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Pakistan Agricultural Research Council

PAKISTAN

RECENT DEVELOPMENTS IN AGRICULTURAL RESEARCH

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INVESTMENT AND CAPACITY TRENDS IN AGRICULTURAL R&D

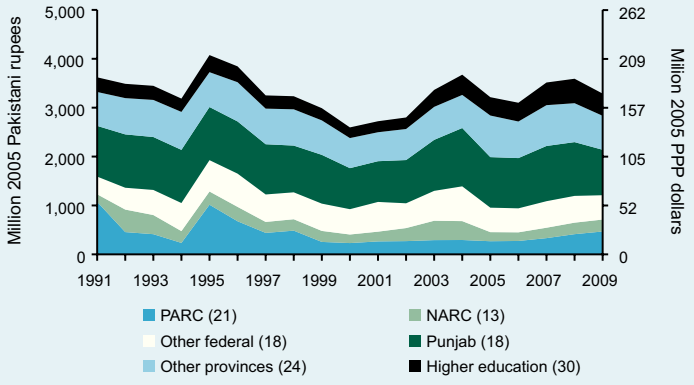
The agricultural sector is especially important in Pakistan, given that it employs half the country's labor force and plays a vital role in the nation's food security. Public agricultural research and development (R&D) investment in Pakistan has fluctuated considerably from year to year but averaged slightly less in more recent years than in the 1990s. In 2009, investments totaled 3.3 billion Pakistani rupees or $172 million purchasing power parity (PPP) dollars, both in 2005 constant prices (Figure 1; Table 1). Unless otherwise stated, all dollar values in this note are based on PPP exchange rates, which reflect the purchasing power of currencies more effectively than do standard exchange rates because they compare the prices of a broader range of local—as opposed to internationally traded—goods and services.[1] After a decade of very slow growth in the 1990s, total public agricultural research capacity fell slightly after 2002 but thereafter increased, reaching 3,532 full-time equivalent (FTE) researchers in 2009 (Figure 2).

The country's principal agricultural R&D agency, the Pakistan Agricultural Research Council (PARC), has a broad mandate to coordinate research among federal, provincial, and higher education agencies and to address areas of research not covered

Key Trends Since 2003

- After exhibiting an erratic, downward trend in the 1990s, agricultural research and development (R&D) spending in Pakistan increased during 2000–09, albeit at an irregular pace.
- Employing over 3,500 FTE researchers, Pakistan has one of the largest agricultural research systems of any of the world's developing countries; however, the share of researchers with PhD degrees remains low, at only 18 percent.
- The country's provincial public agricultural R&D agencies account for approximately half of national agricultural research investments and human resource capacity, whereas federal agencies account for about one-third of each.
- The government funds most agricultural R&D, but donor funding also makes a significant contribution.
- Although it has grown in recent years, the involvement of the private sector in agricultural R&D in Pakistan is minimal.

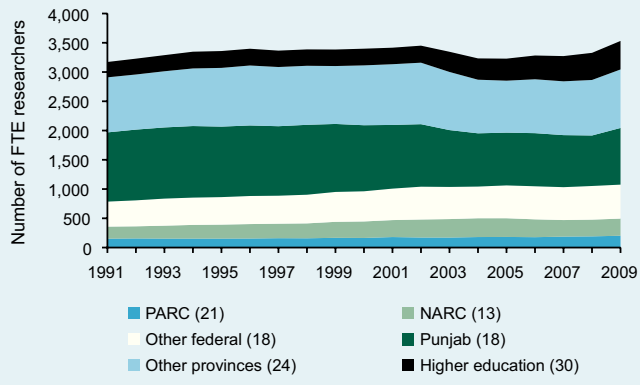
Figure 1—Public agricultural R&D spending adjusted for inflation, 1991–2009



Sources: Calculated by authors from ASTI– PARC 2011–12 and Beintema et al. 2007.

Notes: Figures in parentheses indicate the number of agencies in each category. Total agency sample includes one provincial agency that discontinued research activities before 2009. For more information on coverage and estimation procedures, see the Pakistan country page on ASTI's website at asti.cgiar.org/pakistan.

Figure 2—Public agricultural research staff in full-time equivalents, 1991–2009



Sources: Calculated by authors from ASTI– PARC 2011–12 and Beintema et al. 2007.

Notes: Figures in parentheses indicate the number of agencies in each category. Data exclude degree-qualified technicians not officially classified as researchers. Total agency sample includes one provincial agency that discontinued research activities before 2009.

