AGRICULTURAL SCIENCE
AND TECHNOLOGY INDICATORS

AGRICULTURAL RESEARCH AND DEVELOPMENT IN PAKISTAN:

POLICY, INVESTMENTS, AND INSTITUTIONAL PROFILE

ASTI Country Report

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About the ASTI Initiative

The Agricultural Science and Technology Indicators (ASTI) initiative compiles, processes, and makes available data on institutional developments and investments in agricultural R&D worldwide, and analyzes and reports on these trends. Tracking these developments in ways that make for meaningful comparisons among different countries, types of agencies, and points in time is critical for keeping policymakers abreast of science policy issues pertaining to agriculture. The main objective of the ASTI initiative is to assist policymakers and donors in making better informed decisions about the funding and operation of public and private agricultural science and technology agencies by making available internationally comparable information on agricultural research investments and institutional changes. Better informed decisions will improve the efficiency and impact of agricultural R&D systems and ultimately enhance the productivity growth of the agriculture sector. The ASTI initiative is managed by the ISNAR division of the International Food Policy Research Institute **(www.ifpri.org)** and comprises a network of national, regional, and international agricultural R&D agencies. Primary funding for the ASTI initiative's survey round in Asia was provided by the World Bank and IFPRI core funding.

The ASTI data and associated reports are made freely available for research policy formulation and priority-setting purposes, and can be found at the ASTI website: **www.asti.cgiar.org**

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ACRONYMS[*]**

AARI	Ayub Agricultural Research Institute
ACIAR	Australian Centre for International Agricultural Research
AgGDP	agricultural gross domestic product
AIDAB	Australian International Development Assistance Bureau
ALP	Agricultural Linkage Program
APAARI	Asia–Pacific Association of Agricultural Research Institutes
AREF	Agricultural Research Endowment Fund
ARP–I	Agricultural Research Development Project
ARP–II	Agricultural Research Development Project – Phase II
ARIT	Agricultural Research Institute Tandojam
AVRDC	Asian Vegetable Research and Development Centre
AZRC	Arid Zone Research Centre
BoG	Board of Governors (of PARC)
BSc	Bachelor of Science
CGIAR	Consultative Group on International Agricultural Research
CIDA	Canadian International Development Agency
CIMMYT	International Maize and Wheat Improvement Center
FAO	Food and Agriculture Organization of the United Nations
ECNCST	Executive Committee of the National Commission for Science and Technology
fte	full-time equivalent
GDP	gross domestic product
HEC	Higher Education Commission
ICARDA	International Center for Agricultural Research in the Dry Areas
ICIMOD	International Centre for Integrated Mountain Development
IDRC	International Development Research Centre
IFPRI	International Food Policy Research Institute
IIMI	International Irrigation Management Institute
ILRI	International Livestock Research Institute
IRRI	International Rice Research Institute
IWMI	International Water Management Institute
KARINA	Karakoram Agricultural Research Institute for Northern Areas
MART	Management of Agricultural Research and Technology Project
MINFAL	Ministry of Food, Agriculture, and Livestock
MSc	Master of Science
MST	Ministry of Science and Technology
MTDF	Medium Term Development Framework
NARS	National Agricultural Research System

[*] Note: that the list only includes general acronyms used in the text, not those listed in Table 1 or Appendix C.

ACRONYMS (CONTINUED)

NARC	National Agricultural Research Centre
NCRP	National Coordinated Research Programs
NCST	National Commission for Science and Technology
NGO	non-governmental organization
NSCRI	National Sugar Cane Research Institute
NTRI	National Tea Research Institute
NWFP	North-West Frontier Province
OECD	Organisation for Economic Co-operation and Development
PARC	Pakistan Agricultural Research Council
PCRWR	Pakistan Council for Research in Water Resources
PCST	Pakistan Council for Science and Technology
PFI	Pakistan Forest Institute
PFRI	Punjab Forestry Research Institute
PhD	Doctor of Philosophy
PIDE	Pakistan Institute of Development Economics
PPP	purchasing power parity
RAC	Research Advisory Committee
R&D	research and development
S&T	science and technology
SARC	Southern Zone Agricultural Research Centre
SAU	Sindh Agricultural University
STED	Science and Technology for Economic Development Program
TTI	Technology Transfer Institute
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

ABSTRACT

This report presents an overview of Pakistan's national agricultural R&D system in terms of institutional developments and recent trends in human and financial resources based on data collected under the Agricultural Science and Technology Indicators (ASTI) initiative.

Public agricultural research in Pakistan is conducted by federal and provincial government agencies and by various higher education agencies. The organizational structure of agricultural R&D in Pakistan is somewhat complex, but with a clear distinction between federal- and provincial-level research agencies. Research conducted by federal government agencies is largely long-term priority research, while the research conducted at the provincial level is mostly adaptive. Total public agricultural research spending fell by about one-third during the 1990s, but rebounded during 1999-2003. Public agricultural R&D in Pakistan is heavily reliant on government sources of support. Foreign donor support has traditionally played an important role in financing agricultural R&D in Pakistan (mostly through grants and loans from the United States and the World Bank), although exact shares of donor funding were not available.

Agricultural research conducted by private companies is limited in Pakistan. In 2003, the private sector accounted for just 6 percent of the country's total public and private agricultural R&D spending.

The total number of agricultural researchers in Pakistan's public sector has grown only slowly over the past two decades, mainly as a result of prolonged periods of recruitment restrictions. Compared to most countries in the Asia-Pacific region, average qualification levels of Pakistan's agricultural research staff are relatively low; only 15 percent of the country's agricultural researchers hadd PhD degrees in 2003. In addition, researchers at the government agencies face limited promotion opportunities, low salary levels, and few other incentives. This has led to a brain drain of researchers from the government sector to universities, non-research agencies, or to opportunities outside Pakistan. Further, Pakistan's agricultural R&D agencies employ only a small portion of female scientists compared to other countries in the Asia-Pacific region.

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INTRODUCTION

The Islamic Republic of Pakistan (hereafter, "Pakistan") is highly dependent on the agricultural sector, which is the main income- and employment-generating sector of the economy. In 2005, the agricultural sector accounted for 22 percent of gross domestic product (GDP) and employed 45 percent of the labor force, while agro-industries accounted for about two-thirds of total industrial output (Ministry of Finance 2006). In addition to providing food to consumers and fibers to domestic industries, the agricultural sector is also a source of scarce foreign exchange earnings and it provides a market for industrial goods. However, severe water shortages, in combination with salt-affected soils, soil erosion, low-yielding varieties, and the limited use of modern farming technologies, have resulted in relatively low crop yields (Alam and Naqvi 2003). In the meantime, Pakistan has one of the highest population growth rates in the Asia–Pacific region (2.4 percent annually or, in absolute numbers, an additional 3 to 4 million people each year).

In order to attain food security for this fast-growing population, food production needs to grow by at least the same rate as the population. Agricultural growth rates of at least 5 to 6 percent are required to reduce the country's poverty at a substantial level. Because land and water resources are becoming increasingly scarce in Pakistan, this agricultural production growth will need to take place through increasing yields and crop intensification (Alam and Naqvi 2003). This will require the broad dissemination of new and improved technologies, and agricultural research and development (R&D) is the channel through which this can occur. Investments in agricultural R&D are, therefore, important in achieving higher agricultural growth in developing countries such as Pakistan.

This report provides an overview of recent institutional developments and investment and personnel trends in agricultural R&D in Pakistan based on a comprehensive survey conducted by IFPRI and PARC during 2004–06 (see Appendix A for an overview of the methodology and data collection processes). Keeping track of this type of information is important for policymakers and donors to make better-informed decisions about the funding and operation of public and private agricultural S&T agencies. The quality of such decisions has a direct impact on the efficiency and effectiveness of agricultural R&D systems.

Macroeconomic Context

Pakistan is one of the largest countries in Asia in terms of land area and population. The country covers a large variety of agro-ecological zones ranging from coastal areas in the south to the Himalayan Mountains in the north; hence it has great capacity for producing a wide range of food commodities. Most of Pakistan is classified as arid or semi-arid, so the agricultural sector is highly dependent on water supply through either irrigation or water harvesting. In 2003, 72 percent of Pakistan's agricultural area was irrigated (FAO 2006). Pakistan has the largest network of irrigation canals in the world, distributing water from the three major basins in Punjab province. Lack of water is one of the major constraints to agricultural growth in Pakistan. During the drought of 2000–01, for example, the total production of wheat and rice declined by 10 and 19 percent, respectively (FAO 2006).

The most important crops produced in Pakistan are wheat, sugarcane, cotton, and rice. Combined, they accounted for more than three-quarters of total crop output in 2005 (FAO 2006). Wheat is the main staple food in Pakistan and it is by far the country's largest food crop in terms of production volume. In 2005, Pakistan produced more wheat than all of Africa and nearly as much as all of South America (FAO 2006). Cotton is not only an export crop that earns foreign exchange, but also a provider of raw material to the local textile industry. In 2005, cotton production contributed 2 percent to Pakistan's GDP. Rice is an important food cash crop and also one of Pakistan's principal exports. Sugarcane is a major raw material for producing both white sugar and gur (jaggery) (Ministry of Finance 2006).

The livestock sector contributes about half of the value added in the agriculture sector, amounting to nearly 11 per cent of Pakistan's GDP, which is more than the crop sector (Ministry of Finance 2006). Cattle are raised throughout the country and Pakistan is the world's fifth-largest milk-producing country by volume. Buffaloes are kept mainly in the northern and southern irrigated plains, while more than half the country's sheep are reared in the western dry mountains, western dry plateau, and northern dry mountains. Large herds of goats are common in areas with forage and grazing. In addition, Pakistan has a vibrant poultry sector, with more than half a billion birds produced annually (Ministry of Finance 2006).

Forests cover about 4 million hectares, or less than 5 percent of the country (Ministry of Finance 2006). Most forests are in the Northern Areas and Azad Kashmir, where coniferous trees predominate. However, forest management and exploitation are held back by the geographic isolation of these two regions. In other parts of the country, most of the native forests were destroyed before independence in 1947 as a result of population pressure, overcultivation, and overgrazing. The lack of tree cover in these parts greatly contributes to many of the agricultural sector's problems, including soil erosion, the silting of streams, flooding, and a shortage of timber and firewood ((Ministry of Finance 2006).

Fisheries play only a minor role in the national economy, accounting for just 0.3 percent of GDP in 2005 (Ministry of Finance 2006). Nonetheless, it is the principal source of livelihood for the communities inhabiting the coasts of Sindh and Balochistan, as well as along the major rivers and lakes. Fish exports have become increasingly important in recent years and the national government is taking important infrastructural measures to improve the sector as a whole.

Science and Technology Policies and Investments

There is strong empirical evidence that high levels of R&D investments lead to high productivity and eventually to increased economic performance (Cororaton 1999). The rapid economic growth achieved by certain Asian countries in the 1990s can be partially attributed to a rapid generation of knowledge and intellectual property, including new technologies. Developed countries tend to spend around 3 percent of their GDP on research and development. Most developing countries spend much less.

The Pakistan Council for Science and Technology (PCST) is the country's central body charged with formulating policies, programs, and projects in support of national development priorities. PCST reviews continually the state and needs of science and technology (S&T) in the context of the country's development goals. In addition, it advises the Pakistani government on S&T policies and suggests measures for the promotion, development, and application of S&T in the country. PCST hosts the Secretariat of the National Commission for Science and Technology (NCST). NCST is headed by Pakistan's prime minister and is the country's ultimate decision-making body for the development of S&T. PCST works in close consultation with the federal ministries and provincial departments, major R&D organizations and universities, and representatives from the private sector. Its plans are reviewed by the Executive Committee of the National Commission for Science and Technology (ECNCST) before they are presented to NCST for final approval (PCST 2007).

In 2001, as part of the new Science and Technology Policy, the national government increased the Ministry of Science and Technology's budget from 120 million to 5.9 billion current Pakistani rupees (a 5,000 percent increase), 44 percent of which was directed towards agriculture. This policy stresses technology-based development by investing in the latest technologies in order to gain an edge in indigenous industrial growth. Over 300 projects for the development of S&T in general and for information technology in particular have been launched, mainly in the field of information technology. Many of NCST's programs have concentrated on human resource development and the upgrading of physical research infrastructure. The establishment of knowledge markets in selected priority areas where Pakistan has a potential competitive advantage is the next step forward.[1]

During the years following the launch of the new Science and Technology Policy, total S&T spending in Pakistan rose rapidly from 5.9 billion current Pakistani rupees in 2001 to 8.6 billion in 2003 (PCST 2005). However, the S&T budget nearly halved to 4.4 billion in 2006, following the separation of the Higher Education Commission (HEC) from the Ministry of Science and Technology (MST).

[1] The priority areas are information technology, biotechnology, engineering, industrial electronics, mineral development, pharmaceuticals, and renewable energy. A number of projects of strategic importance have been identified for each priority area (PCST 2007).

After recognition of biotechnology as a priority research area in 2001, MST created a National Commission on Biotechnology, composed of renowned scientists in the field of biotechnology. This commission advises the Pakistani government on specific measures for the development of agricultural, health, and environmental biotechnology to the economic development of the country. It is also charged with strengthening collaboration between the government and the private sector in the development and production of biotechnology products in the agricultural and health sectors.[2]

The Pakistani government's Medium Term Development Framework (MTDF) 2005–10 stresses the role of agricultural research in enhancing agricultural productivity. It specifically emphasizes accelerating the development of high-yielding, disease-resistant varieties of crops, and says that programs on genetic engineering, biotechnology, and tissue culture will be established and strengthened in selected institutes. In addition, the coordination and linkages between research and extension will be reinforced, and capacity development in agricultural R&D will be improved by earmarking an adequate share of agricultural scientists in PhD programs of the Higher Education Commission.

