

# JORDAN

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*This country brief reviews the major investment and institutional trends in public agricultural research in Jordan in recent years, using data collected under the Agricultural Science and Technology Indicators (ASTI) initiative (IFPRI 2004–05).<sup>1</sup>*

## INSTITUTIONAL DEVELOPMENTS

Jordan is a lower middle-income country in the Middle-East with a total population of just five million. The economy is heavily dependent on the services sector, such as banking and tourism. In 2003, the agricultural sector constituted only 2 percent of Gross Domestic Product (GDP) and employed about 10 percent of the country's labor force (World Bank 2005; FAO 2005). Jordan's agricultural sector, however, has serious environmental problems related to water resources, water pollution, deforestation, and soil erosion (Encyclopedia of Nations 2005). The primary crops are citrus and other fruits and vegetables, such as tomatoes, eggplants, cucumbers, cauliflowers, and cabbages. Though small, and operated on a nomadic or semi-nomadic basis, livestock is also an important subsector. Animal production accounts for about a third of agricultural output value, and sheep and goats account for about 90 percent of livestock output.

Slightly less than 10 percent of Jordan's total land area is cultivated, but only 3

**Table 1—Composition of agricultural research expenditures and total researchers, 2003**

Type of agency	Spending		Researchers (fte's)	Share		Agencies in sample <sup>a</sup> (number)
	2000 Jordanian dinars (millions)	2000 international dollars		Spending (percent)	Researchers	
<i>Public agencies</i>						
NCARTT	1.8	5.9	148.4	45.8	58.5	1
<i>Higher education</i>						
UOJ	na	na	60.0	na	23.7	2
JUST	na	na	17.7	na	7.0	2
Other	na	na	18.9	na	7.4	3
Subtotal higher education	1.9	6.1	96.5	47.7	38.1	7
<i>Subtotal public</i>	<b>3.8</b>	<b>12.0</b>	<b>244.9</b>	<b>93.6</b>	<b>96.6</b>	<b>8</b>
<i>Private enterprises<sup>f</sup></i>	0.3	0.8	8.7	6.4	3.4	7
<b>Total</b>	<b>4.0</b>	<b>12.8</b>	<b>253.6</b>	<b>100</b>	<b>100</b>	<b>15</b>

Sources: Compiled by authors from ASTI survey data (IFPRI 2004–05).

<sup>a</sup> See note 2 for a list of the 15 agencies included in this sample.

<sup>b</sup> Expenditures for the seven higher education agencies were estimated based on NCARTT's expenditures per researcher, adjusted to allow for higher university salaries. The 329 professional staff in the higher education agencies spent between 10 and 50 percent of their time on research, resulting in 96.5 fte researchers.

<sup>c</sup> Expenditures for the business enterprises were estimated on the assumption that they were 50 percent higher than those in the higher education.

## KEY TRENDS

- During 1996–2003, Jordan's agricultural research staff numbers grew steadily, while spending growth was more erratic.
- The National Center for Agricultural Research and Technology Transfer (NCARTT), the only government agency involved in agricultural research, constituted about half of the country's agricultural research staff and R&D spending in 2003.
- The higher education sector accounted for more than one-third of the agricultural research staff in 2003.
- Private-sector involvement in agricultural research, while still small, is scattered among a variety of private companies.

## 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.

Funding for the ASTI initiative's survey round in North Africa and the Middle East region was provided by the CGIAR Finance Committee/World Bank, IFPRI unrestricted funding, and the U.S. Agency for International Development (USAID).

percent is used for agricultural production, and only 1 to 2 percent is irrigated—mainly in the Jordan Valley and highlands (FAO 2005). This leaves the country heavily dependent on rainfall, a factor that has hindered agricultural growth.

Agricultural production was seriously affected by the droughts of the late 1990s, such that agricultural GDP in 2003 (adjusted for inflation) was only half the 1991 level. With a view to expanding the irrigated area, the country's economic development plans emphasize soil and water conservation (Encyclopedia of the Nations 2005).

We identified 16 agencies involved in agricultural R&D in Jordan in 2003, 15 of which are included in our sample.<sup>2</sup> That year, these 15 agencies employed more than 250 full-time equivalent (fte) researchers and spent 4 million Jordanian dinars (in 2000 prices) on agricultural R&D—the equivalent of 13 million 2000 international dollars (Table 1).<sup>3</sup>

The main agricultural research agency is the National Center for Agricultural Research and Technology Transfer (NCARTT), which accounted for close to 60 percent of the country's total agricultural research staff in 2003. Established in 1985 as a semi-autonomous institute under the Ministry of Agriculture (MoA) (see *A Short History on Government-Based Agricultural Research* below), NCARTT is the only government agency involved in agricultural research in Jordan. Consequently, it has a broad mandate, including coordinating the country's agricultural research strategies, adopting and transferring appropriate technologies, and developing the nation's agricultural research capacity. In 2003, NCARTT employed 212 senior staff, who spent 70 percent of their time, on average, on research, resulting in 148 fte's.

