compared regionally and globally**



Sources: Senegal compiled from Figure 1b; AgGDP from World Bank (2003); other intensity ratios from Pardey and Beintema (2001).

Salaries have historically accounted for the largest share of ISRA's expenditures; between 1991 and 2001 they represented 60 percent of total expenditures on average (Figure 7). However, with decreasing researcher numbers and the replacement of expatriates with cheaper local staff, total salary expenditures steadily decreased from \$18 million in 1991 to \$10 million in 2001. Operating costs accounted for approximately 30 percent of ISRA's total expenditures in the 1990s, while capital costs fluctuated in line with donor funding. ARP-II financed the building of ISRA's new headquarters in Dakar, as well as the rehabilitation of some of the institute's research infrastructure, which explains the peak in capital expenditures in the early 1990s. Expenditure shares at ITA throughout 1991-2001 were similar to those of ISRA, with salaries accounting for 59 percent of total expenditures; operating costs, a 31 percent share; and capital costs, a 10 percent share (IFPRI-INSAR-CORAF/WECARD 2002-03).

**Figure 7—Cost-category shares in ISRA's expenditures, 1991-2001**



Source: Compiled by authors from ASTI survey (IFPRI-INSAR-CORAF/WECARD 2002-03).

Notes: Data include estimated salaries for expatriate staff (see *Methodology* on page 10).

## FINANCING PUBLIC AGRICULTURAL R&D

Agricultural research in Senegal is largely funded by the national government, loans from the World Bank, and aid from other (foreign) donors, supplemented by revenues raised through producer organizations and internal revenue-raising activities. In addition to the national government and the World Bank, the Canadian International Development Agency (CIDA) was a significant donor to ITA in the 1990s, ultimately enabling the institute to undergo needed restructuring. In 2002, CIDA launched an additional five-year program valued at 8 million Canadian dollars to support the food-processing sector. Other contributors to ITA's research programs during 1991-2000 were USAID, ROCAFREMI, FAO, CWBI, and AIEA (ITA 2003). Throughout the same period, 11 percent of ITA's total funding, on average, was generated internally through the sale of products and services (IFPRI-INSAR-CORAF/WECARD 2002-03). In addition to government funding, agricultural research activities at the higher-education agencies were funded through World Bank loans and joint projects with foreign universities.

The World Bank was involved in the development of Senegal's agricultural research sector through a number of projects. ARP ran from 1982 until 1989 at a total budget of US\$106.1 million, comprising a World Bank loan, counterpart funding from the national government, and contributions from other international donors. The project enabled overall restructuring of the institute, renovation and construction of research infrastructure, procurement of equipment and vehicles, and recruitment of researchers and other personnel. In addition, ISRA's management was nationalized and a number of valuable technologies were produced under the project (World Bank 1997). In terms of restructuring, the number of multidisciplinary research departments was reduced from seven to five, and three new bureaus were established to manage human resources, macroeconomic analyses, and research planning and evaluation (Mazzucato and Ly 1994).

The follow-up project, ARP-II, was implemented between 1991 and 1996. ARP-II focused on implementing research programs identified in ISRA's five-year research program, such as applied research targeted to priority areas like natural resources management; improving ISRA's programming and budgeting systems, and personnel and financial management; and making ISRA's research more farmer-driven, for example, implementing adaptive research activities. ARP-II's budget totaled US\$38.9 million, comprising US\$18.5 million from the World Bank loan and US\$20.4 million from the Senegalese government. Despite problems with funding disbursements at the beginning of the project, final expenditure totaled US\$46.3 million, close to 20 percent more than budgeted. This increase resulted from higher government contributions and the 1994 devaluation of the CFA franc, which resulted in a favorable change in the US dollar exchange rate (World Bank 1997).

ISRA's Dakar headquarters were constructed under ARP-II and the institute's relationships with international institutions were significantly strengthened. Despite the project's positive outcomes in several areas, efforts to strengthen financial and administrative management were largely unsatisfactory due to lack of staff qualifications and motivation. In addition, the project did not succeed in integrating farmer interests into the research programs, and the impact on agricultural development was insufficient (World Bank 1997).