THE ORGANIZATION OF AGRICULTURAL R&D IN PAKISTAN

This report categorizes Pakistan's agricultural R&D agencies by government agencies, higher education agencies, nonprofit agencies, and businesses (see Appendix A for definitions and methodology used in this report). A total of 111 agencies were identified to be involved in agricultural R&D in Pakistan; completed survey forms were received from 237 entities within these 111 agencies (listed in Appendix C.).[3] In 2003, these 111 agencies together employed more than 3,600 full-time equivalent (fte) researchers and spent 2.4 billion 2000 Pakistani rupees—equivalent to nearly 200 million constant international dollars at year 2000 prices (Table 1).[4]

[2] PCST is executing a project called the 'Promotion of Biotechnology Research in Pakistan and Preparation of Biotechnology Action Plan' to promote biotechnology research in Pakistan. The project has prepared a draft National Biotechnology Policy and Action Plan. Grants have been provided to scientists and institutes that promote biotechnology research, to organize national workshops and seminars, and to coordinate and strengthen biotechnology research in the selected R&D organizations.

[3] The survey round was conducted in a decentralized manner. For example, we received separate survey returns for each of the programs and other units under the various NARC institutes and provincial agricultural research institutes.

[4] Unless otherwise stated, all data on research expenditures are reported in international dollars or in 2000 rupees.

Table 1—*Composition of agricultural R&D expenditures and researchers, 2003*

Type of agency	Total Spending		Total researchers	Share		Agencies/ units in sample[a]	Number of surveys received
	2000 rupees	2000 international dollars		Spending	Researchers		
	(*millions*)		(*fte's*)	(*percentage*)		(*number*)	
Public agencies							
Federal government							
PARC	202.7	17.0	239.0	8.6	6.6	15	22
NARC	415.8	34.8	500.0	17.6	13.9	11	44
Other	228.5	19.1	285.9	9.6	7.9	11	11
Subtotal	*847.1*	*70.9*	*1,024.9*	*35.8*	*28.4*	*37*	*77*
Provincial government							
Balochistan	94.6	7.9	169.2	4.0	4.7	6	27
NWFP	138.1	11.6	354.0	5.8	9.8	4	14
Punjab	677.9	56.8	1,162.7	28.6	32.3	16	47
Sindh	229.5	19.2	485.5	9.7	13.5	18	30
Subtotal	*1,140.1*	*95.5*	*2,171.4*	*48.1*	*60.2*	*44*	*118*
Higher-education[b]	245.3	20.5	281.1	10.4	7.8	17	29
Total public	*2,232.5*	*186.9*	*3,477.4*	*94.2*	*96.5*	*98*	*224*
Private enterprises[c]	136.3	11.4	127.6	5.8	3.5	13	13
Total	2,368.8	198.3	3,605.0	100	100	111	237

Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

[a] See Appendix C for a list of the 111 agencies included in this sample.

[b] Expenditures for the higher education sector in our sample are estimates based on average expenditures per researcher at the government agencies. Staff at the higher education agencies spent between 10 and 40 percent of their time on research, resulting in 281.1 fte researchers.

[c] Expenditures for seven private enterprises are estimates based on average expenditures per researcher for the private enterprises for which data were available.

Federal Government Agencies

The main federal agency involved in agricultural research is the Pakistan Agricultural Research Council (PARC), part of the Ministry of Food, Agriculture, and Livestock (MINFAL). PARC was established in 1981 (see Appendix B for a short history of agricultural research in Pakistan) to conduct, support, coordinate, and promote agricultural research throughout Pakistan. PARC also provides training for research staff and acquires and disseminates research information to improve the use of new technologies. PARC is managed by a board of governors (BoG). The BoG is the highest authority of the Council and is responsible for the control, direction, and superintendence of PARC's affairs. The federal minister for Food, Agriculture, and Livestock is also President of the Council and chair of the BoG. The board is assisted by the Research Advisory Committee (RAC), which is composed of the chairman and members of PARC,

federal and provincial heads of agricultural research institutions, progressive growers, non-governmental organizations (NGOs), and other stakeholders. RAC supports the BoG to review PARC's research program and identify researchable issues of national importance. PARC's headquarters is in the capital, Islamabad, and it employed 105 fte researchers in 2003.

In addition to its headquarters, a number of institutions under PARC's umbrella conduct agricultural research in various agro-ecological zones within the country. The largest of these is the National Agricultural Research Centre (NARC) with 500 fte researchers and a budget of US$35 million in 2003. NARC was established in 1984 and is located near Rawal Lake, just outside Islamabad. The center is mandated to conduct research on crops, natural resources, livestock, socioeconomics and agricultural production resources. In addition, NARC tests and disseminates germplasm from various food grains, vegetables, and fruit crops. The research activities are organized into 11 institutes grouped into five sectors: crop sciences, animal sciences, natural resources, social sciences, and scientific information. NARC conducts research on more than 130 agricultural crops and its focus is on national problems (in contrast to the provincial research institutes that focus on local problems). NARC is managed by a Director General and five Deputy Director Generals for each sector.

Other federal government research institutes under the PARC umbrella include:

- The National Tea Research Institute (NTRI), located at Shinkiyari in Mansehra District, conducts research on all aspects of tea production and processing. In 2003, NTRI employed 8 fte researchers. Further, a large number of MSc and BSc students from the North-West Frontier Province (NWFP) Agricultural University conduct thesis-related research on tea cultivation and processing issues.
- The National Sugar Cane Research Institute (NSCRI) at Thatta in Sindh's delta coastal zone conducts research on the breeding and testing of improved sugarcane varieties. NSCRI employed 9 fte researchers in 2003.
- The Karakoram Agricultural Research Institute for Northern Areas (KARINA) at Juglot in Norther Areas. KARINA has four satellite research establishments located in different ecologies of the Northern Areas. Research activities

encompass food grains, vegetables, and fruit crops for high-altitude arid areas. In 2003, these five establishments combined employed 13 fte researchers.

- The Arid Zone Research Centre's (AZRC) headquarters in Quetta, Balochistan has affiliated institutes in the other three provinces. AZRC's research focuses on crops and livestock problems that are related to Pakistan's arid zones. The four centers combined employed 31 fte researchers in 2003.
- Southern Zone Agricultural Research Centre (SARC) is located at Karachi and conducts research on grain storage, pesticide use, and control. SARC consists of six research institutes and stations and employed 45 fte researchers in 2003.

Extension is formally the responsibility of the provincial governments, but linkages with PARC are not strong. Therefore PARC established technology transfer institutes (TTI) in Pakistan's four provinces – Balochistan, NWFP, Punjab, and Sindh – and two federally administrated areas – Northern Areas and Azad Kashmir. In addition, PARC has three liaison offices, in Karachi, Lahore, and Tarnab. The TTIs also conduct socioeconomic research.

Four other federal agencies under MINFAL are involved in agricultural research. The Agricultural Price Commission and the Soil Survey of Pakistan (25 fte researchers each in 2003) conduct applied research related to agricultural prices and soil resources, respectively. The Federal Seed Certification and Registration Department's 19 fte researchers focused on the sampling and testing of seeds and the conduct of post-control trials. The National Veterinary Laboratory employed 15 fte researchers in 2003 who conducted research related to animal disease control and vaccine development.

A large number of federal government agencies that work under ministries other than MINFAL conduct agriculture-related R&D and are listed in Appendix C. The most important ones, in terms of fte agricultural research staff, are the Pakistan Council for Research in Water Resources (PCRWR) and the Pakistan Forest Institute (PFI). PCRWR under the Ministry of Science and Technology was established in 1985 and is charged with conducting and promoting research in all aspects related to water resources. Its headquarters is in Islamabad and there are six research centers scattered over the country. In 2003, the council employed 114 fte researchers. PFI under the Ministry of Environment is the principal agency in Pakistan involved in forestry research and

training. The institute is located in Peshawar (NWFP) and employed 40 fte researchers in 2003. The Pakistan Institute of Development Economics (PIDE), under the Ministry of Planning and Development, is the leading agency involved in development economics in general. In 2003, 15 fte research staff conducted agriculture-related research, mostly within the institute's Agricultural Production, Markets, and Institutions Division.

Provincial Government Agencies

As mentioned previously, Pakistan is divided into four provinces. At the provincial government level, agriculture is divided into five fields: crops, livestock and fisheries, food, natural resources (soil water, forestry, and wildlife), and education. Research conducted by the federal government agencies is largely long-term priority research, while the research conducted by the provincial research system is mostly adaptive in nature. Each of the four provinces has a main agricultural research institute under the administrative oversight of the Department of Agriculture. The Ayub Agricultural Research Institute (AARI) in the Punjab province is the largest of the four, with 739 fte researchers in 2003. AARI came into being in 1962 when the Punjab Agricultural College was split into separate institutes to build up infrastructure and human resources, to meet the needs of the burgeoning population and growing industrial sector, and to serve the farming community. The institute has 22 directorates and 10 sections. The main campus is located at Faisalabad, and comprises directorates and research sections in both crops and allied subjects with satellite research institutes and research stations functioning in specific agroecological zones in the Punjab Province. The Livestock and Diary Development Department is responsible for livestock and veterinary research in the province. The department consists of a director general and four research institutes and employed close to 240 fte researchers in 2003. The 55 fte researchers at the Forestry, Wildlife, and Fisheries department focused on foresty, wildlife, and fisheries research.

Agricultural research under the Department of Agriculture in Balochistan and NWFP is organized in a similar manner as the Department of Agriculture in the Punjab, with all research activities taking place under one entity, the Agricultural Research Institute Sariab in Balochistan (140 fte researchers in 2003) and the Agricultural Research System in NWFP (267 fte researchers in 2003). Livestock and veterinary research in Balochistan is the responsibility of the 29 fte researchers at the Directorate of

Livestock Research and Development. What distinguishes the organization of agricultural R&D in NWFP from Punjab and Balochistan is that livestock research in NWFP falls under the umbrella of the Department of Agriculture and Livestock. Second, during the 1980s, as part of a USAID-funded project, the Agricultural Research Wing of the department was merged with the NWFP Agricultural University Peshawar to become the NWFP Agricultural Research System. The aim was to improve the quality of agricultural education and research to become more responsive to farmers' needs. Although collaboration between the agencies has increased, the merger of education and research has not been fully successful because of the dual administrative control. The provincial government not only has financial control over the research entities, but also interferes in administrative issues. The university falls under the Ministry of Education and receives its funding from the higher education commission of the federal government.

Agricultural research under Sindh's Department of Agriculture is less consolidated than in the other three provinces. The Agricultural Research Institute Tandojam (ARIT) focuses on crops research except for rice, wheat, and horticulture – for which separate commodity research institutes exist. Livestock research is also separate and falls under the provincial Department of Livestock and Fisheries.

All four provinces have a number of other government agencies involved in agricultural research on areas such as veterinary sciences, water resources, fisheries, wildlife, and environmental issues. A complete list of these agencies can be found in Appendix C.

Unlike the provinces, Pakistan's federally administered areas (Azad Kashmir and Northern Areas) and the federally administered tribal areas do not have an official research infrastructure as such. Nonetheless, PARC has established the aforementioned KARINA in the Northern Areas. In Azad Kashmir, PARC conducts research through the Technology Transfer Institute in Muzaffarabad.

Higher Education Agencies

We identified 17 higher education units involved in agricultural research; these accounted for about 10 percent of total agricultural R&D spending and staff in 2003.[5] The most important agricultural higher education agencies in Pakistan are the agricultural universities in Faisalabad, Rawalpindi, Peshawar, and Tandojam. The University of Agriculture in Faisalabad (Punjab) is by far the largest of the four, employing 377 faculty staff in 2003 distributed over six faculties: the Faculty of Agriculture, the Faculty of Agricultural Economics and Rural Sociology, the Faculty of Agricultural Engineering and Technology, the Faculty of Animal Husbandry, the Faculty of Veterinary Science, the Faculty of Basic Sciences, and the Directorate of Extension and Education. They spent an estimated 25 to 40 percent of their time on research, resulting in 120 fte researchers. The university's research activities are coordinated through the Directorate of Research, which is also responsible for communication with national and international partners and funding agencies and advises the university's management on all issues related to the promotion of research and its results.

Sindh Agricultural University (SAU) in Tandojam is the second-largest university in Pakistan in terms of agricultural R&D staff and spending. In 2003, the university employed 73 fte researchers involved in a wide range of crop, livestock, and socio-economic research themes. The agricultural universities of Rawalpindi and Peshawar, with 11 and 15 fte researchers in 2003, are smaller. The other higher education agencies in our sample are also much smaller, employing at most 10 fte agricultural researchers in 2003.

Private-sector Agencies

In addition to the public-sector agricultural R&D agencies described above, our survey sample includes 13 business enterprises, ranging from locally owned companies to multinationals. Private-sector agricultural R&D in Pakistan is discussed later in this report.

[5] With the inclusion of the other colleges with possible agricultural-related research activities, these totals would be slightly – though not substantially – higher, given that the omitted agencies are reported to conduct minimal agricultural research.

International Linkages and Cooperation

Pakistani agricultural R&D agencies cooperate at national, regional, and international levels. PARC works in close cooperation with the provincial research institutes and the universities. As mentioned previously, delegates from universities and provincial research institutes are represented on PARC's Board. In the mid-1970s, PARC introduced the National Coordinated Research Programs (NCRPs) as a mechanism for conducting joint research. These NCRPs have proven to be a very effective tool for joint-research planning with a view to eliminating the wasteful duplication of research efforts and to improving the allocation of scarce research resources. Until the mid-1980s, PARC implemented 33 NCRPs on major commodities or disciplines in close collaboration with the provincial and federal institutions. In the late 1980s, keeping in view the overall resources available, PARC re-prioritized its research plan and activities and short-listed some of the programs of national importance. At present, 14 NCRPs on different crops are being implemented by the Technical Divisions of PARC at the national level with the federal and provincial research institutes and the universities. The research areas covered by NCRPs include rice; wheat; maize; sorghum and millet; sugar crops; oil seeds; pulses; fodder crops; fruits; vegetables; potatoes; floriculture; rangeland management; breeding for large ruminants; and breeding for small ruminants. The national coordinator of each program is stationed at NARC with a team of scientists, while the cooperating units in the provinces are headed by the provincial senior scientists.