Table 1—Overview of public agricultural R&D spending and research staff levels, 2009

Type of agency	Total spending			Total staffing	
	Pakistani rupees	PPP dollars	Shares	Number	Shares
	(million 2005 prices)		(%)	(FTEs)	(%)
Federal government					
PARC (21)	467	24	14.2	202	5.7
NARC (13)	244	13	7.4	293	8.3
Other federal (18)	498	26	15.1	581	16.4
Subtotal federal (52)	*1,210*	*63*	*36.8*	*1,076*	*30.5*
Provincial government					
Balochistan (2)	165	9	5.0	218	6.2
Khyber Pakhtunkhwa (5)	256	13	7.8	402	11.4
Punjab (18)	929	49	28.3	968	27.4
Sindh (16)	274	14	8.3	380	10.8
Subtotal provincial (41)	*1,624*	*85*	*49.4*	*1,968*	*55.7*
Higher education (30)	454	24	13.8	487	13.8
Total (123)	**3,288**	**172**	**100**	**3,532**	**100**

Source: Compiled by authors from ASTI–PARC 2011–12.

Notes: Figures in parentheses indicate the number of agencies in each category. Data exclude degree-qualified technicians not officially classified as researchers.

ASTI Website Interaction

- More details on institutional developments in agricultural research in Pakistan are available in the 2007 country brief at asti.cgiar.org/pdf/PakistanCR.pdf.
- Underlying datasets can be downloaded using ASTI's data tool at www.asti.cgiar.org/data.
- A list of the 94 government and 30 higher education agencies included in this brief is available at asti.cgiar.org/pakistan/agencies.

asti.cgiar.org/pakistan

by other agencies. Established in 1981, PARC previously reported to the Ministry of Food, Agriculture, and Livestock. With the 2010 introduction of the 18th Amendment to the Constitution of Pakistan, the Ministry was dissolved and its functions were devolved to the provincial level or assigned to other ministries. In 2011 oversight of PARC was transferred to the Ministry of Science and Technology and then later that year to the newly established Ministry of Food Security and Research.

PARC has 12 satellite institutes and oversees a number of federal government research agencies located in various parts of the country. One of the largest is the National Agricultural Research Center (NARC), which in turn oversees a number of its own research institutes. Including NARC, PARC accounts for one-fifth of all investments and 14 percent of total research capacity in national agricultural research. Excluding NARC, the number of researchers employed at the remaining PARC agencies increased from 171 FTEs in 2003 to 202 FTEs in 2009. Expenditures for this group also increased slightly during this period, to 0.5 billion rupees or 24 million PPP dollars (both in 2005 constant prices). NARC's employment of 293 FTE researchers in 2009 and expenditures of 0.2 billion rupees or 13 million PPP dollars (both in 2005 constant prices) represented a slight decline in investment and capacity from 2003.

Aside from PARC, a number of federal government agencies conduct agriculture-related R&D under the auspices of various ministries. These agencies include the Pakistan Council of Research on Water Resources (Ministry of Science and Technology), International Waterlogging and Salinity Research Institute (Ministry of Water and Power), National Fertilizer Development Centre (Ministry of Planning and Development), National Veterinary Laboratory (Ministry of Commerce), Marine Fisheries Department (Ministry of Ports and Shipping), and Pakistan Forest Institute (Ministry of Environment), among others. The Pakistan Atomic Energy Commission oversees four relatively large research agencies related to agriculture: the National Institute for Biotechnology and Genetic Engineering, Nuclear Institute for Agriculture and Biology, Nuclear Institute for Agriculture, and Nuclear Institute for Food and Agriculture.

Despite the country's numerous federal agencies, agricultural research in Pakistan also falls within the domain of the provincial governments. Provincial governments accounted for half of all the country's agricultural R&D investment and more than half of its agricultural research capacity in 2009. One province, Punjab, employed nearly 1,000 agricultural researchers in 2009 (in FTEs) and accounted for about half of the country's provincial-level investment. The Government of Punjab hosts the Punjab Agricultural Research Board (PARB), a provincial body that guides research planning and resource allocation specifically relating to the province's research priorities. The provincial government also hosts the Ayub Agricultural Research Institute, which manages more than half these researchers located across 28 crop-related research institutes and units. Capacity in several agencies in Punjab declined during 2002–03 mainly due to brain drain stemming from a lack of promotional opportunities and structural discrepancies between research and academic positions. Thereafter, staff levels were also affected by the further devolution of responsibilities from the provincial government to local district governments.