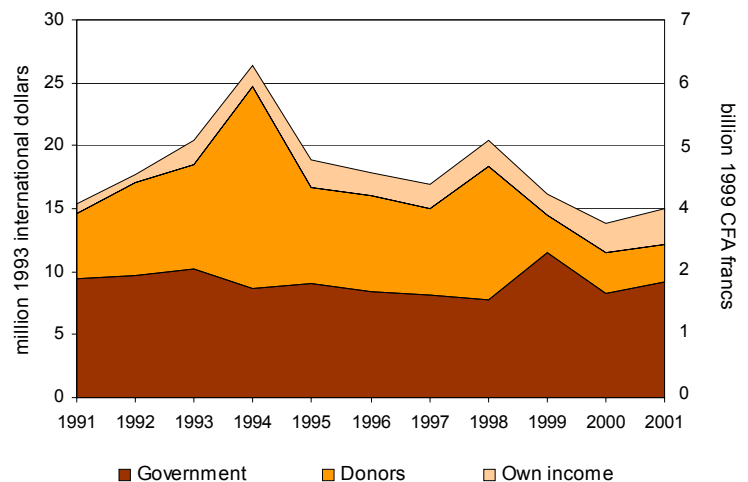
A third World Bank project supporting agricultural R&D in Senegal, PSAOP, was launched in 1999 (and phase one is ongoing as of 2004). PSAOP's overall objective was further institutional reform to strengthen capacity and promote linkages among agricultural research institutes, extension agencies, and farmer and producer organizations, making research more demand-driven in the process. PSAOP began with a planned budget of US\$123.8 million comprising a US\$69.8 million World Bank loan, US\$36.9 million in counterpart funding from the Senegalese government, US\$15.5 million in donor funding from the International Fund for Agricultural Development (IFAD), and US\$1.6 million from other beneficiaries including extension and producer organizations.

The budget for phase one (PSAOP-I) was US\$47.1 million—US\$27.4 million through a World Bank loan, US\$13.5 from the national government, US\$6.0 million from IFAD, and US\$0.2 million from beneficiaries (World Bank 1999). Close to 20 percent of this initial budget was allocated to ISRA and ITA.<sup>7</sup> PSAOP-I was initially scheduled to run from December 1999 until December 2002 but is now scheduled to conclude sometime between the end of 2004 and the middle of 2005. An important component of PSAOP-I was the introduction of NARF, the funding mechanism previously mentioned, which promotes farmer and private-sector interests in the setting of agricultural research priorities (Gage et al. 2001) (see the detailed description below). Other initiatives under PSAOP-I—all directed at ISRA and ITA—have been further training of research and managerial staff, further rehabilitation of infrastructure, and acquisition of vehicles and equipment (World Bank 1999). Again, despite a number of delays, PSAOP-I has largely been successful in achieving its objectives. Preliminary information from the World Bank indicates that the conditions for a second phase of PSAOP have been satisfied, and Senegal's government has confirmed its commitment to phase two.

## Senegalese Agricultural Research Institute

Between 1991 and 2001, ISRA's financing averaged \$17 million per year. Government contributions in real terms (adjusted for inflation) remained relatively stable, at around \$8 million per year, with the exception of the \$11 million total in 1999 (Figure 8). Throughout 1991–2001, government contributions accounted for about half of ISRA's total funding, on average, and donor contributions accounted for about 40 percent. Aside from World Bank loans, primary donors over this period were the governments of Canada, France, Germany, and Japan; the European Union; the African Development Bank (ADB); USAID; and various United Nations organizations. As previously mentioned, ARP-II financed the renovation of ISRA's headquarters in Dakar in the early 1990s, explaining the peak in donor funding during this time.

Figure 8—ISRA's funding sources, 1991–2001



Source: Compiled by authors from ASTI survey data (IFPRI–ISNAR–CORAF/WECARD 2002–03).

Internally generated funding gained importance at ISRA throughout 1991–2001, increasing from just 5 percent of total funding in 1991 to 18 percent in 2001. Over the years, ISRA has developed a capacity to produce basic seeds and vaccines, but revenues from the sale of these has increased significantly in 1990s and early 2000s. With improved efficiency and an appropriate marketing strategy, these internally generated revenues could be further developed in the future, and will very likely need to be (Sompo-Ceesay 2000). Senegal's Ministry of Finance recently determined that the institute's fixed R&D costs should no longer be funded by donors but rather by the national government. However the government cannot afford to support ISRA's extensive research infrastructure, so the contraction of services is unavoidable (World Bank 2004). ISRA will need to operate more like a private company in the coming years if it is to survive in an increasingly competitive environment. Given shrinking donor support and the robust competition for funding with the introduction of NARF, increased self-funded activities will be an important avenue for ISRA to pursue in the future.