Besides cooperating at the national level, Pakistan's agricultural R&D agencies cooperate widely at the regional and international level as well. PARC maintains close links with the Consultative Group on International Agricultural Research (CGIAR) centers and has been drawing upon their facilities for training, expert services, research methodologies, germplasm, and scientific information. Links are particularly close with the International Center for Agricultural Research in the Dry Areas (ICARDA), the International Livestock Research Institute (ILRI), the International Water Management Institute (IWMI), the International Rice Research Institute (IRRI). ICARDA and the International Maize and Wheat Improvement Center (CIMMYT) also operate country offices in Islamabad. Several research and training projects have been implemented in Pakistan in PARC's own and provincial research institutes with the cooperation of

experts from the international agricultural research centers (PARC 2007). Other links are in place between PARC and the Asian Vegetable Research and Development Centre (AVRDC), the Australian Centre for International Agricultural Research (ACIAR), the International Centre for Integrated Mountain Development (ICIMOD), and the Asia–Pacific Association of Agricultural Research Institutes (APAARI). The country office of the Food and Agriculture Organization (FAO) located at NARC works closely with PARC in undertaking a technical cooperation program on various commodities. PARC has also entered into bilateral agreements with research organizations in a number of countries in order to exchange experts, technical material, and germplasm and to reciprocate the use of training and research facilities. PARC cooperates with institutes in some 40 countries in Asia, the Middle East, Latin America, Africa, Europe, Australia, and North America. There are currently sixteen cooperation protocols between Pakistan and China. As of late 2006, PARC was in the process of setting up memorandums of understanding (MoUs) with South Korea, Uzbekistan, and Vietnam. An Australian government delegation signed a cooperation agreement with PARC in 2005.

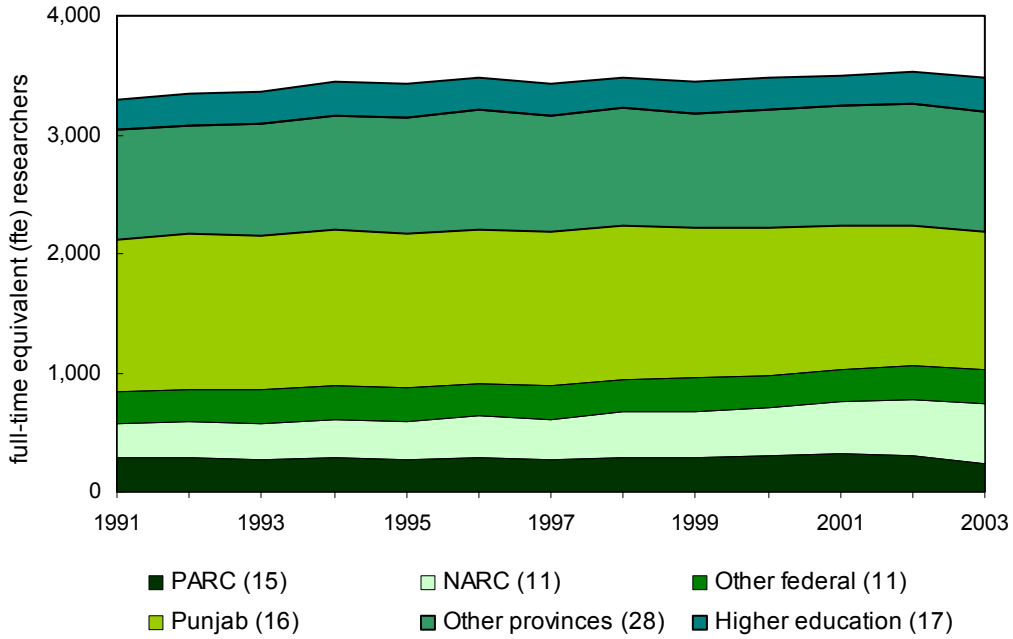
The Directorate of Research of the University of Agriculture, Faisalabad, also maintains close linkages with PARC, the Punjab Forestry Research Institute (PFRI), the International Irrigation Management Institute (IIMI), and universities in China and the United States (UAF 2007). Likewise all other agriculture universities maintain linkages with PARC and other R&D institutions.

HUMAN RESOURCES IN PUBLIC AGRICULTURAL R&D

During the period 1991–2003, the total number of agricultural researchers in Pakistan's public sector grew slowly, from 3,291 to 3,477, averaging 0.4 percent per year (Figure 1). Most of this growth took place at NARC, where total researcher numbers increased by 75 percent from 287 fte researchers in 1991 to 500 in 2003. This was the result of the filling of longstanding vacant positions following two recruitment-freeze periods during 1988–94 and 1996–99. The total number of research staff at PARC was fairly stable during the 1990s, but dropped by more than 20 percent in 2003. This was the result of the departure of 80 research staff at PARC headquarters (a decline of more than 40 percent) during that year. Total fte researcher numbers also declined in the provincial government agencies in

the Punjab throughout this period, but there was an increase of roughly 10 percent at provincial government agencies in Balochistan and Sindh provinces. Researcher totals at NWFP remained fairly stable (Figure 2). The institutional composition of public agricultural research staff in Pakistan showed only minor shifts during 1991–2003. The share of NARC rose gradually from 9 to 14 percent, while the Punjab-based provincial government agencies showed a steady decline throughout this period. The share of the remaining institutional categories remained more or less unchanged.

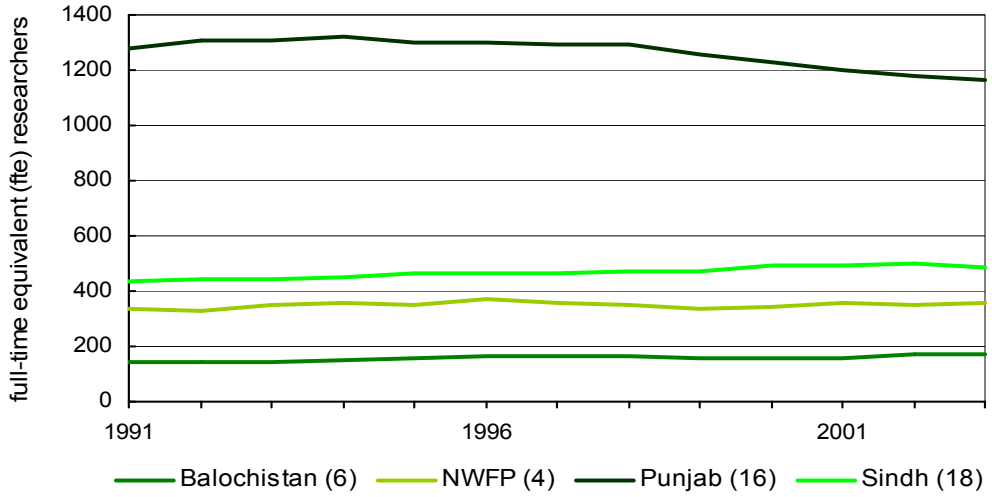
Figure 1—*Longterm composition of public agricultural researchers 1991-2003*



Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

Notes: See Table 1. Figures in parentheses indicate the number of agencies in each category. Total researcher numbers and expenditures for some of the government agencies have been interpolated or extrapolated using average the spending per researcher of government agencies for which data were available. Underlying data are available at the ASTI website (www.asti.cgiar.org).

Figure 2—*Trends in total research staff at the provincial governments, 1991-2003*



Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

Notes: See Table 1. Figures in parentheses indicate the number of agencies in each category. Total researcher numbers and expenditures for some of the government agencies have been interpolated or extrapolated using average the spending per researcher of government agencies for which data were available. Underlying data are available at the ASTI website (www.asti.cgiar.org).

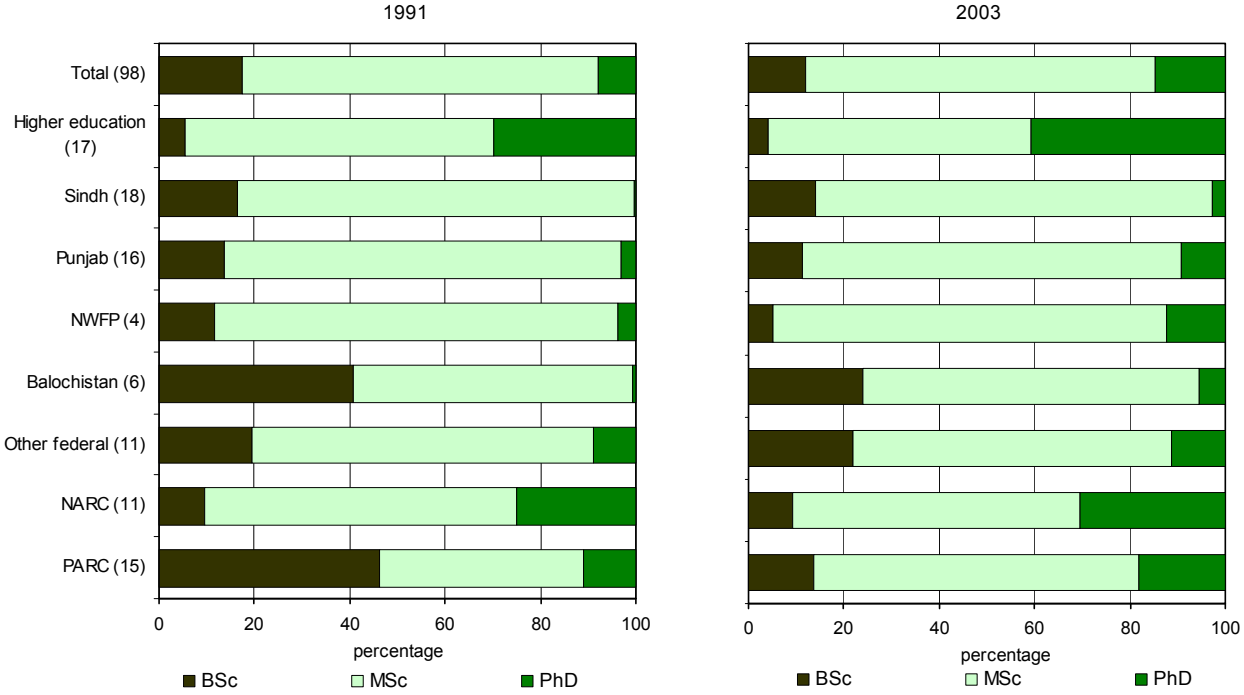
Degree Status

In 2003, 15 percent of the nearly 3,500 researchers in the sample of 98 public agencies were educated to PhD level, 73 percent to MSc, and 12 percent to BSc (Figure 3). The share of Pakistani agricultural researchers trained to PhD level is lower than in other South Asian countries, such as India (55 percent), Nepal (17 percent), Bangladesh (26 percent), and Sri Lanka (15 percent) (Beintema et al. 2007; Stads and Shrestha 2006; Beintema and Kabir 2006; Stads, Gunasena and Herath 2005).

Overall, the degree levels attained by Pakistani research staff increased throughout 1991–2003. In 2003, 88 percent of the researchers in our survey sample had a postgraduate degree (MSc or Ph.D.), compared to 83 percent in 1991. It is a consistent finding across developing countries worldwide for higher education agencies to have higher shares of research staff holding postgraduate degrees than the principal government agencies. Pakistan is no exception. In 2003, 40 percent of research staff at the country's higher education agencies had a Ph.D. degree, compared to 13 percent at the government agencies. NARC institutes, however, employed a much higher share of

researchers with doctorate degrees (31 percent) than this government-sector average. In contrast, research staff at the provincial government agencies are considerably less qualified than their federal government counterparts. The share of Ph.D. holders in total research staff was just 3 percent in Sindh, 5 percent in Balochistan, 9 percent in Punjab, and 12 percent in NWFP. Although the 2003 share of researchers with Ph.D. degrees at the provincial level is comparatively low, it nevertheless represents a substantial increase from 1991 levels. In that year, only 3 percent of combined research staff employed at the provincial government agencies had received PhD-level training. Noteworthy are the very low 1991 shares of 0.3 and 0.7 percent, respectively, of PhD-qualified research staff out of total research staff in Sindh and Balochistan. By 2003, the average shares for these two provinces had increased to 2.6 and 5.3 percent, respectively.

Figure 3—*Educational attainment of research staff by institutional category, 1991*



Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

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

Both the federal and provincial government agencies are suffering from the lack of qualified research personnel. During the 1980s and 1990s, a large number of researchers followed short- or long-term training, within and outside of Pakistan, as part

of the Agricultural Research Project I and II (ARP–I and II) which were financed through the World Bank loan. But after the completion of ARP-II in 1998, the Pakistani government never established a formal system of human resource development to increase the agricultural research capacity and quality. In addition, many senior researchers who received training as part of the two projects have retired (or are about to do so) and could not be replaced as a result of a decade-long recruitment freeze put in place by the government (Khushk, Lashari, and Memon 2004; Sheikh and Afzal 2004). Further, researchers at the government agencies face limited promotion opportunities, low salary levels, and few other incentives. For example, it is common for researchers to retire in the same salary scale in which they were hired years ago. Promotions, when they take place, are based on seniority and not on merit.[6] This has resulted in senior staff being promoted to management positions outside their area of expertise. In Punjab, for instance, a senior scientist who had been working in cotton research for 25 years was promoted to the position of director general of the province's rice research institute. In some provinces key positions, such as breeders for the country's four principal crops (wheat, cotton, rice, and sugarcane), are currently vacant due to retirements, long periods of recruitment freeze, and a lack of available suitable candidates. This has led to a brain drain of researchers from the government sector to universities, non-research agencies, or to opportunities outside Pakistan.

Realizing the importance of human resource development, NCST prioritized the development of PhD-qualified S&T manpower. Four major programs were launched in 2001 that combined the funded training of 700 scientists to PhD level over a period of three years. In areas where expertise does not exist in the country, PhD candidates were to be sent abroad (PCST 2007). In order to enhance the national output of PhDs, (which was at 70–80 per year in the early 2000s), NCST also announced support to universities to upgrade their R&D infrastructure. It is unclear how many agricultural researchers and universities are benefiting from this support.