NCARTT is headquartered in the Baq'a area, about 10 kilometers from Amman, and has 6 (soon to be 7) regional centers and 12 research stations across the country. NCARTT is governed by a council that is chaired by the Minister of Agriculture and comprises NCARTT's director general; the secretary generals of the Higher Council of Science and Technology, MoA, the Ministry of Water and Irrigation; the deans of the faculties of agriculture; the director general of the Agricultural Credit Association; and the director of MoA's Extension Department as an observer (Taimeh and Sunna 1999). NCARTT's activities are structured around five-year plans. The 2001–05 plan focused on strengthening human resource capacity, applied research, and infrastructure. The

current workplan (2006–10) emphasizes technology transfer.

We identified seven higher education agencies involved in agricultural research in Jordan. Combined, these agencies accounted for more than one-third of total agricultural R&D staff in 2003.<sup>4</sup> The University of Jordan (UoJ), located in Amman, is home to the country's oldest and largest Faculty of Agriculture, which comprises six departments covering crops, horticulture, livestock, food sciences, natural resources, the environment, economics, and agribusiness. It is estimated that the faculty's staff spent about half their time on research, focusing mainly on locally grown crops, livestock, soil improvement, water harvesting, and biotechnology. In addition to its faculty of agriculture, UoJ also houses the Water and Environment Research and Study Center (WERSC), though it has autonomous status. It is governed by a board of directors appointed by the university's council of deans, and conducts research in the areas of irrigation, water harvesting, and water recycling (Taimeh and Sunna 1999).

The Jordan University of Science and Technology (JUST), located in Irbid, operates a Faculty of Agriculture and a Faculty of Veterinary Medicine, which together in 2003 employed 18 fte agricultural researchers who spend an estimated 20 to 25 percent of their time on research. The Faculty of Agriculture's research activities are organized through the university's Agricultural Centre for Research and Production. The center's mandate includes developing technologies to address regional farming challenges, developing drought-resistant and short-duration field crop varieties, introducing new and improved vegetable crop varieties, standardizing seed production technologies, and improving sheep production through breeding and nutrition (JUST 2006). During the past few years, the faculty has established a number of farms and plants, which are used for teaching, research, and production of agricultural products. The Faculty of Veterinary Medicine's research activities focus on nutrition and reproductive management issues for goats and other animals.

The remaining three higher education agencies involved in agricultural research are the Faculty of Technological Agriculture at Al Balqa' Applied University, the Faculty of Agriculture at Mu'tah University, and the Faculty of Agriculture at University of Jerash. In 2003, these three faculties employed four to five fte researchers.

## A Short History of Government-Based Agricultural Research

Formal agricultural research in Jordan began in the early 1950s with the creation of the first agricultural research station in the Jordan Valley. That decade, various other research stations were established throughout the country. Research was initially carried out by the technical divisions of the Ministry of Agriculture. They were transferred to the Department of Scientific Agricultural Research when it was created in 1958, and then in 1970 the department was merged with the Ministry's extension unit to form the Department of Scientific Research and Agricultural Extension. The Ministry of Agriculture was restructured in the mid-1980s, resulting in the creation of the National Center for Agricultural Research and Technology Transfer (NCARTT). NCARTT developed over the years, in part through the National Agricultural Development Project (NADP), which was co-funded by the United States Agency for International Development (USAID) and the Government of Jordan.

Agricultural research within the higher education sector began in the early 1970s with the establishment of the Faculty of Agriculture (1972) and the Marine Science Station (1974) at the University of Jordan (UoJ). This was followed with the establishment of the Research Center for Water Studies (now WERSC) at the same university in 1982. The Faculty of Agriculture and the Faculty of Veterinary Medicine were established at the Jordan University of Science and Technology (JUST) during the second half of the 1980s. Additional faculties of agriculture were established at Jerash University in 1993 and at Muta University in 1994.

Source: Taimeh and Sunna (1999).

Seven private companies were identified as conducting a limited amount of agricultural research in 2003. Unifert Company employed five fte researchers that year, focusing on vegetable seed production. The other six companies employed no more than one fte researcher each in 2003; the Modern Company for Fertilizer Production focused on fertilizer research, while the remaining five companies focused on fruit and vegetable research.

Jordan's agricultural research agencies participate in a significant amount of collaborative research nationally, regionally, and on an international basis. While national linkages have traditionally been limited, for example, a review of Jordan's research and technology transfer activities during the late 1990s identified considerable gaps (see Taimah and Sunna 1999), NCARTT and the various agricultural colleges have begun to collaborate on a project basis. Since 2000, NCARTT has signed agreements with universities, the Royal Society for Science and Technology, the Agricultural Engineer's Association, the Farmers Union, and many other agencies. In addition, NCARTT professionals teach at the universities, and many MSc students and PhD candidates conduct thesis research in collaboration with NCARTT.