## National Agricultural Research Fund

NARF is an independent entity (created in 1999 under PSAOP-I, as already mentioned), established for the purpose of separating research financing from research implementation, while providing a competitive means for qualified public and private agricultural research agencies to access funding. NARF was allocated US\$13.2 million for the period 2000–05. Another primary objective of the fund is to optimize agricultural research performance by increasing collaboration among the various agencies involved. Under NARP, ISRA and ITA now compete for funding with the higher-education agencies, agricultural extension agencies, nongovernmental organizations (NGOs), and agrochemical and food processing companies (Sompo-Ceesay 2000; NARF 2004; World Bank 2004). NARF funds are derived from the national government, the World Bank, foreign donors, the local private sector, and others. Research proposals are submitted by teams of researchers from various agencies. NARF has a Technical and Scientific Committee (CST) comprising 15 scientific resource persons (including six from outside Senegal). The committee reviews proposals and provides comments and recommendations to NARF's Management Committee (CG), which is responsible for final selections based on the scientific and technical quality of the team and the proposal, and the proposal's relevance (NARF 2004). Projects are thoroughly screened; only 26 of the first 79 research proposals submitted to NARF were approved. As of 2003, 38 entities had received funding through the scheme. The fund is expected to narrow its scope in the future, favoring priority research themes above issues relating to basic food crops or crops with high export potential (World Bank 2004). The main constraints affecting NARF are delays in funding availability, varied commitment on the part of project collaborators (meaning that some are more motivated than others), and financial and legal difficulties that delay the execution of research projects.

Despite these difficulties, the competitive nature of NARF has transformed the day-to-day operations of agricultural R&D agencies in Senegal. The more established institutes, such as ISRA and ITA, must become increasingly competitive and responsive to farmer needs if they are to succeed in maintaining their research programs. Further rationalization of activities is likely to occur in response to this changing environment.