After Punjab, the provinces with the next highest human resource capacity for agricultural R&D in 2009 were Khyber Pakhtunkhwa (402 FTEs), Sindh (380 FTEs), and Balochistan (218 FTEs), although these levels fluctuated considerably in the previous decade. In Khyber Pakhtunkhwa, crop-related research

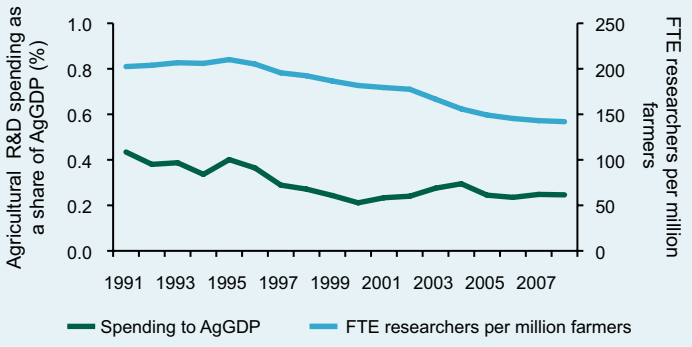
agencies remain coordinated under the Agricultural Research System. In Sindh, the Agriculture Research Institute at Tandojam continues to lead crop research alongside the research institutes focused on rice, wheat, and horticulture. Balochistan's agencies were restructured in 2004 under the Directorate of Agricultural Research and the Directorate of Research and Supplies of Livestock.

The higher education sector accounted for 14 percent of national agricultural research capacity in 2009, employing 487 FTEs, which represented a substantial increase over levels in the early 1990s. The University of Agriculture, Faisalabad (UAF) remains Pakistan's largest agricultural university with six separate faculties conducting agricultural research in addition to its Division of Education and Extension and Water Management Research Centre. Other major agricultural universities include Sindh Agriculture University Tandojam (92 FTEs), Agricultural University Peshawar (61 FTEs), Pir Mehr Ali Shah Arid Agriculture University Rawalpindi (56 FTEs), and the University of Veterinary and Animal Sciences, Lahore (56 FTEs). Overall student enrollments almost doubled between 2003 and 2009 to reach about 27,000 students (ASTI–PARC 2011–12).

Nonprofit and for-profit private companies were found to have minimal, but growing, involvement in agricultural R&D in Pakistan. A number of private companies have active breeding programs, including programs focused on genetically modified Bt cotton, hybrid maize, vegetables, and several other crops. A recent survey of firms engaged in seed research estimated aggregate investment at 121 million rupees or US$1.3 million (in current prices) with the average firm spending 5.5 percent of its sales revenue on R&D. Private R&D is also sizeable in the fertilizer sector; one of the largest firms spent nearly 287 million rupees in 2009, primarily on research to improve fertilizer manufacturing (for example, energy saving technologies). Private research investments in livestock, irrigation, processing, and other areas were nominal (Naseem et al. 2012).

A common, cross-country indicator of agricultural research investment is the research intensity ratio, in this case measured as total spending on agricultural R&D as a percentage of agricultural output (AgGDP). In 2009, for every $100 of agricultural output in Pakistan, $0.21 was invested in agricultural R&D (Figure 3). This level represents a decline from a high of 0.43 in 1991 and indicates that investments failed to keep pace with growth in the country's AgGDP. This ratio is also one of the lowest in South Asia, compared with India (0.40), Sri Lanka (0.34), Bangladesh, (0.32), and Nepal (0.26) (Rahija et al. 2011a and 2011b; Girihagama and Rahija 2012; Pal, Rahija, and Beintema 2012). An alternative measure of research intensity—the number of FTE agricultural researchers per million farmers—also declined from the 1990s, reaching 147 FTEs per million farmers in 2009.

Figure 3—Intensity of public agricultural research spending and capacity, 1991–2009



Sources: Calculated by authors from ASTI–PARC 2011–12, Beintema et al. 2007, World Bank 2011, and FAO 2012.

ASTI Website Interaction

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

asti.cgiar.org/pakistan

INSTITUTIONAL STRUCTURE AND POLICY ENVIRONMENT

Recent developments have significant implications for agricultural research in Pakistan. As described earlier, the shuffling of PARC between ministries following passage of the 18th Amendment in 2010 briefly introduced a sense of uncertainty in the agricultural research community. Nonetheless, by devolving agricultural sector responsibilities to the provinces, provincial research systems appear to have gained a clearer mandate in science, technology, and innovation. A key challenge facing Pakistan will be to ensure that resources and capacities are more evenly distributed, both from the central government to the provinces and among the provinces themselves, given that Punjab is viewed as having the strongest provincial research system. Moreover, the devolution required PARC to revise its structures and renew its relationship with the provinces to help achieve their common visions. Efforts are underway to strengthen PARC and improve its relevance and effectiveness under the government's new configurations and economic growth priorities. Similar processes are being pursued in light of the government's plans to devolve public universities to the provinces.