During the period 1975–2006, more than 450 PARC scientists obtained their MSc or PhD degrees through scholarship funding through ARP–I and II, the United States Agency for International Development (USAID), and a wide number of other funding

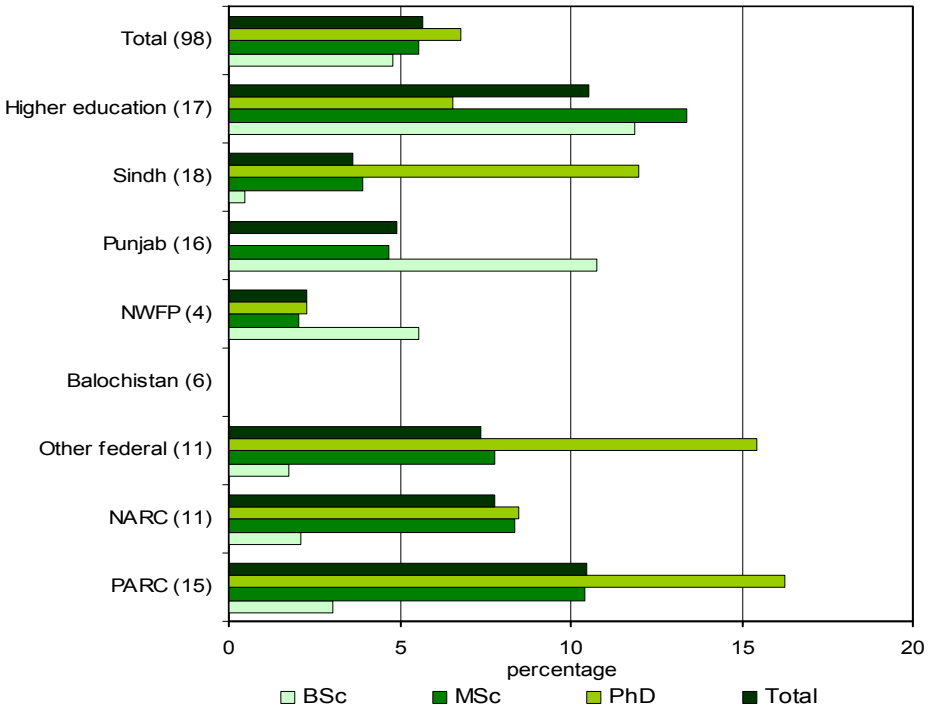
[6] In 2007, a special pay scales at PARC was introduced to improve the incentives for scientists.

agencies. Besides official degree-level training, participation in international workshops and seminars is also encouraged by PARC. These allow PARC scientists to develop useful contacts with foreign experts. PARC has been sending abroad more than 30 scientists on average each year from all over the country during the past five years (PARC 2007).

Gender

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). Pakistan is no exception. In 2002, only 6 percent of the fte researchers in a 98-agency sample were female, making up 7 percent of researchers holding doctorate degrees, 6 percent of researchers with only MSc degrees, and 5 percent of researchers trained to BSc level (Figure 4). As with the previous indicators, this share is low compared with other South Asian countries: the number of women scientists in Bangladesh, India, Sri Lanka, and Nepal, for example, was 21, 14, 25, and 9 percent, respectively, in the same year (Beintema and Kabir 2006; Beintema et al. 2007; Stads, Gunasena, and Herath 2005; Stads and Shrestha 2006). PARC and the higher education agencies employed a relatively higher number of female researchers. Only 83 of nearly 3,200 fte researchers in the provincial government agencies in our sample were female (4 percent). Only 1 percent of the provincial government researchers with PhD degrees were women. Balochistan and Punjab did not employ any female researchers trained to PhD level. Balochistan also did not employ any female researchers with BSc and MSc degrees, but interestingly at its main university, the University of Balochistan, 34 percent of the fte agricultural research staff were female.

Figure 4—*Share of female researchers, 2003*

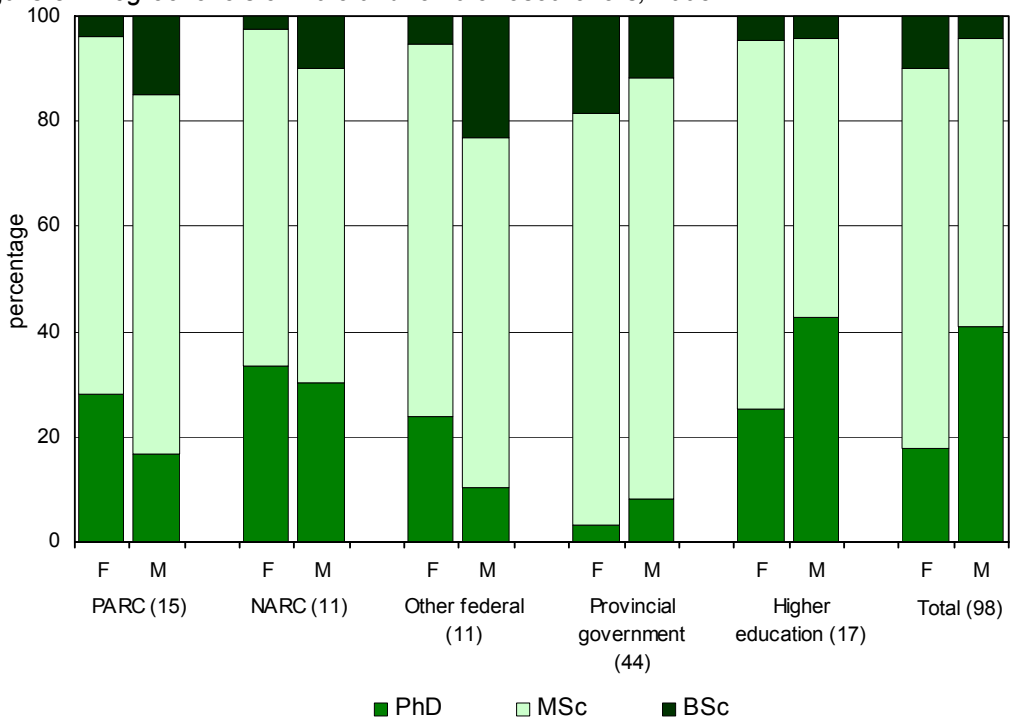


Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

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

Unsurprisingly, Pakistan's overall share of female agricultural researchers with postgraduate degrees (MSc or PhD) is lower than the corresponding male share. In 2003, 80 percent of Pakistan's female agricultural researchers were trained to postgraduate level, compared to 96 percent of their male colleagues (Figure 5). Interestingly, the 2003 share of female researchers with a postgraduate degree was higher than the corresponding share of their male counterparts at PARC, NARC, and the other federal government agencies.

Figure 5—*Degree levels of male and female researchers, 2003*



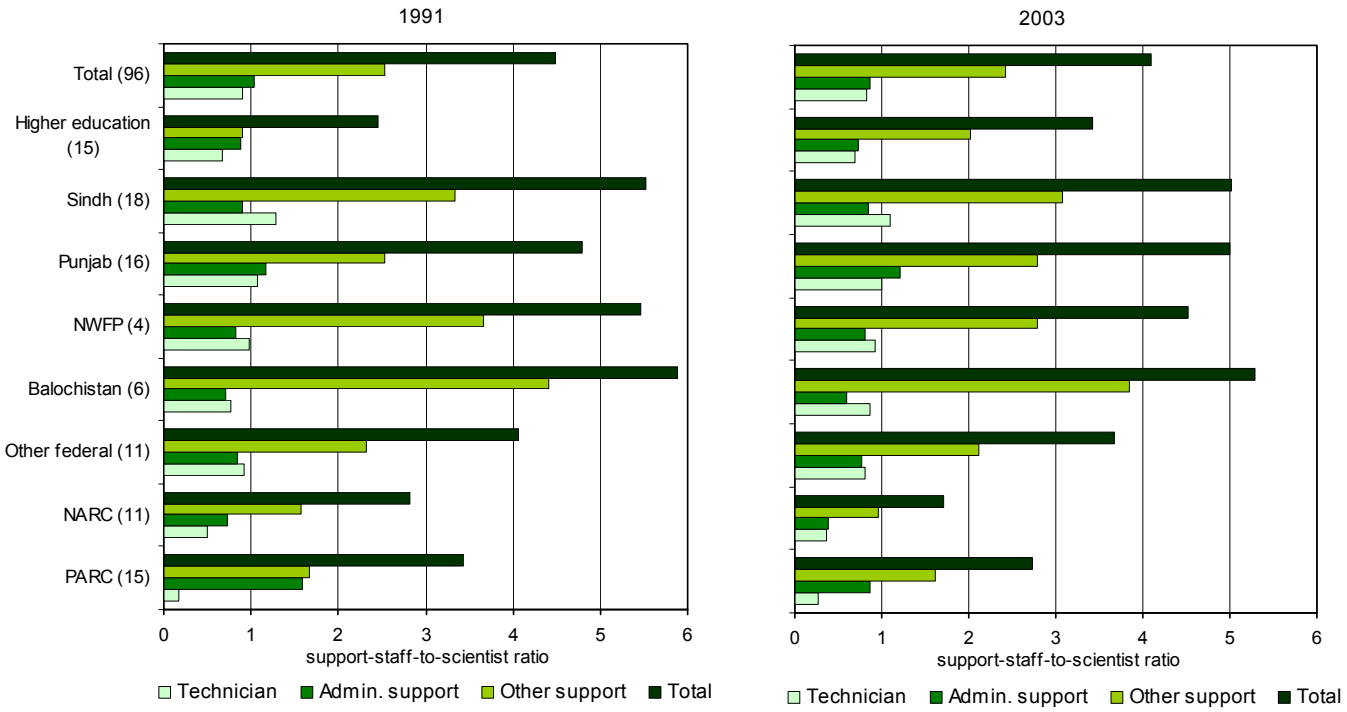
Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

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

Support Staff

In 2003, the average number of support staff per scientist in our 96-agency sample was 4.1: 0.8 technicians, 0.9 administrative personnel, and 2.4 other support staff such as laborers, guards, and drivers (Figure 6). The provincial government agencies employed between 4.8 and 5.9 fte research staff per researcher; this is considerably higher than the corresponding ratios for PARC and NARC (2.7 and 1.7, respectively). Over the past years, the support-staff-per-scientist ratio has declined slightly. In 1991 Pakistan employed 4.5 fte support staff for each agricultural scientist compared to the aforementioned ratio of 4.1 in 2003.

Figure 6—*Support-staff-to-researcher ratios, 1991 and 2003*



Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

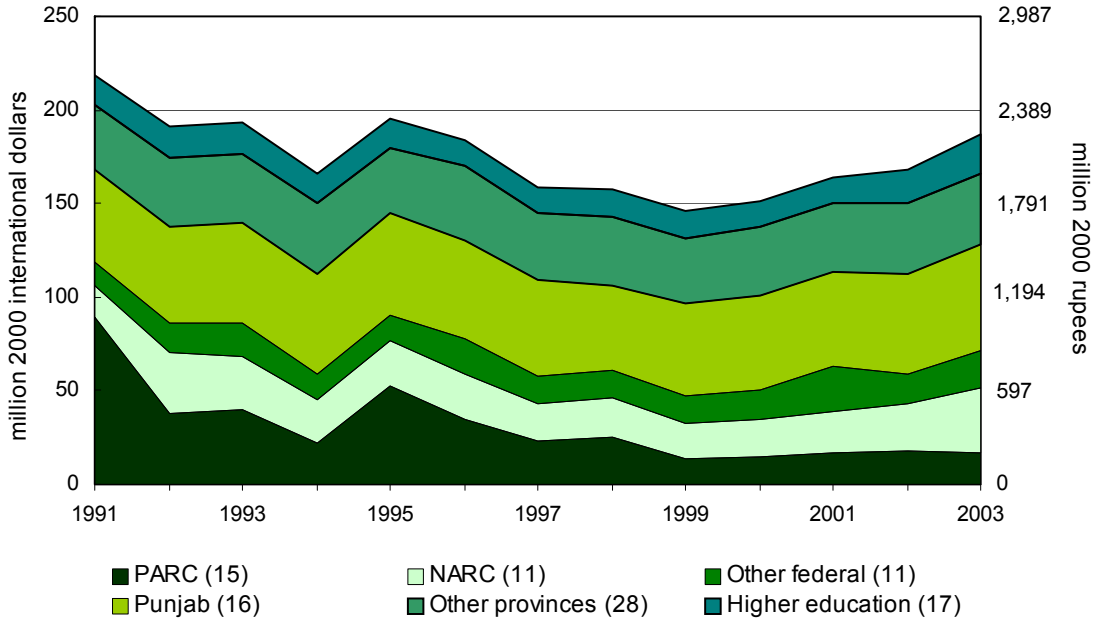
Note: Figures in parentheses indicate the number of agencies in each category.

PUBLIC AGRICULTURAL R&D INVESTMENT TRENDS

Total agricultural research spending for our sample of 98 agencies (excluding the private sector) fell by about one-third between 1991 and 1999, partly because of the completion of various projects at PARC funded by the United States Agency for International Development (USAID) and other donors, and partly due to declining public funding overall (Figure 7). PARC's spending levels rebounded during 1999–2003, largely due to the US-financed Agricultural Linkage Program (ALP). ALP was launched in 2000 and its main objective is to promote and support agricultural R&D activities in accordance with Pakistan's long-term development goals and to promote long-term scientific cooperation between Pakistan and the United States in the agricultural sector (see *Financing Public Agricultural R&D* section). In contrast, NARC's spending more than doubled during the 1991–2003 period, reflecting growth at most, if not all, of the center's institutes. The primary cause for this increase was a rise in salary expenditures following the aforementioned hiring of new staff when the recruitment freeze ended. Since 2003,

government allocations to federal agricultural research agencies increased slightly, with a sharp increase during the 2006-07 budget period.