At the regional level, NCARTT collaborates with agricultural research agencies in neighboring countries. Activities have generally been initiated through NCARTT's participation in the Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA) and through joint projects with either the Arab Center for the Study of Arid Zones and Dry Lands (ACSAD) or the Arab Organization for Agricultural Development (AOAD). At the international level, NCARTT and the faculties of agriculture collaborate with various centers of the Consultative Group on International Agricultural Research (CGIAR), particularly the Syria-headquartered International Center for Agricultural Research in the Dry Areas (ICARDA). NCARTT also collaborates with public research agencies in other Arab countries, and with research centers in Syria, the Palestinian Authority, Egypt, Tunisia, the United Arab Emirates, Lebanon, and many other countries. The agricultural colleges also have collaborative projects with regional universities and others in Europe and the United States. JUST's Faculty of Agriculture, for example, has partnerships with NCARTT, ICARDA, International Plant Genetics Resources Institute (IPGRI), Jordan Badia R&D Program as well as various universities abroad.

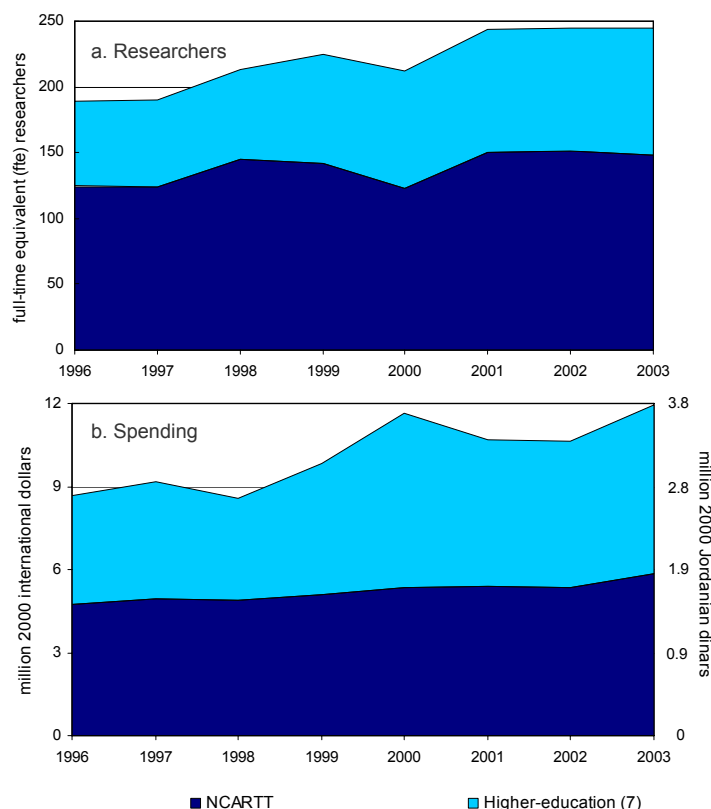
## HUMAN AND FINANCIAL RESOURCES IN PUBLIC AGRICULTURAL R&D

### Overall Trends

Total public agricultural research staff increased at an average rate of 4.2 percent per year, from 189 in 1996 to 244 in 2003 (Figure 1a). Staffing at NCARTT remained fairly stable in the late 1990s but fell by 28 in 2000 before rebounding in 2001—in part because a number of employees returned to the center upon completion of MSc and PhD training. In contrast, the higher education agencies experienced average annual growth of 9.2 percent during 1996–2000, leveling off to 2.4 percent per year after 2000. The trend in total agricultural research expenditures during 1996–2003 was similar, on average, increasing by 4.6 percent, though most of this growth occurred at the higher

education agencies in the late 1990s (Figure 1b). NCARTT's total research expenditures grew at 2.7 percent per year over this timeframe. Average expenditures per researcher remained relatively constant during 1996–2003 and averaged \$49,000 in 2003 (Figure 2). Levels were much lower at NCARTT, mainly because of the significantly lower salary levels.

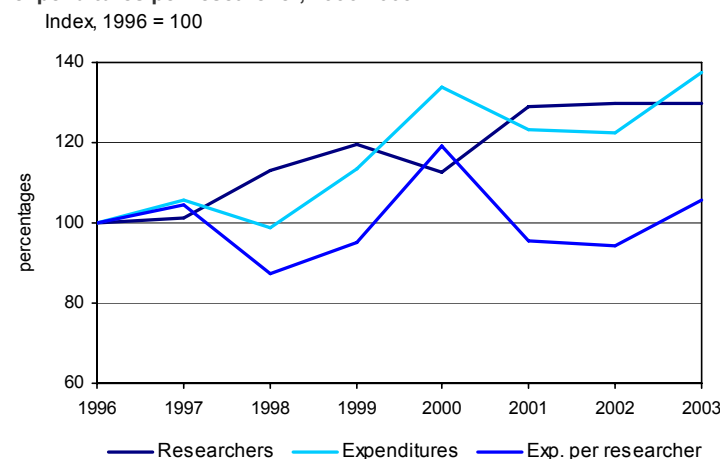
**Figure 1—Long-term composition of public agricultural researchers 1996–2003**



Sources: Compiled by authors from ASTI survey data (IFPRI 2004–05) and Taimah and Sunna (1999).