Agricultural research structures vary by province. Only Punjab hosts an agricultural research board, the aforementioned PARB,

which is mandated to prioritize research areas; allocate funds; monitor outcomes and impact; and coordinate national, international, and industry stakeholders in support of the province's research agenda. This board provides the province with governance and financing structures that enhance its ability to address challenges and solve problems at the local level. Sindh, Balochistan, and Khyber Pakhtunkhwa do not yet have parallel structures.

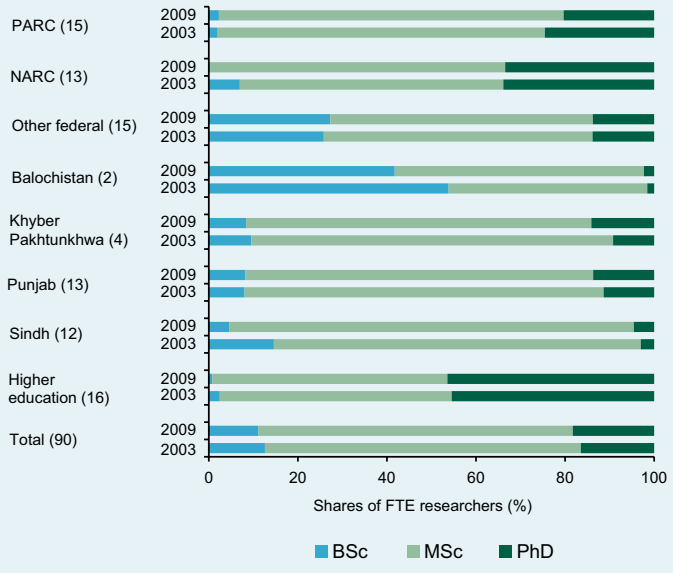
DEVELOPMENTS IN AGRICULTURAL RESEARCH STAFFING

MSc-qualified staff accounted for about three-quarters of Pakistan's total agricultural research capacity in 2009, whereas researchers with BSc degrees constituted 11 percent, and those with PhD degrees represented 18 percent (Figure 4). Average qualification levels of research staff remained similar between 2003 and 2009. Compared with neighboring countries, the share of PhD-qualified staff is still quite low, indicating the need for further training and capacity building. In India, 86 percent of researchers at the main government agency held PhD degrees in 2009; in Sri Lanka and Bangladesh, comparable shares were 33 and 30 percent, respectively (Rahija et al 2011a; Girihagama and Rahija 2012; Pal, Rahija, and Beintema 2012).

Of note, a number of technicians held PhD, MSc, or BSc degrees but were not officially classified as researchers. In 2009, about 9 percent of technicians were degree-qualified; 3 FTE technicians held PhD degrees, 17 held MSc degrees, and 105 held BSc degrees (ASTI–PARC 2011–12).

Universities worldwide generally employ higher shares of agricultural researchers with PhD and MSc degrees, and this holds true in Pakistan. In 2009, the share of PhD-qualified researchers in the higher education sector was 46 percent, whereas MSc-qualified researchers accounted for about half of capacity. After the universities, Punjab and NARC employed the highest number of faculty staff with PhD degrees. In contrast, Sindh and Balochistan employed only 13 and 5 FTE researchers with PhDs, respectively.

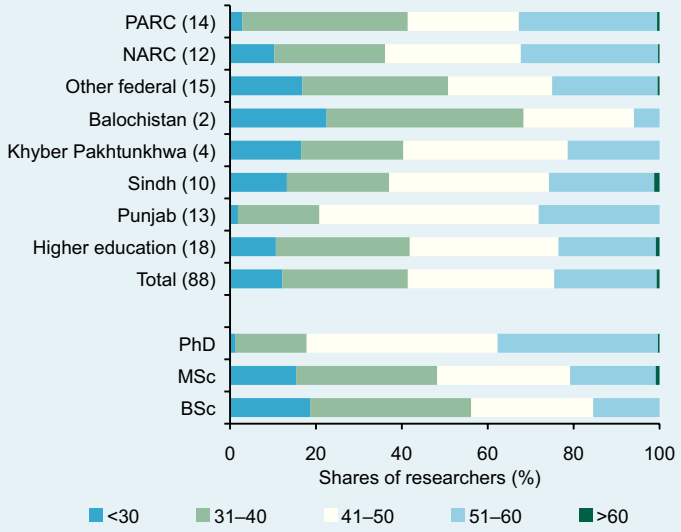
Figure 4—Qualifications of researchers by institutional category, 2003 and 2009



Sources: Calculated by authors from ASTI–PARC 2011–12 and Beintema et al. 2007.