Figure 7—*Longterm composition of public agricultural R&D expenditures, 1991-2003*

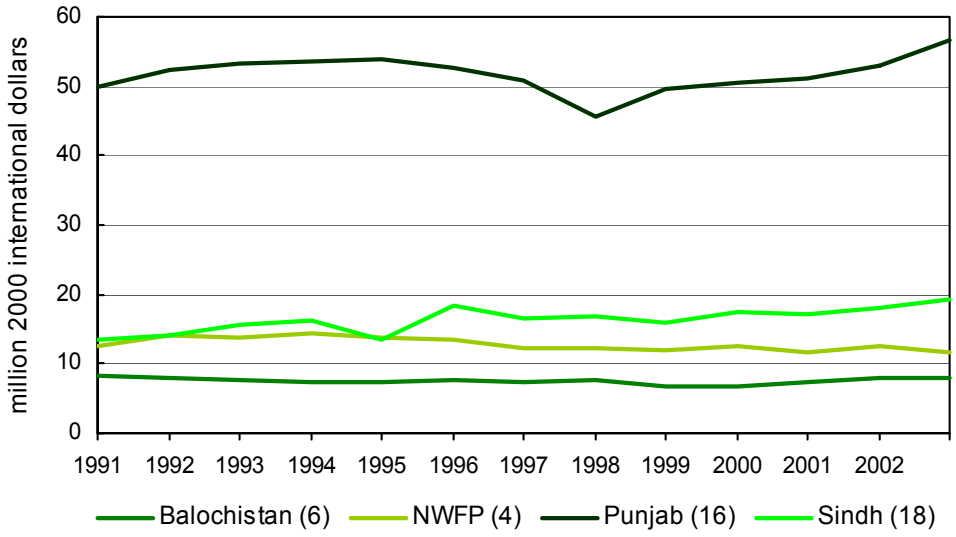


Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

Notes: See Table 1. Figures in parentheses indicate the number of agencies in each category. Total researcher numbers and expenditures for some of the government agencies have been interpolated or extrapolated using average the spending per researcher of government agencies for which data were available. Underlying data are available at the ASTI website (www.asti.cgiar.org).

Total agricultural R&D spending at provincial government agencies in Balochistan and NWFP declined slightly during 1991–2003, at rates of 0.4 and 1.4 percent per year, respectively, while spending remained fairly stable in the Punjab and increased by 2.3 percent per year in Sindh throughout the same period (Figure 8). Agricultural R&D spending by the higher education sector grew at an average rate of 0.5 percent per year during 1991–2003.

Figure 8—*Trends in R&D spending at provincial governments, 1991-2003*



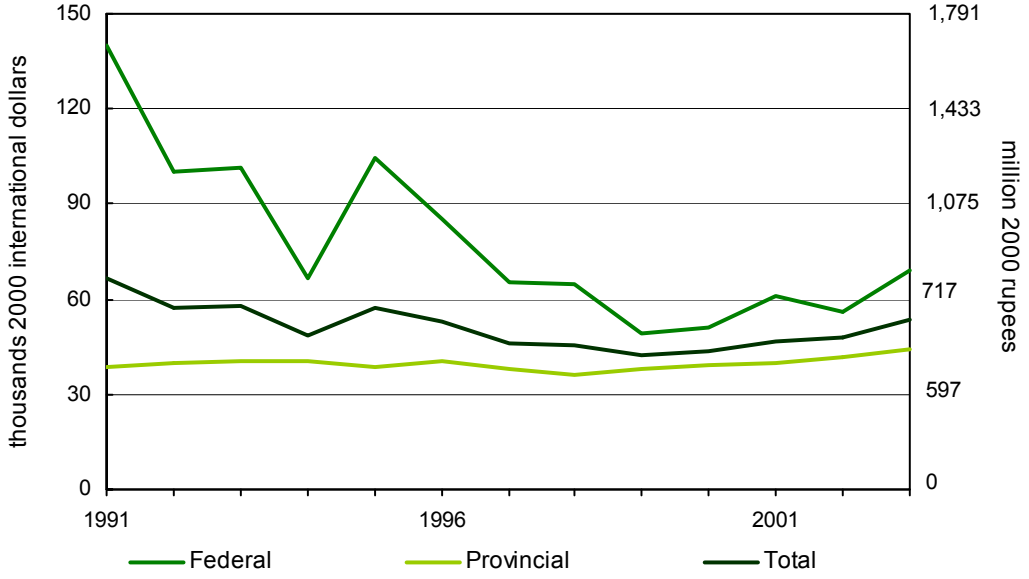
Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

Notes: See Table 1. Figures in parentheses indicate the number of agencies in each category. Total researcher numbers and expenditures for some of the government agencies have been interpolated or extrapolated using average the spending per researcher of government agencies for which data were available. Underlying data are available at the ASTI website (www.asti.cgiar.org).

Spending per Scientist

Agricultural R&D expenditures per researcher in Pakistan for our sample of 81 federal and provincial government agencies fell from $66,000 in 1991 to $42,000 in 1999 (Figure 9). The federal government agencies' average expenditure showed a rapid decline during 1991–99, due to the aforementioned completion of World Bank and USAID-financed projects. In contrast, average spending at the provincial agencies remained relatively stable throughout this period. After 1999, average spending levels at both the federal and the provincial government agencies showed an upward trend to roughly $54,000 in 2003.

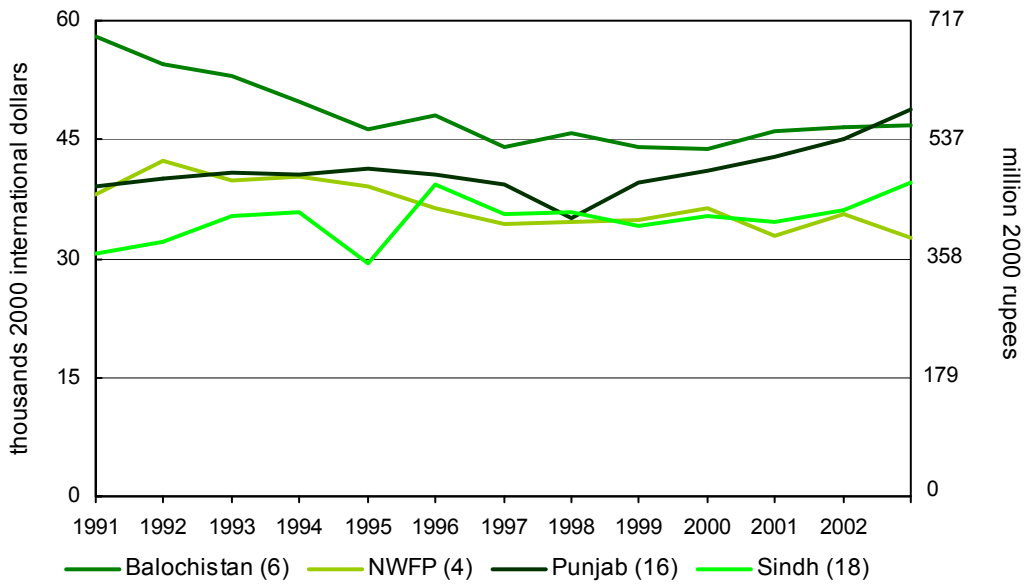
Figure 9—*Differences in level of expenditures per researcher, 1991-2003*



Sources: Figures 1 and 7.

In 1991, provincial government agencies in Balochistan spent an average of nearly $60,000 per scientist, nearly twice the amount than their colleagues in Sindh were spending (Figure 10). During 1991–2003, average expenditure per researcher improved for provincial government agencies in Punjab and Sindh. Their counterparts in NWFP and Balochistan, on the other hand, experienced a fall in average expenditure per researcher throughout this period. Therefore, by 2003, the differences in average spending per researcher from one province to the next had become somewhat less pronounced.

Figure 10—*Differences in level of expenditures per researcher at provincial level, 1991-2003*

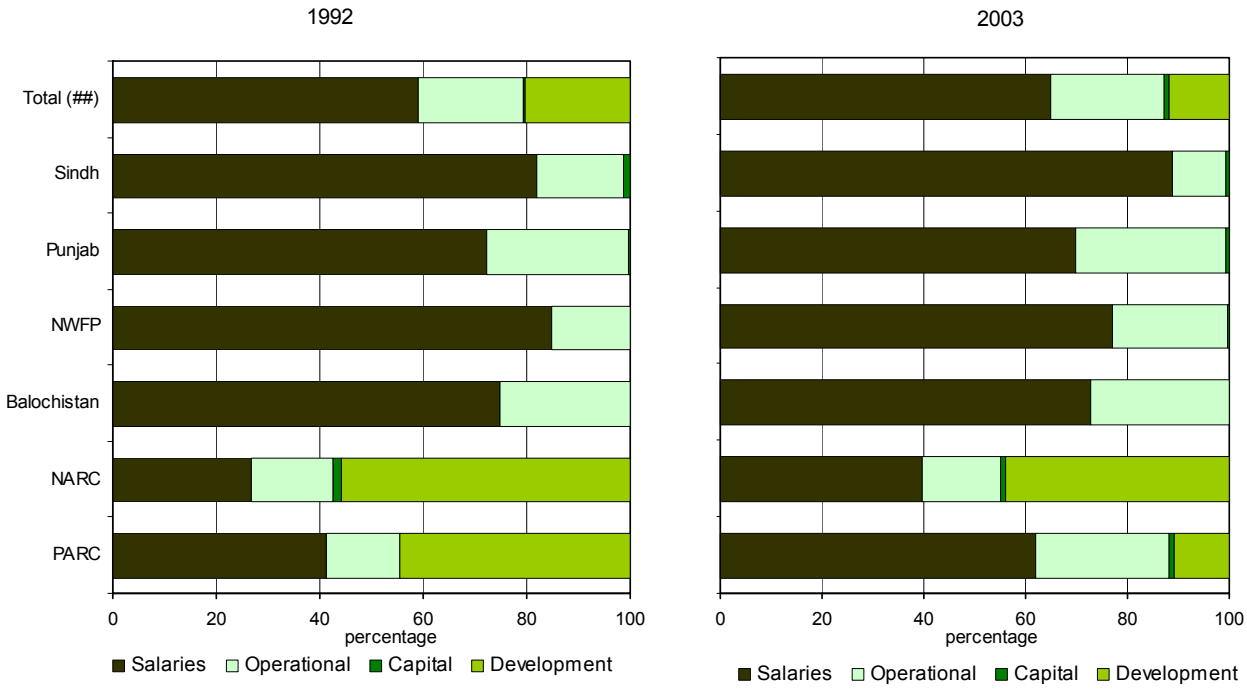


Sources: Figures 2 and 8.

Cost Categories

The allocation of research budgets across salaries, operating costs, and capital costs affects the efficiency of agricultural R&D and therefore detailed data on cost categories were collected as part of this study. In 2003, the 81 government agencies for which cost category data were available spent 61 percent on salaries, 33 percent on operating costs, 1 percent on capital costs, and 12 percent on development costs (that is expenditure as part of the development budget). Of note is the very low share of capital costs to total costs when compared with other countries in South Asia such as Nepal, Bangladesh, and Sri Lanka. The cost structures for the government agencies shifted somewhat over the 1992–2003 period (Figure 11). Development costs as a share of total costs had dropped sharply from 20 percent in 1992 to 12 percent in 2003. The share of salary costs, on the other hand, rose from 60 to 65 percent during this period.

Figure 11—*Cost-category shares in government agencies' expenditures, 1992 and 2003*

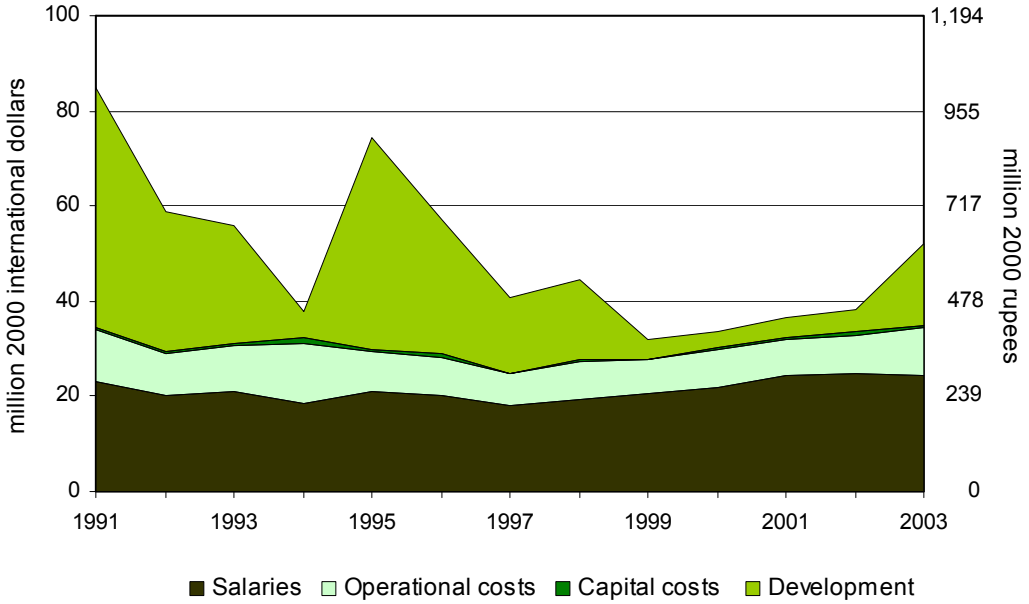


Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

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

These averages mask significant variation between both the various categories and the agencies in each category. In 2003, development costs accounted for 44 percent of total expenditure at NARC. Salaries accounted for a larger share of total spending at the provincial government agencies than at PARC and NARC (Figure 12). In 2003, operating costs ranged from 11 percent at Sindh's provincial government agencies to 30 percent in Punjab's provincial government agencies.