Notes: See Table 1. Figures in parentheses indicate the number of agencies in each category. Underlying data are available at the ASTI web site ([www.asti.cgiar.org](http://www.asti.cgiar.org)).

**Figure 2—Trends in public expenditures, researchers, and expenditures per researcher, 1996–2003**



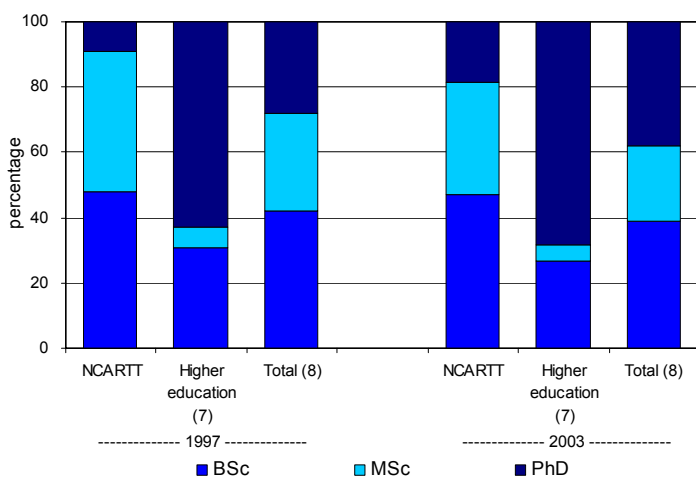
Sources: Figure 1.

Notes: Figure 1.

## Human Resources

In 2003, 61 percent of the 245 fte researchers in the eight public agencies in our sample had undertaken postgraduate-level training, and more than one-third held a doctorate degree (Figure 3). This was slightly lower than the corresponding shares in other AARINENA countries such as Morocco and Tunisia, where share of postgraduates were over 90 percent. In contrast, only 25 percent of the agricultural researchers in neighboring Syria held MSc or PhD degrees (Stads and Kissi 2005; Stads et al. 2006; Beintema et al. 2006). The seven higher education agencies reported a significantly higher share of research staff trained to the postgraduate level (74 percent compared with only 53 percent at NCARTT). This is consistent with findings in most countries in the region and in developing countries worldwide, although the relatively lower salary levels at NCARTT (about two-thirds less than those in the higher education agencies) are a contributing factor. Further, promotion within NCARTT is based on seniority rather performance, creating a disincentive for the more highly qualified researchers to seek, or continue, employment at NCARTT. Negotiations are in progress between NCARTT and the Jordanian government to raise salaries to redress this problem. Of the higher education agencies, UoJ and JUST reported a comparatively higher proportion of PhD-qualified staff than the other universities, which is unsurprising given their dominant status within this grouping.

**Figure 3—Educational attainment of researchers, 1997 and 2003**



Sources: Compiled by authors from ASTI survey data (IFPRI 2004–05) and Taimah and Sunna (1999).

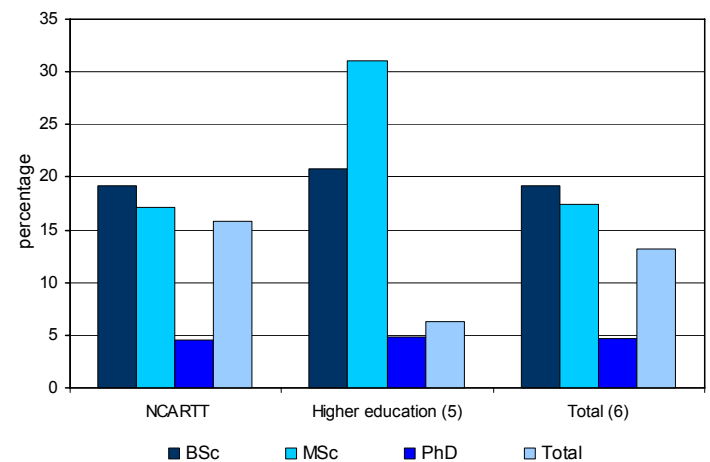
Note: Figures in parentheses indicate the number of agencies in each category.

On a national level, the share of researchers with postgraduate degrees increased slightly, from 58 percent in 1997 to 61 percent in 2003, but the mix shifted because of the comparatively higher increase in the number of PhD-qualified researchers (from 53 to 93 fte's). NCARTT was a strong contributor to this growth given the aforementioned returned of employees upon completion of their graduate studies, which

resulted in an increase in the center's share of doctorate degree holders from 9 to 18 percent. NCARTT's focus on human resource development in its recently completed five-year workplan was responsible for some of the training underlying this growth, and further training proposals are currently being developed on a project basis in order to maintain this trend. NCARTT has instituted a goal of employing 70 PhD-qualified researchers by the year 2020.