Notes: Figures in parentheses indicate the number of agencies in each category. Degree data account for 86 percent of total researchers. For more information on coverage and estimation procedures, see the Pakistan country page on the ASTI website at http://asti.cgiar.org/pakistan. Data exclude degree-qualified technicians not officially classified as researchers (3 FTEs qualified to the PhD level, 17 FTEs qualified to the MSc level, and 105 FTEs qualified to the BSc level).

Figure 5—Age distribution of researchers by degree and institutional category, 2009



Source: Calculated by authors from ASTI–PARC 2011–12.

Notes: Figures in parentheses indicate the number of agencies in each category. Shares of researchers are based on headcounts, not FTEs. Age data account for 85 percent of total researchers. For more information on coverage and estimation procedures, see the Pakistan country page on the ASTI website at http://asti.cgiar.org/pakistan.

Two major phases of capacity building were launched by PARC during the implementation of the World Bank–financed Agricultural Research Project (commonly known as ARP-I and ARP-II), where a majority of (particularly young) scientists were trained during the 1980s and 1990s. Since then, however, opportunities of this magnitude have not materialized either at PARC or at the country's provincial agricultural research systems. Nevertheless, capacity improvements have been supported through general scholarships for students from the Pakistan Science Foundation (PSF), the Higher Education Commission of Pakistan (HEC), and the Punjab Educational Endowment Fund (PEEF), among others. It should be noted, however, that these mechanisms are not specifically designated for agricultural scientists. Recent initiatives may be opening the door for new opportunities; the Chief Minister of Punjab, for example, recently announced that 300 scholarships valued at 3 billion rupees would be made available from PEEF for UAF students to undertake PhD study overseas.

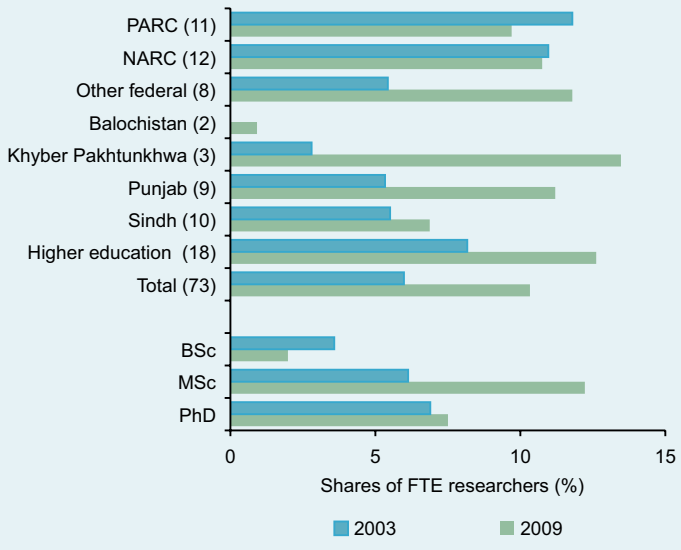
Corresponding with the low number of PhD-qualified researchers, Balochistan also employs the youngest group of researchers among Pakistan's public agricultural R&D agencies (Figure 5). Two-thirds of researchers were under the age of 40 in 2009, and one-quarter of those were under the age of 30. In contrast, 80 percent of researchers in Sindh were over the age of 40. At PARC, NARC, and the other provincial and higher

education agencies, a majority of researchers were over the age of 40. The remaining federal agencies tended to employ younger researchers (half, on average, were under the age of 40 in 2009). Significantly, more than half of PARC's and NARC's PhD-qualified researchers were over the age of 50, suggesting that a growing number of senior researchers at these agencies are nearing retirement.

Women continue to be underrepresented in agricultural R&D in Pakistan. In 2009, female researchers constituted 10 percent of total agricultural research staffing (Figure 6). Despite representing an increase from the 2003 share of 6 percent (Beintema et al. 2007), this share is still quite low compared with other countries in the region such as Sri Lanka (48 percent) and Bangladesh (16 percent) (Rahija et al 2011a; Girihagama and Rahija 2012). Shares of female researchers tended to be higher at the federal agencies, the universities, and in Punjab province, but lower in Sindh and Balochistan provinces. In addition to variation across agencies, shares of female researchers differed across degree levels. The share of women—while low across the board—was highest at the MSc level; shares were 2 percent of all BSc-qualified researchers, 12 percent of all MSc-qualified researchers, and 8 percent of all PhD-qualified researchers (ASTI–PARC 2011–12). Across the federal and provincial agency groups, PARC employed the highest share of female researchers with PhD degrees.