## RESEARCH ORIENTATION

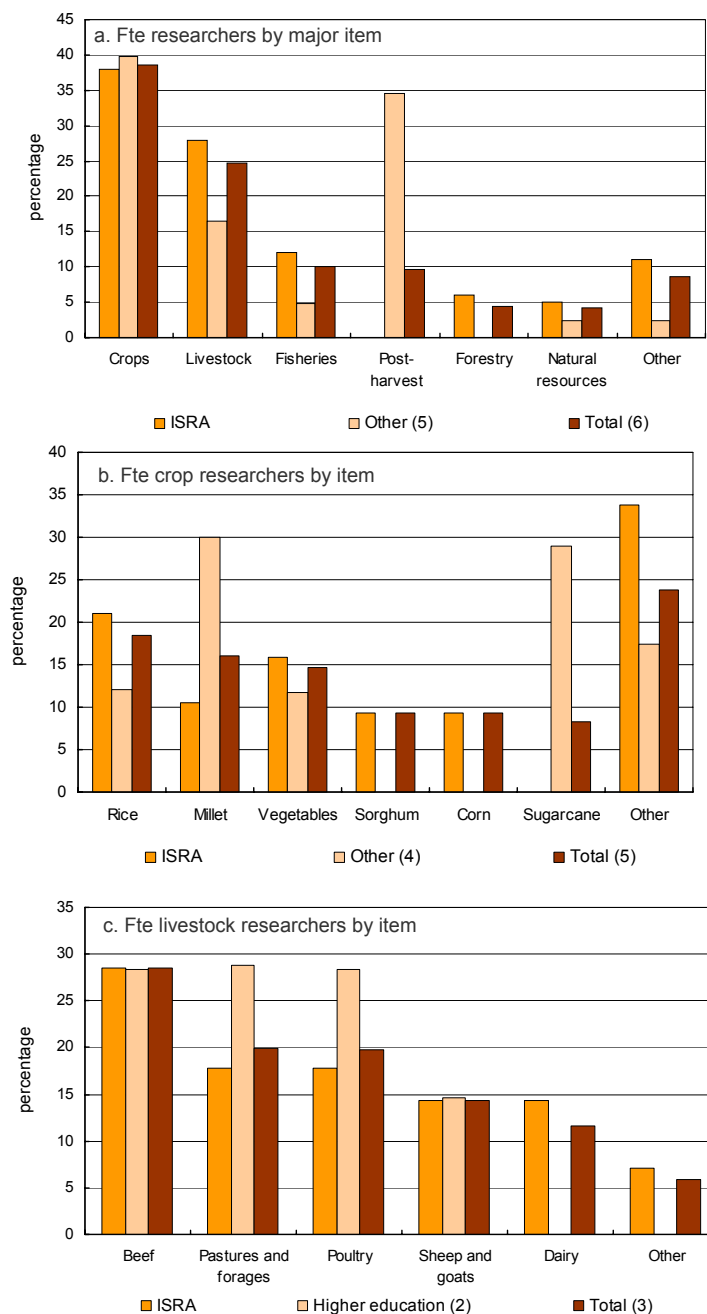
### Commodity Focus

The allocation of resources across various lines of research is a significant policy decision; hence detailed survey information was collected on the number of fte researchers working in specific commodity and thematic areas.

In 2001, nearly 40 percent of the total 157 fte researchers in a six-agency sample conducted crop research (Figure 9a). Livestock accounted for 25 percent, while fisheries and postharvest activities accounted for 10 percent each. Senegal's most researched crops were rice and millet, accounting for 19 and 16 percent of fte crop researchers in 2001, respectively (Figure 9b). Other important crops included vegetables (15

percent), sorghum (9 percent), corn (9 percent), and sugarcane (8 percent). Livestock researchers at ISRA, UCAD, and ENSA concentrated primarily on beef (29 percent), followed by pastures and forages (20 percent), poultry (20 percent), sheep and goats (14 percent), and dairy (12 percent) (Figure 9c).

**Figure 9—Commodity focus, 2001**



Source: Compiled by authors from ASTI survey data (IFPRI–ISNAR–CORAF/WECARD 2002–03).

Notes: Figures in parentheses indicate the number of agencies in each category. Figure 9b only includes agencies involved in crop research; Figure 9c only includes agencies involved in livestock research.

## Thematic Focus

In 2001, 20 percent of ISRA's agricultural researchers were working on crop genetic improvement, while 10 percent worked on crop pest and disease control, and 10 percent on livestock genetic improvement (Table 2). Animal pest and disease control was another important theme (8 percent). Crop genetic improvement (34 percent) and postharvest activities (23 percent) were the most dominant research themes at the other five agencies in our sample.

**Table 2—Thematic focus, 2001**

	Numbers of researchers		Shares	
	ISRA	Other (5)	ISRA	Other (5)
	<i>(in fte's)</i>		<i>(percent)</i>	
Crop genetic improvement	22.6	12.4	20.0	33.6
Crop pest and disease control	11.3	4.9	10.0	13.3
Other crop	20.3	1.6	18.0	4.4
Livestock genetic improvement	11.3	1.5	10.0	4.0
Livestock pest and disease control	9.0	—	8.0	—
Other livestock	11.3	4.5	10.0	12.2
Soil	6.8	1.3	6.0	3.4
Water	4.5	0.3	4.0	0.7
Other natural resources	—	1.0	—	2.7
Postharvest	—	8.5	—	23.0
Other	15.8	1.0	14.0	2.7
<b>Total</b>	<b>113.0</b>	<b>37.0</b>	<b>100</b>	<b>100</b>

*Source:* Compiled by authors from ASTI survey data (IFPRI-ISNAR-CORAF/WECARD 2002-03).

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

## CONCLUSION

Agricultural R&D expenditures in Senegal have fallen gradually since the mid-1980s. The cause of this decline is threefold: nationalization of agricultural research resulted in large numbers of expatriate researchers being replaced with less expensive national staff, many researchers left the two government research agencies (ISRA and ITA) for more lucrative positions at international research agencies or in the private sector, and ITA increased its focus on nonresearch activities. During 1991–2004, ISRA was strongly dependent on two consecutive projects: ARP-II, funded by a World Bank loan and counterpart funding from the Senegalese government, and PSAOP-I, funded by a World Bank loan, the national government, IFAD, and additional beneficiaries. These projects supported substantial institutional change at ISRA and greatly strengthened its financial and administrative management.

A significant component of PSAOP-I was the introduction of NARF, a competitive research fund that has transformed agricultural R&D financing in Senegal. All public and private agricultural R&D agencies compete equally for NARF funding, which has promoted demand-driven research and the rationalization of agency operations. In addition, further changes prevent donors from funding fixed research costs, and with the national government unable to fill this funding gap, both ISRA and ITA will need to further rationalize their operations and develop alternative sources of funding, such as internally generated funds through the sale of products and services. The planned second phase of PSAOP, scheduled to begin sometime after the conclusion of PSAOP-I (late 2004 to mid-2005), will likely reinforce the shift toward competitive financing mechanisms and restructuring of agency infrastructure to promote efficient, demand-driven, and farmer-focused research programs.