Despite a rise in the number of women pursuing scientific careers worldwide, female researchers still tend to be underrepresented in senior scientific and leadership positions (Sheridan 1998), and Jordan is no exception. In 2003, 13 percent of fte researchers in a six-agency sample were female (Figure 4). This is low compared with corresponding ratios in other AARINENA countries, such as Morocco (18 percent), Syria (23 percent), and Tunisia (28 percent) (Stads and Kissi 2005; Stads et al. 2006; Beintema et al. 2006). In terms of qualifications, women represented 5 percent of researchers with doctorate degrees, 17 percent of those trained to the MSc level, and 19 percent of researchers with BSc degrees (Figure 4).

**Figure 4—Share of female researchers, 2003**

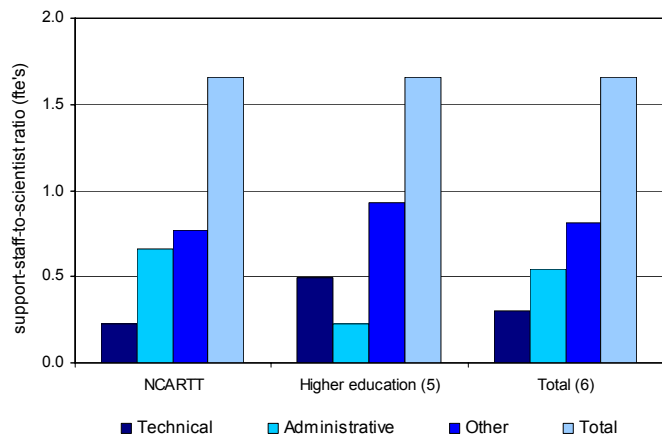


Source: Compiled by authors from ASTI survey data (IFPRI 2004–05).

Note: Figures in parentheses indicate the number of agencies in each category. NCARTT data is for 2005. Figure excludes two higher-education agencies for which data were unavailable.

In 2003/05, the average number of support staff per scientist in a six-agency sample was 1.7, comprising 0.3 technicians, 0.5 administrative personnel, and 0.8 other support staff such as laborers, guards, and drivers (Figure 5). It is common to find that government agencies employ a higher ratio of support staff to scientists than higher education agencies. NCARTT employed relatively less technicians per scientists than the higher-education agencies combined, but had a higher administrative staff per researcher ratio. This is in contrast to many other countries where government agencies employ a higher ratio of technicians to scientists than higher education agencies.

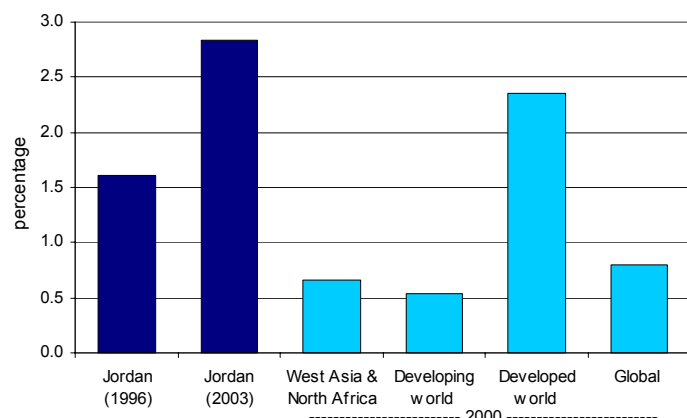


**Figure 5—Support-staff-to-researcher ratios, 2003**

Source: Compiled by authors from ASTI survey data (IFPRI 2004-05).  
 Notes: Figures in parentheses indicate the number of agencies in each category. Figure excludes two higher-education agencies for which data were unavailable.

### Spending

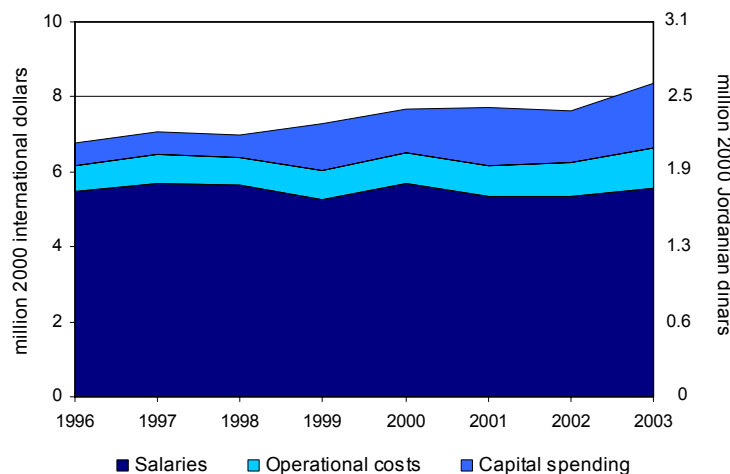
Total spending as a percentage of agricultural output (AgGDP) is a commonly used indicator for comparing agricultural R&D spending across countries. In 2003, Jordan invested \$2.83 for every \$100 of agricultural output, which was a substantial increase over the 1996 ratio of \$1.61 (Figure 6). The shift resulted from an increase in agricultural R&D spending during 1996–2003 and a decline in AgGDP in response low rainfall levels. The 2003 ratio was also considerably higher than the average ratio for West Asia and North Africa (0.80 percent) and for the developed world as a whole (2.36 percent), but in this case—rather than indicating high levels of R&D investment in agriculture—the high ratio actually reflects agriculture’s particularly small share of the country’s GDP. Further, Pardey, Roseboom, and Anderson (1991) and Alston and Pardey (1993) found that research intensity ratios are often higher in countries with small populations and high levels of per capita income. This is logical.