Figure 12—*Cost-category shares in expenditures for PARC and NARC, 1991-2003*

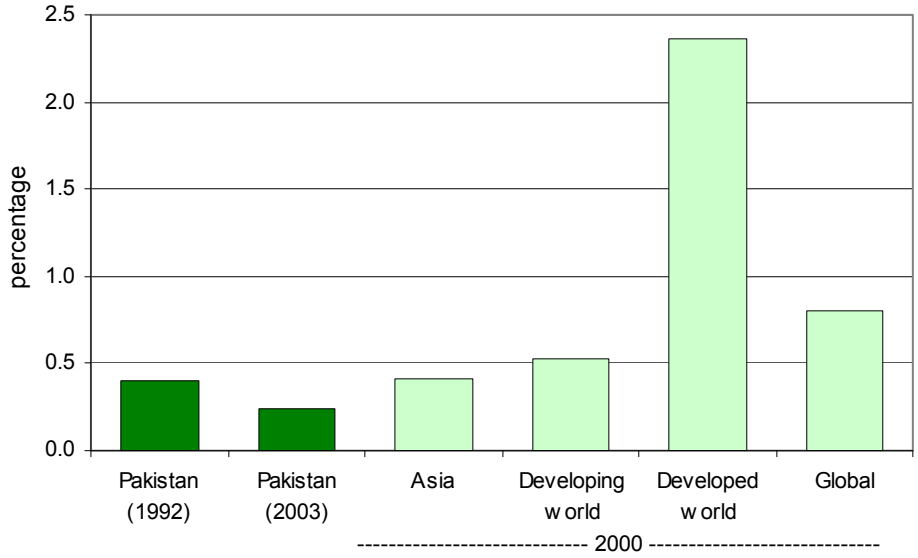


Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

Intensity Ratios

Total public spending as a percentage of agricultural output (AgGDP) is a common research investment indicator that helps to place a country's agricultural R&D spending in an internationally comparable context. In 2003, Pakistan invested $0.24 in agricultural research for every $100 of agricultural output, an intensity ratio of 0.24, considerably lower than the 1991 ratio of 0.40 (Figure 13). Pakistan's intensity ratio is also low compared with many other South Asian countries such as Bangladesh (0.36), India (0.33), and Sri Lanka (0.36), but higher than Nepal (0.22) (Beintema and Kabir 2006; Beintema et al. 2007; Stads, Gunasena and Herath 2005; Stads and Shrestha 2006). The 2003 ratio was also lower than the 2000 average reported for the Asia–Pacific region (0.41). In general, Asia has a much lower agricultural R&D investment intensity level than other regions in the world; the average for the developing world in 2000, for example, was 0.53, while the average for Sub-Saharan Africa was 0.72 (Pardey et al. 2006).

Figure 13—*Pakistan's agricultural research intensity compared regionally and globally*



Sources: Pakistan data are compiled from Figure 7; AgGDP data are from World Bank (2005); all other intensity ratios are from Pardey et al. (2006).

FINANCING PUBLIC AGRICULTURAL R&D

During the past decade, funding for agricultural research in Pakistan has come from a number of sources, principally the national government, internally generated resources, and foreign donors. The World Bank and USAID have traditionally been major donors to the agricultural research system in Pakistan.

In order to improve Pakistan's agricultural research capabilities, the World Bank funded the first Agricultural Research Development Project (ARP–I), which ran from 1981 to 1990. As part of the objectives of this project PARC was established, technical assistance and support for information dissemination and equipment was provided, and the provincial governments were encouraged to undertake research in priority areas: horticulture, livestock, soil science, integrated pest management, and social sciences. This project was followed by ARP–II, which was funded by a US$23 million loan combined with a US$10 million contribution by the Pakistan government, and it ran from 1991 to 1998. The World Bank's ARP–II concentrated mainly on human resource development; that is local and foreign short-term and long-term training (see *Human Resources* section earlier). In addition, it focused on consolidating and improving the

advances made under ARP–I, such as improving research and extension linkages, reorganizing and strengthening research management at the federal and provincial levels, and strengthening research in priority areas at federal and provincial levels. The latter also included setting up closer collaboration with international agencies (World Bank 1990 and 1998).

The Management of Agricultural Research and Technology Project (MART) ran from 1984 to 1994 and received US$33 million from USAID, combined with a government contribution of US$1 million. MART had a strong human resource development component as well as a focus on improving federal–provincial research and research–extension linkages. In addition, the project provided funding to strengthen NARC's library system and the libraries of selected provincial agricultural research institutes (PARC 1991).

USAID has worked with PARC and the Agricultural University in Peshawar to make agricultural research and education more relevant to farmers. In order to improve agricultural productivity in dry areas, USAID supported the Arid Zone Research Institute in Quetta. In addition, USAID gave equipment worth more than US$4 million during the 1980s and other support to the Pakistan Forestry Institute in Peshawar and to the Agricultural Universities at Faisalabad and Tando Jam (USAID 2007). In addition, USAID funding helped to establish a branch of the International Irrigation Management Institute (IIMI) in Lahore. Other donors to PARC include the Canadian International Development Agency (CIDA), the International Development Research Centre (IDRC, Canada), the United Nations Development Program (UNDP), the Food and Agriculture Organization of the United Nations (FAO), the Australian International Development Assistance Bureau (AIDAB), and the governments of Japan, Switzerland, and Italy (PARC 2007).

The Agricultural Linkages Program (ALP) is a joint program between PARC and the United States Department of Agriculture (USDA). The objective of ALP is to promote and support agricultural research and development activities in accordance with Pakistan's long-term development goals. As part of this program, the proceeds of sales of 200,000 ton wheat donated by the United States to Pakistan are transferred to an Agricultural Research Endowment Fund (AREF), managed by PARC. ALP's total

endowment is 1.3 billion current rupees (approximately US$23 million) and is invested in one of five government-approved schemes. The scope of agricultural R&D activities financed by ALP covers all scientific activities related to agriculture including production, processing, marketing, and agricultural services. The program emphasizes the support of strategic research, which improves food security and poverty alleviation while promoting sustainable agriculture. R&D projects are supported with up to three years' funding (ALP 2007). Since inception, ALP has played a significant role in invigorating R&D by providing timely and appropriate financial, physical, and technical support to the individuals and institutes engaged in agricultural R&D. As of 2006, 251 ALP projects had been approved at a total cost of 744 million current Pakistani rupees. Of these approved projects, 164 projects are ongoing, while 87 have been completed successfully (PARC 2006).[7]

PRIVATE AGRICULTURAL R&D

The private sector accounts for only a small share of agricultural R&D in Pakistan. During the 1970s and early 1980s, many agribusiness firms were nationalized and merged under state-owned corporations. It was not until 1988 that the government took a more favorable stance toward private investment, and that the privatization of agricultural enterprises began in earnest. Most private investors are still relatively cautious, however, especially when it comes to investing in research with a long-term payoff. Pakistan's political and economic climate, coupled with unresolved intellectual property rights, is still regarded as unfavorable by many private investors (Ahmad and Nagy 2001). We identified 13 private-sector agencies involved in agricultural R&D in Pakistan. In 2003, these agencies accounted for 4 percent of agricultural research staff and 6 percent of

[7] Examples of completed projects include: (i) development of canola-quality mustard genotypes project at a cost of Rs.1.3 million (three years); (ii) Integrated Pest Management of Aphids in canola at a cost of Rs.0.75 million (three years); (iii) Development and Commercialization of Mobile Seed Processing Unit at a cost of Rs.2.1 million (three years); (iv) Diagnosis and Remedial Measures of Micro-nutrient Deficiencies in Fruit Plant of Economic Importance in Pakistan – Umbrella Project at a cost of Rs.1.2 million (three years); (v) Molecular Characterization of Infectious Bronchitis Virus (IBV) Variants and Development of an Effective Vaccine at a cost of Rs.2 million (three years); (vi) WTO Trade Liberalization Move: Implications of Pakistan's Agriculture with Special Reference to Sustainable Development, Poverty Alleviation and Environmental Concerns at a cost of Rs.1.8 million (three years); (vii) Structure, Conduct and Performance of the Marketing System, Margins and Seasonal price Variation of Selected Fruits and Vegetables in Pakistan at a cost of Rs.1.96 million (two years).

agricultural R&D spending.[8] Nevertheless, the share of the private sector involved in agricultural R&D appears to have been rising in recent years, although we do not have time-series data for all agencies in our sample.

As mentioned previously, private-sector agricultural R&D in Pakistan ranges from research conducted by local companies to research carried out by multinationals. In 2003, the 13 agencies included in our survey sample employed 128 fte researchers and spent $11 million on agricultural R&D (in 2000 constant prices). Most of the private-sector agencies were small, employing 7 fte researchers or less. Only three companies employed 25 fte researchers or more: the Pakistan Tobacco Company (PTC), Ali Akbar, and Lakson Tobacco Company (LTC).

The Pakistani government has undertaken various steps to increase private-sector involvement in agricultural R&D. The recently launched Science and Technology for Economic Development (STED) program initiates joint projects on the technology-based production of high-value-added goods between research institutions and private-sector companies. Projects should be designed in such a way that they improve or add value to products, enhance productivity, and sustain development through import substitution or export promotion. The STED program is a public–private partnership program where the public sector contributes 75 percent and the private sector 25 percent. Agriculture and biotechnology are among the priority areas of STED. Some of the approved projects include the development of maize hybrids, the establishment of a modern citrus nursery, the production of value-added fruit products, and the production of export-quality cut flowers (PCST 2007).

[8] These shares are significantly lower than those found in Ahmad and Nagy (2001). These discrepancies can be explained by the fact that the ASTI survey used a much narrower definition of what research activities are. For example, many of the sugar mills employ "scientists" that are responsible for quality control. They were included as researchers under Ahmad and Nagy, but excluded in our study.

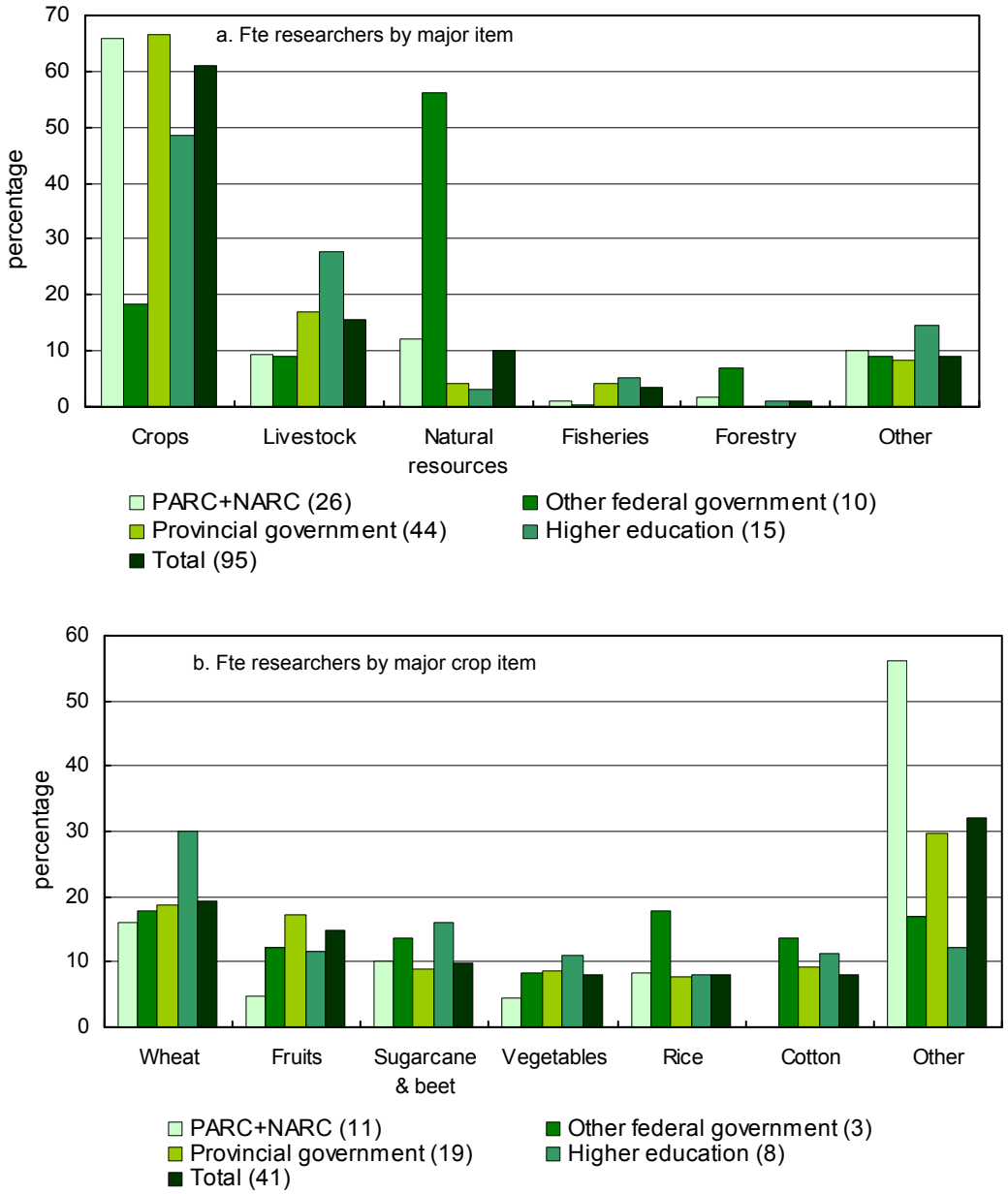
RESEARCH ORIENTATION

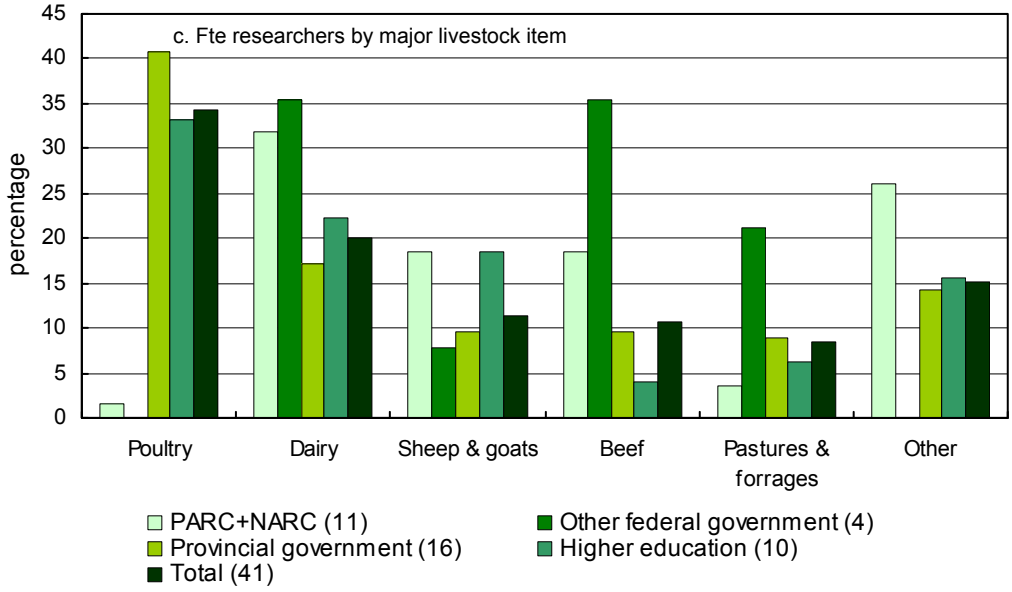
The allocation of resources across various lines of research is a significant policy decision; hence detailed survey information was collected on the number of fte-researchers working in specific commodity and thematic areas.