Pakistan's average ratios of support staff to researchers changed very little from 2003 to 2009. In 2009, the 4.1 ratio comprised 0.5 technicians, 1.0 administrative staff, and 2.6 other support staff per researcher (ASTI–PARC 2011–12). In general, the provincial government agencies employed the highest ratios of support staff. Lower support-staff ratios are common in the higher education sector given that research is not their primary mandate.

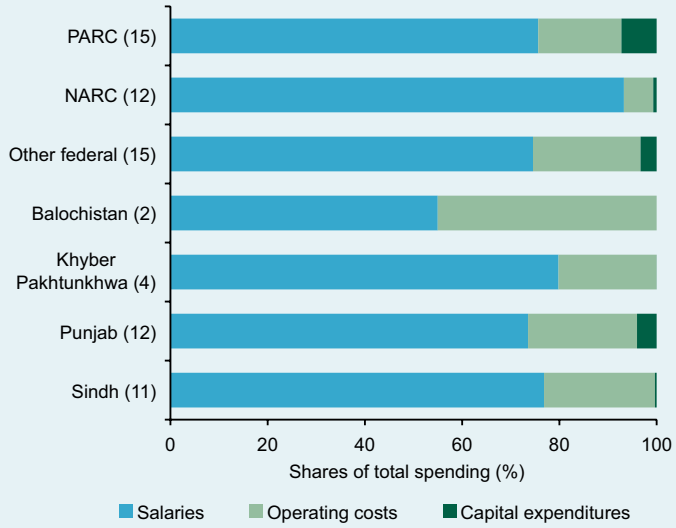
Figure 6—Female share of researchers by degree and institutional category, 2003 and 2009



Sources: Calculated by authors from ASTI–PARC 2011–12 and Beintema et al. 2007.

Notes: Figures in parentheses indicate the number of agencies in each category. Gender data account for 72 percent of total researchers. For more information on coverage and estimation procedures, see the Pakistan country page on the ASTI website at http://asti.cgiar.org/pakistan.

Figure 7—Cost category shares, 2009



Source: Calculated by authors from ASTI–PARC 2011–12.

Notes: Cost category data were provided by 42 federal and 29 provincial agencies. Combined, these account for 84 percent of total expenditures, excluding higher education. For more information on coverage and estimation procedures, see the Pakistan country page on the ASTI website at http://asti.cgiar.org/pakistan.

INVESTMENT TRENDS

Expenditures

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 government agencies as part of this study. In 2009, salaries at PARC accounted for three-quarters of total spending, whereas operating costs comprised 17 percent, and capital expenditures 7 percent. At 93 percent, salaries accounted for a much higher share of expenditures at NARC. This trend was common at the federal and provincial agencies, with the exception of Balochistan province, where salaries accounted for only half of total spending (Figure 7). The high salary share across agencies indicates limited funding for the other costs associated with research. Given the dependence by many federal agencies on research funding from donors directed toward output- and outcome-oriented activities, longer term research maintenance issues tend to be overlooked.

Funding Sources

The government funds most agricultural R&D in Pakistan, but donor funding also makes a significant contribution to research investment. Recurrent government budgets generally fund the cost of salaries, while donor contributions are directed towards operating costs and capital investments. PARC and the other federal agencies receive a variety of donor funding, but much less is directed to the provincial institutes. Proceeds from the sale of goods and services accounted for a moderate amount of funding for federal agencies other than PARC. In general, investment levels were higher in the 1980s and 1990s due to substantial financial support by the World Bank and United States Agency for International Development (USAID).

Two major government programs have affected funding levels for agricultural research in recent years. Although these programs are operated by the government, they are funded by donors, making it difficult to accurately estimate the share of donor funding at the federal agencies. The Agricultural Linkages Program (ALP) and its funding mechanism, the Agricultural Research Endowment Fund (AREF), have been operating in Pakistan since 2000. With funding derived from the sale of wheat donated by the United States government, the endowment of 1.3 billion current rupees is managed by PARC and supports agricultural research in a number of priority areas across crop and animal sciences, natural resources, and social sciences (Beintema et al. 2007; PARC 2012).