**Figure 6—Jordan’s public agricultural research intensity compared regionally and globally**

Sources: Jordan data are compiled from Figure 1; AgGDP are from World Bank 2005; other intensity ratios are from Pardey et al. 2006.

when you consider that human and capital investments have a fixed base component, regardless of population size, especially when facilities and services are spread across regions.

Between 1997 and 2003, salaries averaged 74 percent of NCARTT’s total expenditures, while operating and capital costs accounted for 11 and 15 percent, respectively (Figure 7). Total salary expenditures remained fairly constant between 1997 and 2003, but both operating and capital spending grew substantially, though from a very low base. This increase can be explained by the focus on modernization and maintenance of NCARTT’s infrastructure in the 2001–05 workplan. Consequently, NCARTT’s research facilities are in good condition.

**Figure 7—NCARTT’s expenditure shares by cost category, 1997–2003**

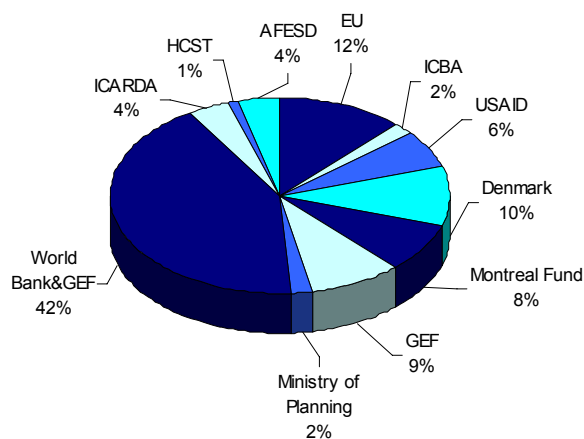
Source: Compiled by authors from ASTI survey data (IFPRI 2004-05).

### FINANCING PUBLIC AGRICULTURAL R&D

Agricultural research in Jordan is mainly financed through the national government, though funding from external donors has gained prominence in recent years (Figure 8). In 2005, NCARTT received roughly 11 million dinar (in current prices) from donors and development banks, 42 percent of which was provided by the World Bank and the Global Environment Fund (GEF) as part of two separate projects. The Conservation of Medicinal and Herbal Plants Project—which is scheduled to run from 2003 to 2008—aims to enhance the conservation of medicinal and herbal plants as well as the living standards of rural communities. The main objective of the Horticultural Exports Promotion and Technology Transfer Project (2002-06) is the expansion of Jordan's export opportunities through improved product quality, marketing, and technological capacity of farmers (World Bank 2006). As of June 2006, NCARTT had received 5 million dinar as part of each multi-year project. In 2005, additional financial contributions were provided by the European Union (EU), Denmark, other GEF-financed projects, the Montreal Fund, and the United States Agency for International Development (USAID). Each of these donors accounted for 6 to 12 percent of total donor funding received in 2005. During the same year, other funding sources included the Arab Fund for Economic and Social Development (AFESD), the Ministry of Planning, the International Center for Biosaline Agriculture (ICBA), and the Higher Council for Science and

Technology (HCST). Most of the projects that NCARTT undertakes with ICARDA are financed by the International Fund for Agricultural Development (IFAD) with additional funds provided by AFESD and GEF.

**Figure 8—NCARTT donor funding, 2005**



Source: Data provided by NCARTT.

Over the past years, other donors have provided funds to NCARTT, of which the major was the United Nations Development Program (UNDP) through the Agro-biodiversity Project. The objective of this project, which ended in mid-2005, was to protect species and rare landraces by undertaking in situ and ex situ conservation, establishing special nurseries, and expanding public awareness, mainly on irrigation and other water management issues.

Agricultural research at the universities is mainly funded through university budgets and supplemented by other sources. HCST, for example, is a major source of funding for research projects conducted by UoJ's Faculty of Agriculture. Other faculty donors are AFESD, USAID, and the European Union. JUST's Faculty of Agriculture has been less successful in attracting funding from donors, and consequently depends more on the university to fund its research activities. The few donor projects undertaken in recent years were funded by USAID and the Czech Republic. JUST's Faculty of Veterinary Medicine received donor funding from HCST, EU, and the Swedish International Foundation for Science (IFS).