Commodity Focus

In 2003, about 60 percent of the 3,323 fte researchers in a 92-agency sample conducted crop research. Livestock and natural resources research accounted for 16 and 10 percent of the total, respectively. Research on fisheries and forestry issues in Pakistan is relatively minor with shares of 3 and 1 percent of the total (Figure 14a). Research staff at the other government agencies combined spent relatively more time on natural resources management than their counterparts at PARC, NARC, and the provincial government agencies. The provincial government agencies combined spent relatively more time on livestock research (17 percent). This was especially true in Balochistan and Punjab, where about one-fifth of the fte researchers in the provincial government agencies conducted livestock research. Wheat and fruits, respectively, accounted for 19 and 15 percent of the research conducted on crops. Sugarcane and beets, vegetables, and rice accounted for 8 to 10 percent each (Figure 14b). The remainder of the researchers focused on a wide variety of other crops. Research staff in the higher education sector spent relatively more time on wheat research while their colleagues at PARC and NARC had a much wider focus that included many other commodities, which is shown by the high share of "other" for this category. About one-third of the livestock researchers focused on poultry research (Figure 14c). Other livestock research areas were dairy (20 percent) and beef, sheep, and goats (11 percent each). Noteworthy is that most of the livestock research is conducted at the provincial level. Close to three-quarters of the livestock researchers worked at the provincial government level, mostly in the Punjab. Also noteworthy is the 1 percent share of poultry research for the livestock researchers at the federal government agencies; these researchers spent relatively more time on beef and dairy research (23 and 33 percent, respectively).

Figure 14—Commodity focus, 2003





Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).

Note: Figures in parentheses indicate the number of agencies in each category. Figure 14b only includes agencies involved in crop research; Figure 14c only includes agencies involved in livestock research.

The congruency or parity model is a commonly used method of assessing the allocation of research resources. This usually involves allocating funds (or, in this instance, research personnel) among research areas in proportion to their corresponding contribution to the value of agricultural production. For example, if the value of rice output were twice that of maize, then congruence would be achieved if research on rice were to receive twice as much funding (or, say, employ twice as many scientists) as maize. The model assumes that an additional dollar spent on research would yield a higher return if spent in areas with a relatively low ratio of research funding to output value, therefore funds should flow toward programs with relatively low research intensities and from those with high research intensities. If research spending or scientist shares were congruent with the corresponding value of output for a particular commodity,

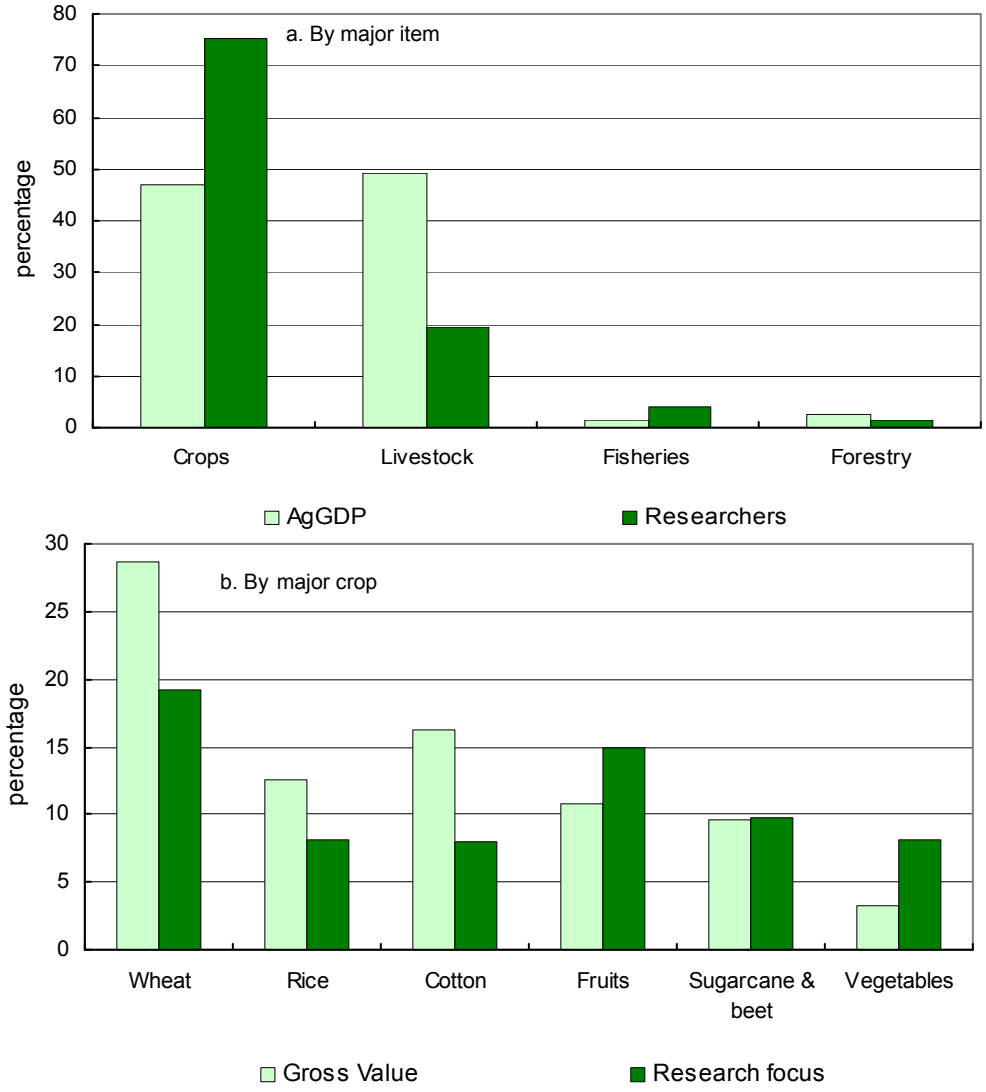
then the congruency ratio for that commodity – measuring the commodity share of researchers to the corresponding share of output – would be equal to 1.0.[9]

Figure 12a shows the shares of crops, livestock, fisheries, and forestry in gross value of agricultural production with the corresponding share of research staff in these areas (excluding the "other" area presented in Figure 15a). In 2003, 75 percent of the researchers in our sub-sample conducted crop research, which was much higher than the share of crops in total production value (47 percent). In contrast the share of livestock in production value was more than double the share of livestock researchers, resulting in a congruency ratio of 0.4. The congruency ratio for forestry was 3.0, showing share in research staff three times higher than production value. On the other hand the congruency for fisheries was only 0.5. Unfortunately no agricultural production value data were available for the provincial level, so we were unable to conduct congruency analyses at the sub-national level.

There were major incongruencies between the shares of researchers and output values revealed at the individual crop level (Figure 15b). Cotton, for example, accounted for 16 percent of the total value of crop production in Pakistan in 2003, but only 8 percent of the crop researchers in our survey sample conducted cotton research (the congruency ratio was 0.5). The congruency ratios for Pakistan's main staple crops (wheat and rice) were also below 1.0. For vegetables the congruency ratio was 2.5, indicating a more intensive research effort than a consideration of crop values alone would justify.

[9] It is important to note, as described in Alston, Norton, and Pardey (1998), that the model overlooks key factors affecting the payoff to R&D, such as the differences in probability of research success, likely adoption rates, and the likely extent of research-induced productivity gains. In addition, the model does not account for technology spill-ins from other countries, or differences in costs per scientists among different R&D areas. So, while the congruence rule is both useful for allocating resources and a distinct improvement over precedence and some other shortcut methods, ratios that differ from 1.0 are not necessarily a cause for concern.

Figure 15—*Congruence between agricultural R&D and production value, 2003*



Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05) and BAS (2006).

Note: Postharvest and other research themes are not included. Production values are for 2003, research focus values are for 2002.

Thematic Focus

Of the 3,293 fte researchers in a sample of 95 agencies, 19 percent focused on crop genetic improvement and 13 percent on crop pest and disease control, while 23 percent focused on other crop-related research themes (Table 2). Other important themes included water and soil research (7 percent each), and livestock genetic improvement and livestock pest and disease control (6 percent each). The federal government agencies combined spent relatively more time on water, soil, and other natural resources, but

focused less on livestock research themes than their counterparts at the provincial government and higher education agencies. In the higher education sector 18 and 14 percent of the fte researchers focused on livestock genetic improvement and livestock pest and disease control, respectively, which was higher than in other institutional categories.

Table 2—*Thematic focus, 2003*

	Federal government (36)	Provincial government (41)	Higher education (16)	Total (93)
Shares		*(percentage)*		
Crop genetic improvement	13.2	23.1	9.1	19.3
Crop pest and disease control	15.3	12.1	8.0	12.7
Other crop	19.6	25.1	19.2	23.1
Livestock genetic improvement	2.5	7.9	5.7	6.3
Livestock pest and disease control	1.3	7.2	7.5	5.6
Other livestock	4.3	4.1	12.4	4.8
Soil	9.3	6.2	3.1	6.8
Water	12.8	4.5	7.4	7.0
Other natural resources	3.6	0.3	0.8	1.2
Postharvest	1.2	2.1	2.7	1.9
Other	16.9	7.4	24.2	11.3
Total	100	100	100	100

Source: Compiled by authors from ASTI survey data (IFPRI–PARC 2003–05).
Notes: Figures in parentheses indicate the number of agencies in each category.

CONCLUSION

With nearly 3,600 fte researchers in 2003, Pakistan has one of the largest agricultural R&D systems in Asia. However, agricultural researcher totals in Pakistan have increased only slowly during the past two decades, mainly as a result of prolonged periods of recruitment restrictions. In addition, at just 15 percent in 2003, the share of Pakistani agricultural research staff trained to PhD level is relatively low, compared to some of Pakistan's South Asian neighbors. Further, researchers at the government agencies face limited promotion opportunities, low salary levels, and few other incentives. Promotions, when they take place, are based on seniority and not on merit. This has led to a brain drain of researchers from the government sector to universities, non-research agencies, or to opportunities outside Pakistan.

Agricultural R&D expenditure in Pakistan contracted significantly during 1991–99 due to cuts in the government budget and the completion of large donor-funded

projects, but rebounded somewhat since the establishment of ALP, a joint program between PARC and the United States Department of Agriculture. In 2003, the country invested $187 million in agricultural R&D (in 2000 international dollars), significantly lower than the $219 million recorded in 1991.

The organizational structure of agricultural R&D in Pakistan is somewhat complex, but with a clear distinction between federal- and provincial-level research agencies. Research conducted by federal government agencies is largely long-term priority research, while the research conducted at the provincial level is mostly adaptive at the provincial level. PARC is the country's principal federal agency involved in agricultural R&D and it oversees a number of institutions that conduct agricultural research in a wide variety of agro-ecological zones within the country. One of these agencies is NARC, the country's largest in terms of research staff and spending. In addition, each of Pakistan's four provinces has a well established research institute attached to the Department of Agriculture. Each such provincial research institute has several satellite research stations, research farms and other research facilities in various commodities specific and agroecological zones within a province. At 10 percent of total research staff and spending, the higher education sector plays a relatively limited role in the conduct of agricultural R&D in Pakistan.

Agricultural R&D in Pakistan is still dominated by the public sector. By our estimates, private-sector agencies accounted for just 6 percent of the country's agricultural R&D expenditures in 2003. Public agricultural R&D in Pakistan is heavily reliant on government sources of support. Foreign donor support has traditionally played an important role in financing agricultural R&D in Pakistan, although exact shares of donor funding were not available. The United States (through USAID and USDA) and the World Bank (through ARP I and II), for example, have directed significant funds toward the establishment of new institutes, the upgrading of research equipment, as well as human resource development and degree-level training.

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APPENDIX A. ASTI METHODOLOGY AND DATA COLLECTION

The ASTI initiative involves a large amount of original and ongoing survey work focused on developing countries, but it also maintains access to relevant S&T data for developed countries collected by other agencies. The initiative maintains collaborative alliances with a number of national and regional R&D agencies, as well as international institutions, and over the years has produced numerous national, regional, and global overviews and policy analyses of agricultural R&D investment and institutional trends. For each country in which ASTI is active, the research team typically works with the national agricultural research institute, which coordinates the in-country survey round and coauthors and co-publishes the resulting country briefs with IFPRI. These surveys focus on research agencies, not research programs.