The Research for Agricultural Development Program (RADP) began in 2007 and was originally expected to conclude in 2011, but financial constraints that limited disbursements have led to its extension until 2013. The Executive Committee of the National Economic Council approved a budget of 3 billion rupees for the program, and as of June 2011 1.1 billion had been released (RADP 2012). RADP funds originate from the Public Sector Development Program (PSDP), a government mechanism for financing development projects. RADP funds PARC's research activities under 22 different priority areas across similar research themes as ALP. It also provides funds for capacity strengthening initiatives and the development of infrastructure, including the maintenance and repair of PARC buildings, upgrades to laboratory and field equipment, and international collaboration. In recent years PARC has collaborated with organizations such as the centers of the Consultative Group on International Research (CGIAR), including the International Center for Agricultural Research in the Dry Areas (ICARDA), International Maize and Wheat Improvement Center (CIMMYT), International Rice Research Institute (IRRI), International Water Management Institute (IWMI), International Potato Institute (CIP), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Food Policy Research Institute (IFPRI), and International Livestock Research Institute (ILRI).

In addition to fellowships for PhD programs, PSF provides competitive research funding for projects in the agricultural sciences.The Higher Education Commission of Pakistan and the Ministry of Science and Technology also finance agricultural research projects. In Punjab, PARB provides competitive research funds.

In addition to World Bank loans, other international sources of agricultural research investment in Pakistan have included the Asian Development Bank (ADB), Food and Agricultural Organization of the United Nations (FAO), International Atomic Energy Agency (IAEA), International Centre for Genetic Engineering and Biotechnology (ICGEB), International Centre for Integrated Mountain Development (ICIMOD), United Nations Children's Fund (UNICEF), United Nations Development Programme (UNDP), United Nations Educational, Scientific and Cultural Organization (UNESCO), and World Food Programme (WFP). Bilateral donors have included the Australian Centre for International Agricultural Research (ACIAR), Egyptian International Center for Agricultural Research (EICA), Japan International Cooperation Agency (JICA), Swiss Agency for Development and Cooperation (SDC), Swiss National Centre of Competence in Research North-South (NCCR), World Vegetable Center (AVRDC), and USAID. Agencies in the province of Punjab also reported receiving funding from the ADB, CIMMYT, and IRRI.

RESEARCH ALLOCATION

Given that the allocation of resources across various lines of research is a significant policy decision, detailed information was collected on the number of researchers working in specific commodity and thematic areas (in FTEs). In 2009, the predominant focus of agricultural research in Pakistan was crops. That year, 59 percent of researchers were involved in crop research, 17 percent focused on research related to livestock, 9 percent on natural resources research, 3 percent on forestry research, and 2 percent on fisheries research (Figure 8). Research priorities also differed across the provinces and by institutional category: a greater share of researchers in higher education agencies focused on issues related to livestock, whereas crop research predominated in Sindh.

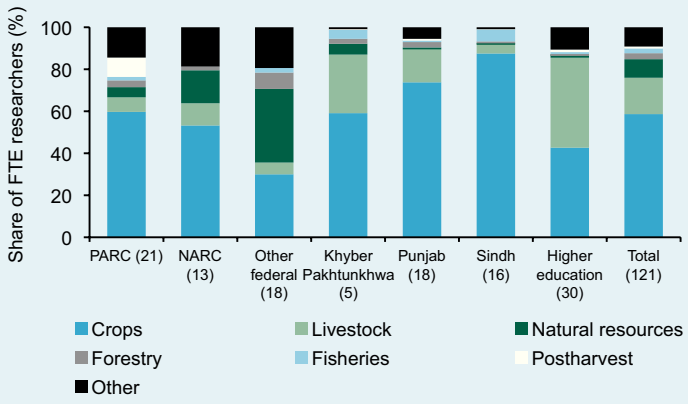
Commodity Focus

Wheat was Pakistan's predominant crop under research during 2009, representing an 18 percent share of combined crop and livestock research (Table 2). Rice and cotton were also being heavily researched that year, with shares of 10 and 8 percent, respectively. Other significant crops included sugarcane, fruit, vegetables, and maize, each accounting for shares of between 4 and 6 percent. In the livestock subsector, poultry and dairy constituted the dominant focus of commodity research, with shares of 8 and 7 percent, respectively.

Thematic Focus

In 2009, crop genetic improvement was the focus of 19 percent of the country's total number of FTE researchers, whereas 12 percent focused on crop pest and disease control (Table3). Livestock genetic improvement and livestock pest and disease control were also major themes (4 and 7 percent of all FTE researchers, respectively). The thematic focus of the remaining researchers included natural resources, socioeconomics, agricultural engineering, and postharvest issues, among others.

Figure 8—Research focus by major commodity area, 2009



Source: Calculated by authors from ASTI–PARC 2011–12.

Notes: Figures in parentheses indicate the number of agencies in each category. No data were available for Balochistan province.