Despite these recent changes, Senegal's agricultural research capacity remains strong compared with many countries in the region. Overall research investment (indicated by the country's research intensity ratio) as well as average levels of spending per researcher remain well above the African average. In addition, Senegal's agricultural researchers are among the most highly qualified in Africa. It will be important to ensure that this capacity is not eroded as Senegal's agricultural research agencies continue to respond to the changing funding environment.



## NOTES

1. The authors are grateful to numerous colleagues in Senegal for their time and assistance with the data collection, and thank Nienke Beintema, Taïb Diouf, Ndiaga Mbaye, Jean Pierre Ndiaye, and Pape Abdoulaye Seck for useful comments on drafts of this brief.
2. The seven-agency sample consisted of:
  - Two government agencies/units: *Institut Sénégalais de Recherches Agricoles* (ISRA) and *Institut de Technologie Alimentaire* (ITA);
  - Three higher-education agencies: *Faculté des Sciences et Techniques* (FST) and *Institut des Sciences de la Terre* (IST), both under *Université Cheikh Anta Diop* (UCAD), and *École Nationale Supérieure d'Agriculture* (ENSA); and
  - Two private enterprises: *Société de Développement des Fibres Textiles* (SODEFITEX) and *Compagnie Sucrière Sénégalaise* (CSS).
 This sample excludes *Centre Interdisciplinaire d'Études et de Recherche de la Vallée* and *Équipe de Recherches sur les Mutations du Rural Sahélien* (LERMURS) under *Université Gaston Berger Saint-Louis* (UGB/SL), for which data were unobtainable.

3. With the inclusion of the two units under the *Université Gaston Berger Saint-Louis* for which data were unobtainable, these totals would be slightly—though not substantially—higher, given the omitted agencies are reported to conduct minimal agricultural research.
4. Unless otherwise stated, all data on research expenditures are reported in 1993 prices and in international dollars or in 1999 CFA francs.
5. English translations of agency names have been used throughout the brief except in note 2, where the original French is provided.
6. Annual growth rates are calculated using the least-squares regression method, which takes into account all observations in a period. This results in growth rates that reflect general trends that are not disproportionately influenced by exceptional values, especially at the end point of the period.
7. US\$6.4 million was budgeted for ISRA, and US\$2.3 million for ITA.

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## METHODOLOGY

- Most of the data in this brief are taken from unpublished surveys (IFPRI, ISNAR, and CORAF/WECARD 2002-03).
- The data were compiled using internationally accepted statistical procedures and definitions developed by the OECD and UNESCO for compiling R&D statistics (OECD 1994; UNESCO 1984). We grouped estimates using three major institutional categories—government agencies, higher-education agencies, and business enterprises, the latter comprising the subcategories private enterprises and nonprofit institutions. We defined public agricultural research to include government agencies, higher-education agencies, and nonprofit institutions, thereby excluding private enterprises. Private research includes research performed by private-for-profit enterprises developing pre, on, and postfarm technologies related to agriculture.
- Agricultural research includes crops, livestock, forestry, and fisheries research plus agriculturally related natural resources research, all measured on a performer basis.
- Financial data were converted to 1993 international dollars by deflating current local currency units with a Senegalese GDP deflator of base year 1993 and then converting to U.S. dollars with a 1993 purchasing power parity (PPP) index, both taken from World Bank (2003). PPP's are synthetic exchange rates used to reflect the purchasing power of currencies, typically comparing prices among a broader range of goods and services than conventional exchange rates.
- The salaries and living expenses of many expatriate researchers working on donor-supported projects are paid directly by the donor agency and are often excluded in the financial reports of the agricultural R&D agencies. These *implicit* costs have been estimated using the average cost per researcher in 1985 to be \$160,000 1993 international dollars and backcasting this figure using the rate of change in real personnel costs per fte researcher in the US state agricultural experiment station system. This extrapolation procedure has the assumption that the personnel-cost trend for US researchers is a reasonable proxy of the trend in real costs of internationally recruited staff in the agricultural R&D agencies.

See the ASTI website (<http://www.ASTI.cgiar.org>) for more details on methodology.

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