## RESEARCH ORIENTATION

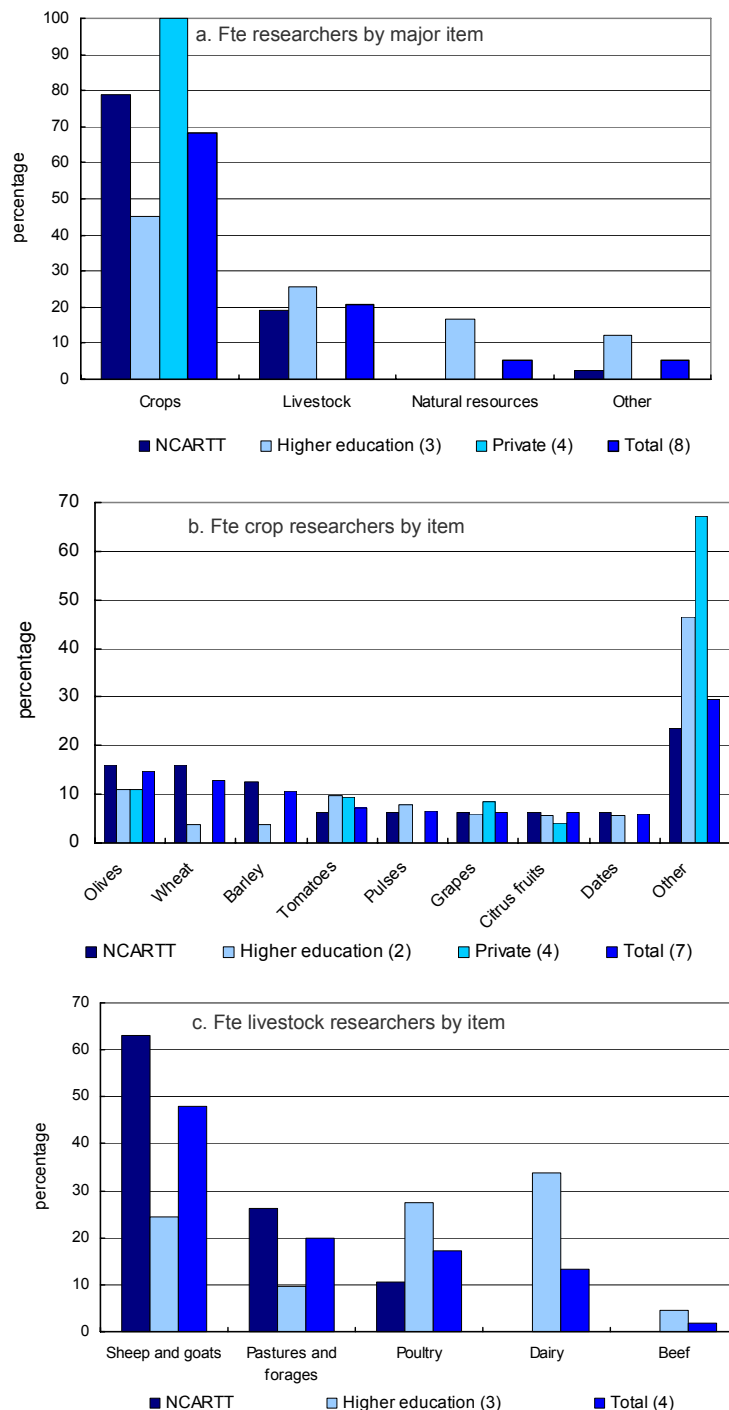
### Commodity Focus

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 2003, more than two-thirds of the 229 fte researchers in an eight-agency sample conducted crop research (Figure 9a). Livestock accounted for 21 percent, while natural resources research accounted for 5 percent. NCARTT researchers spent more time on crops than their colleagues at the higher education agencies. Notably, the four private companies in our sample all focus solely on crop research. Major crops under investigation were olives, wheat, and barley, each accounting for between 11 and 15 percent of all fruits, and dates were each the focus of 6–7

percent of all crop researchers in our sample; tomatoes, pulses, grapes, citrus researchers (Figure 9b). The remaining 29 percent of crop researchers focused their efforts on other crops. Four agencies in our sample conducted livestock research, and almost half of the researchers working in this area focused their efforts on sheep and goats (Figure 9c). Other livestock items being researched were pastures and forages (20 percent), poultry (17 percent), dairy (13 percent), and beef (2 percent).

**Figure 9—Commodity focus, 2003**



Source: Compiled by authors from ASTI survey data (IFPRI 2004–05).

Notes: Figure 9a excludes four higher-education agencies and three businesses for which data were unavailable. Figure 9b only includes agencies involved in crop research; Figure 9c only includes agencies involved in livestock research.