Table 2—Crop and livestock research focus by major item, 2009

Research focus	PARC (20)	NARC (5)	Other federal (8)	Khyber Pakhtunkhwa (3)	Punjab (11)	Sindh (15)	Higher education (24)	Total (86)
Crop items				Shares of FTE researchers (%)				
Wheat	18.3	7.2	13.7	30.8	17.0	27.4	8.9	18.0
Rice	2.5	4.8	15.9	3.4	7.6	23.3	8.9	9.7
Cotton	1.3	—	26.3	—	10.0	10.0	4.2	8.2
Sugarcane	24.8	2.9	3.8	4.4	4.3	9.5	2.6	5.7
Fruits	13.6	1.3	2.0	6.2	8.3	0.6	3.1	5.2
Vegetables	6.3	5.3	3.6	4.9	6.3	0.3	3.3	4.4
Maize	4.2	2.6	1.8	11.4	3.5	2.3	3.1	4.2
Tea	6.7	—	—	—	—	—	—	0.4
Other crop	11.9	59.3	17.1	20.3	25.0	21.2	15.9	23.3
Livestock items								
Poultry	1.6	1.7	2.0	7.5	8.9	3.2	20.3	8.2
Dairy	5.6	8.3	5.4	11.2	4.5	0.7	12.8	6.7
Sheep and goats	2.9	4.1	1.3	—	1.1	1.1	10.7	2.9
Beef	0.4	1.7	3.8	—	3.2	0.5	2.5	2.1
Other livestock	—	0.8	3.3	—	0.2	—	3.8	1.1
Total crop and livestock	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Calculated by authors from ASTI–PARC 2011–12.
Notes: Figures in parentheses indicate the number of agencies in each category. No data were available for Balochistan province. One additional research agency conducts livestock research in Khyber Pakhtunkhwa, the Veterinary Research Institute; however, commodity focus data were not available.

Table 3—Research focus by major theme, 2009

Research focus	PARC (15)	NARC (13)	Other federal (16)	Khyber Pakhtunkhwa (4)	Punjab (13)	Sindh (10)	Higher education (18)	Total (89)
				Shares of FTE researchers (%)				
Crop genetic improvement	10.2	24.4	11.8	9.7	28.7	26.6	5.1	18.9
Crop pest and disease control	10.4	16.6	9.2	8.7	15.0	10.3	10.9	12.2
Other crop issues	21.6	10.1	5.6	25.6	19.8	21.6	11.5	16.2
Livestock genetic improvement	4.5	2.6	2.3	11.5	2.4	0.6	5.0	3.7
Livestock pest and disease control	2.3	2.6	3.0	5.8	8.3	2.9	14.6	6.5
Other livestock issues	7.6	5.3	1.5	4.9	6.7	2.7	23.1	7.3
Soil	6.1	8.6	8.5	10.3	5.4	6.3	5.4	6.9
Water	5.9	4.9	32.5	0.2	3.3	7.5	5.7	9.0
Other natural resources	3.0	3.0	8.3	4.6	3.0	7.0	0.6	4.2
Postharvest	3.3	4.4	—	0.8	1.3	2.0	1.0	1.5
Other	25.1	17.5	17.2	17.9	6.1	12.4	17.0	13.6
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Calculated by authors from ASTI–PARC 2011–12.
Notes: Figures in parentheses indicate the number of agencies in each category. No data were available for Balochistan province. Thematic focus data account for 80 percent of total researchers. For more information on coverage and estimation procedures, see the Pakistan country page on the ASTI website at http://asti.cgiar.org/pakistan.

CONCLUSION

Agricultural R&D investment in Pakistan increased during 2000–09, albeit at an irregular pace. Pakistan has one of the largest agricultural research systems among developing countries, employing over 3,500 FTE researchers. However, based on a number of indicators, Pakistan appears to be falling behind other South Asian countries. As of 2009, agricultural research spending did not match AgGDP growth, resulting in a weakening agricultural research intensity ratio of 0.21; the share of agricultural researchers holding PhD degrees remained low, at 18 percent; and, despite improvements at a number of institutes, overall employment of female researchers continues to be very low. Finally, private investment in agricultural research has grown but remained relatively small as of 2009.

These financial and capacity challenges have occurred at a time of institutional uncertainty. Spending and capacity patterns have fluctuated as agencies adjust to the devolution and reorganization of responsibilities across national, provincial, and local levels of government in response to the 18th Amendment to the country's constitution. Provincial institutes have taken on a larger role in agricultural research, but questions remain as to whether they are resourced and structured to do so effectively.

This period of change has, however, offered opportunities to review existing structures and reassess research priorities. Whether the changes will yield advancements both in the system itself and in agricultural productivity remains to be seen.

NOTES

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

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