## Thematic Focus

In 2003, 20 percent of NCARTT researchers were studying crop genetic improvement and 20 percent were studying water issues (Table 2). The remainder of NCARTT researchers focused largely on other crop-related issues, livestock, other natural resources, and postharvest activities. Water, soil, crop genetic improvement, and crop pest and disease control were dominant at the six other agencies in our sample. Other research themes at these agencies included livestock and other natural resources.

**Table 2—Thematic focus, 2003**

	Numbers of researchers		Shares	
	NCARTT	Other (6)	NCARTT	Other (6)
	<i>(in fte's)</i>		<i>(percent)</i>	
Crop genetic improvement	29.7	6.9	20.0	8.5
Crop pest and disease control	4.5	6.4	3.0	8.0
Other crop	17.8	9.5	12.0	11.7
Livestock genetic improvement	8.9	1.4	6.0	1.7
Livestock pest and disease control	4.5	3.5	3.0	4.3
Other livestock	16.3	11.4	11.0	14.1
Soil	7.4	6.3	5.0	7.8
Water	29.7	9.3	20.0	11.5
Other natural resources	7.4	1.4	5.0	1.8
Postharvest	1.5	0.6	1.0	0.7
Other	20.8	24.3	14.0	29.9
Total	148.4	81.0	100.0	100.0

*Sources:* Figures in parentheses indicate the number of agencies in each category. "Other" includes three higher education agencies and three private agencies.

## CONCLUSION

During 1996-2003, total agricultural research staff and expenditures in Jordan rose steadily. In 2003, the country spent close to \$13 million (in 2000 prices) on agricultural R&D. Compared to many other countries in West Asia and North Africa, Jordan distinguishes itself in having a very high research intensity ratio—not uncommon for a country with a low AgGDP share, a small population and high per capita income.

NCARTT is the only government agency involved in agricultural research in Jordan. Consequently, it has a broad mandate, including conducting and coordinating research, adapting, and transferring technologies, and building the country's agricultural research capacity. The higher education sector plays a significant role in agricultural research in Jordan. The oldest and most important of these agencies is the UoJ's Faculty of Agriculture, where staff spend a substantial amount of their time on research (50 percent in 2003). Various private companies are also engaged in agricultural research—focusing primarily on fertilizer, fruit, and vegetable research—but the research capacity of each company is very small.

The number of researchers with doctorate degrees almost doubled between 1997 and 2003. This primarily stemmed from NCARTT's focus on human resource development in its recently completed five-year workplan and the subsequent return of employees upon completion of their graduate studies. Despite this focus on capacity building, NCARTT's effectiveness and growth has been hindered by low salary caps, which have created a disincentive in attracting and keeping well-qualified staff. Negotiations with the national government are currently ongoing to enable NCARTT to restructure its salary levels and thereby compete effectively for staff with the higher education sector.

## NOTES

1. The authors are grateful to numerous colleagues in Jordan for their time and assistance with the data collection and to Nasri Haddad, Laith Rousan, Kamel Shideed, and Gert-Jan Stads for their useful comments on drafts of this brief.
2. The 15-agency sample consists of the following agencies:
  - One government agency—the National Center for Agricultural Research and Technology Transfer (NCARTT);
  - Seven higher-education agencies—the Faculty of Agriculture and the Water Environment Research and Study Center (WERSC) under the University of Jordan (UoJ); the Faculty of Agriculture (FA) and the Faculty of Veterinary Medicine (FVM) under Jordan University of Science and Technology (JUST); the Faculty of Technological Agriculture at Al Balqa' Applied University; the Faculty of Agriculture at Mu'tah University; and the Faculty of Agriculture at University of Jerash; and

- Seven private enterprises—Hassan Farhana Farms, Dr. Kamel Al-Rudeida Farms, Muneer Sakhtian Group Co., Unifert Co., Modern Company for Fertilizer Production, Al-Mawared Co., Keena Company for Agricultural Equipment and Materials.

The sample excludes the Yarmouk University's Marine Science Center (MSC) and other higher education agencies (such as colleges of sciences, economics, and engineering), which may undertake some research related to the agricultural sciences.

3. Unless otherwise stated, all data on research expenditures are reported in 2000 international dollars or in 2000 Jordanian dinars.
4. These totals would be slightly higher were the omitted entities referred to in note 2 included. The difference is not significant, however, because these agencies reportedly conduct minimal agricultural research.

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## METHODOLOGY

- Most of the data in this brief are taken from unpublished surveys (IFPRI 2004-05) and Al-Ahmad et al. (1999).
- The data were compiled using internationally accepted statistical procedures and definitions developed by the OECD and UNESCO for compiling R&D statistics (OECD 2002; 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 2000 international dollars by deflating current local currency units with a Jordanian GDP deflator of base year 2000 and then converting to U.S. dollars with a 2000 purchasing power parity (PPP) index, both taken from World Bank (2005). 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.
- 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 of the period.

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

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