The dataset for the country sample underpinning this report includes information on roughly 250 agencies and was processed using internationally accepted statistical procedures and definitions developed by the Organisation of Economic Co-operation and Development (OECD) and the United Nations Educational, Science, and Cultural Organization (UNESCO) for compiling R&D statistics (UNESCO 1984; OECD 2002). Agricultural R&D investments are measured on a performer basis. Estimates were grouped into four major institutional categories: government agencies, higher education agencies, nonprofit institutions, and business enterprises. Public agricultural research is defined to include government agencies, higher education agencies, and nonprofit institutions, thereby excluding private enterprises. Government agencies are directly administered by the national government and are typically departments or institutes within a certain ministry. Non-profit institutions, on the other hand, are not directly controlled by the national government and have no explicit profit-making objective. These agencies are often linked to producer organizations or commodity boards. Higher education agencies are academic agencies that combine university-level education with research. They include agricultural faculties, as well as specialized R&D institutes under universities. Private-sector agencies are agencies whose primary activity is the production of goods and services for profit. Some of these companies have an R&D unit dedicated to agricultural research, but R&D is generally not their main activity. Agricultural research activities undertaken by international organizations are explicitly excluded from the

dataset and are reported separately.

Agricultural research, as defined here, includes research on crops, livestock, forestry, fisheries, natural resources, the use of agricultural inputs, and the socioeconomic aspects of primary agricultural production. Also included is research concerning the on-farm storage and processing of agricultural products, commonly referred to as postharvest or food-processing research. Not included in the current data compilation are research activities in support of agrochemical, agricultural machinery, or food-processing industries (which are better reported under those industries), as well as the more basic and discipline-oriented research activities undertaken by departments such as microbiology and zoology. Strict delineations, however, have not always been possible.

A complete list of agencies involved in agricultural R&D was identified at the onset of the survey, and each agency was approached to participate. To this end, three different survey forms were developed: one for government agencies and nonprofit institutions, one for faculties and schools, and one for the private sector. All forms had different sets of questions, and those for government agencies and nonprofit institutions requested the most detail. In general the forms consisted of four sections:

- Institutional details, such as address, affiliation, organizational structure (including number of research stations), institutional history, and so on;
- Human resource information, such as number of researchers by degree level, head count, and full-time equivalents (that is, staffing adjusted for time spent on research), share of female researchers, and support staff by various categories;
- Financial resources, such as expenditures by cost category and funding source; and
- Research focus by commodity (about 35–40 items) and by theme (about 20 items).

Time-series data were collected for the main indicators (research investments, research funding sources, and research staff totals); the remaining indicators were mostly for a particular benchmark year. Additional qualitative information was collected through country visits involving in-depth meetings with various agencies, given that quantitative information often doesn't provide the full picture of developments in agricultural R&D

resources.

The reported research-personnel data are expressed in full-time equivalent (fte) researchers. Researchers should hold at least a BSc degree or equivalent. Fte corrections were made only when more than 20 percent of the reported research staff time was spent on activities other than R&D, such as extension, teaching, or technical services. The contribution of PhD students in research taking place at higher education agencies is usually not included.

Internationally Comparable Measures of R&D, Using PPPs

Comparing economic data from one country to the next is very complex due to important price-level differences that exist between countries. Putting the agricultural R&D expenditure of two countries side by side is particularly difficult, given that roughly two-thirds of research expenditure is typically spent on local research and support staff, rather than on capital or other goods and services, which are usually traded internationally.

The quantity of research resources used in economies with relatively low price levels tends to be understated when R&D spending from different countries is converted to a single currency using official exchange rates. Similarly, the quantity of resources used in countries with high price levels tends to be overstated. Purchasing power parities (PPP) are conversion rates that equalize the purchasing power of different currencies by eliminating the differences in price levels between countries. Therefore, a PPP rate can be thought of as the exchange rate of dollars for goods in the local economy, while the U.S. dollar exchange rate measures the relative cost of domestic currency in dollars. A country's international price level is the ratio of its PPP rate to its official exchange rate for U.S. dollars. Thus the international price level is an index measuring the cost of a broad range of goods and services in one country relative to the same bundle of goods and services in a reference country, in this case the United States. For example, Japan's international price level (that is, the ratio of PPP to exchange rate) of 1.57 in 2000 implies that the price of goods and services in Japan was 57 percent higher than the price of comparable goods and services in the United States that year. In contrast, the corresponding 2000 ratio for Kenya of 0.20 indicates that a bundle of goods and services that cost $20 in Kenya would have cost $100 in the United States (Pardey and Beintema

2001).

No fully satisfactory method has so far been devised to compare consumption or expenditures across countries, either at different points in time or the same point in time. The measures obtained, as well as their interpretation, can be highly sensitive to the deflator and currency converter used. Most financial figures in this report have been expressed in "international dollars" for the benchmark year 2000. At the country level, all expenditure and funding data have been collected in local currency units (Pakistani rupees). These amounts were subsequently converted to 2000 international dollars by deflating the local currency amounts with each country's GDP deflator of base year 2000 and converting to U.S. dollars with a 2000 PPP index (both the GDP deflators and PPP values were taken from the World Bank 2004). For convenience of interpretation, the reference currency – in this case international dollars – is set equal to a U.S. dollar in the benchmark year 2000.

APPENDIX B. HISTORICAL PERSPECTIVES[10]

Agricultural research in Pakistan (previously the northwestern regions of British India) dates back to 1929, when the Imperial (currently Indian) Council of Agricultural Research was founded to promote agricultural research in India. At the time of the partition of British India in 1947, West Pakistan inherited very little of the human and physical capital of the agricultural research system in British India (most institutes were located in India). Only one agricultural college and one research station remained, albeit with insufficient resources. The need to have a national agricultural research organization was acutely felt. Setting up the Food and Agricultural Committee in 1948 was the first step in that direction. It was reconstituted as the Food and Agricultural Council of Pakistan (FACP) in 1951. It was renamed the Agricultural Research Council (ARC) in 1973. However, its scope remained limited as a funding agency. In the late 1950s, research and teaching institutions in the North West Frontier Province, Punjab, and Sindh provinces were founded with assistance from the United States. These institutions laid the groundwork for the current agricultural education and public research system.

ARC's effectiveness and functionality were enhanced as a result of the recommendations that emanated from the joint review of the agricultural research system in Pakistan by a combined team of Pakistani and American scientists in 1968 and in 1973. The year 1978 will go down as an important landmark in the history of agricultural research. ARC was given autonomous status in order to improve the management and effective coordination of research efforts. In 1981, the process culminated in the redesignation of ARC to PARC. One year later, the government announced its agricultural policy, which stressed equitable growth in all aspects of agriculture. The Sixth Five-Year Plan (1983–88) also emphasizes transforming agriculture from subsistence to export-oriented and making the country not only self-sufficient in agricultural commodities but also to achieve a substantial exportable surplus to improve its foreign-exchange-earning capacity. PARC planned its program in accordance with these exigencies and is making concerted efforts to maximize agricultural productivity, through such measures as providing effective coordination, strengthening research facilities, improving the terms and conditions of researchers, creating adequate training

[10] [10] This section draws largely on Mohammed (1983), Nagy (1984), and Akbar (1999).

facilities, funding research activities, diffusing improved production technologies, and by creating National Coordinated Research Programs in the commodities and disciplines that are of national economic importance. In 1998, the Pakistani agricultural research system was reorganized at the federal and provincial level, and few changes have occurred since.

APPENDIX C. FEDERAL AND PROVINCIAL GOVERNMENT AGENCIES AND HIGHER EDUCATION AGENCIES

Type of agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	fte
Federal government	Pakistan Agricultural Research Council (PARC)	Head Office	Crops, livestock, socioeconomics	105	105.0
		National Tea Research Institute (NTRI)	Tea	8	8.0
		National Sugar Cane Research Institute (NSCRI)	Sugarcane, beets	9	9.0
		Karakoram Agricultural Research Institute (KARINA)	Crops, livestock, natural resources	13	13.0
		Arid Zone Research Centre (AZRC)	Socioeconomics, crops, livestock	31	31.0
		Southern Zone Agricultural Research Center, (SARC)	Crops	45	45.0
		3 Liaison Offices	Coordination	5	5.0
		6 Technology Transfer Institutes (TTI)	Socioeconomics, technological transfer	23	23.0
	National Agricultural Research Center (NARC)	Institute of Field and Horticulture Crops (IFHC)	Crops	274	274.0
		Animal Sciences Institute (ASI)	Livestock	44	44.0
		Institute of Plant and Environmental Protection (IPEP)	Crops	35	35.0
		Institute of Agricultural Biotechnology and Genetic Resources (IABGR)	Biotechnology	26	26.0
		Institute of Natural Resources and Environmental Sciences (INRES)	Natural resources, environment	66	66.0
		Farm Machinery Institute (FMI)	Machinery	16	16.0
		Social Science Institute (SSI)	Socioeconomics	10	10.0
		Technology Transfer Institute (TTI)	Technological transfer	5	5.0

Type of agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	fte
		Training Institute (TI)	Training	4	4.0
		Directorate of Scientific Information (DSI)	Services	5	5.0
		Administrative and General Services (DAGS)	Crops, livestock	15	15.0
Other federal agencies	Ministry of Food, Agriculture and Livestock	Agricultural Price Commission (APCOM)	Wheat, rice, sugar cane, cotton	25	25.0
		Federal Seed Certification and Registration Department (SCRD)	Crops	63	18.9
		National Veterinary Laboratory (NVL)	Beef, dairy	15	15.0
		Soil Survey of Pakistan, Lahore (SSP)	Natural resources	42	25.2
	Ministry of Science and Technology	Pakistan Council for Research in Water Resources (PCRWR)	Water resources	114	114.0
		Pakistan Museum of National History (PMNH)	Crops, livestock, natural resources	21	17.9
		Pakistan Science Foundation (PSF)	N.A.	35	7.0
	Ministry of Environment	Pakistan Forest Institute, Peshawar (PFI)	Forestry, natural resources	40	40.0
	Ministry of Planning	National Fertilizer Development Center (NFDC)	Fertilizers	5	2.5
	—	Sustainable Development Policy Institute (SDPI)	Socioeconomics	18	5.4
	—	Pakistan Institute of Development Economics (PIDE)	Socioeconomics	75	15.0
Provincial government					
Balochistan	Department of Agriculture	Agricultural Research Institute Sariab (ARIS)	Crops, socioeconomics	140	140.0

Type of agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	fte
	Directorate of Livestock Research and Development	Veterinary Research Institute	Veterinary medicine	15	15.0
		Beef Research and Production Center Sibi	Beef	6	6.0
		Multiple Purpose Sheep Research Center, Loralai	Sheep	3	3.0 (2004)
		Karakaro Sheep Breeding Farm, Maslak District Killa Abdullah	Sheep breeding	4	1.2
		Wool Research Laboratories	Wool	4	4.0
North-West Frontier Province	Department of Agriculture and Livestock				
		Agricultural Research System	Crops, natural resources	267	267.0
		Veterinary Research Institute, Peshawar	Veterinary medicine	39	39.0
	Department of Fisheries and Transport	Department of Fisheries	Fisheries	31	31.0
	Department of Environment	Forest Department	Forestry	17	17.0
Punjab	Department of Agriculture	Ayub Agricultural Research Institute (AARI)	Crops	739	739.0
		Directorate of Floriculture	Landscaping	27	11.9
		Adaptive Research Center	N.A.	80	80.0
		Agricultural Mechanization Research Institute	Wheat , cotton	17	17.0
	Livestock and Diary Development Department	Director General of Research	Livestock	3	3.0
		Veterinary Research Institute	Veterinary medicine	63	63.0
		Foot and Mouth Research Institute	Veterinary medicine	12	4.8
		Livestock Production Research Institute	Dairy	42	42.0
		Poultry Research Institute	Poultry	126	126.0

Type of agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	fte
	Forestry, Wildlife and Fisheries Department	Punjab Forestry Research Institute	Forestry, natural resources	19	19.0
		Punjab Wildlife Research and Training Center	Wildlife, natural resources	3	3.0
		Director General of Fisheries	Fisheries	11	11.0
		Fisheries Research and Training Institute	Fisheries	22	22.0
	Planning and Development Department	Punjab Economic Research Institute	Socioeconomics	19.0	19.0
	Department of Agriculture	Agricultural Engineering Research	Machinery	3	3.0
Sindh	Department of Agriculture	Agricultural Research Institute Tandojam (ARIT)	Crops	148	148.0
		Rice Research Institute Dokri	Rice	59	59.0
		Sindh Horticulture Research Institute	Horticulture	80	80.0
		Wheat Research Institute Sakrand	Wheat	49	49.0
		Quaid-e-Awam Agriculture Research Institute Larkana at Naudero	Crops	16	16.0
		Directorate of Plant Protection, Director General of Agricultural Extension	Crops	36	18.0
	Department of Livestock and Fisheries (DLF)	Central Veterinary Diagnostic Laboratory	Veterinary medicine	29	8.7
		Livestock Development and Research Farm for Kundhi Buffaloes	Dairy	3	2.1
		Kamorai Goat Farm	Livestock	2	1.4
		Livestock Experimentation Station, Korangi	Beef, dairy	3	1.5

Type of agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	fte
		Livestock Experimentation Station, Nabisar	Livestock	3	1.5
		Research and Training Institute	Livestock	8	4.0
		Directorate of Fisheries	Fisheries	74	28.1
		Poultry Production and Research Sindh	Poultry	61	42.7
		Sindh Poultry Vaccine Center	Poultry	10	5.0
	Forest Wildlife and Environment Department	Silviculture Research Division	Forestry	2	2.0
	Ministry of Science and Technology	Drainage Research Center	Crops, natural resources	23	11.5
	Department of Water and Power	Lower Indus Water Management and Reclamation Research Project	Natural resources, crops, socioeconomics	7	7.0
Higher education agencies	Allama Iqbal Open University	Department of Agricultural Science	Crops	5	1.5
	Quaid-e-Azam University	Department of Biological Science	Crops, livestock, natural resources	20	6.0
Balochistan	University of Balochistan	Chemistry Department	N.A.	22	2.2
		Institute of Biochemistry	Livestock, fisheries, environment	10	3.0
		Department of Zoology	Livestock, fisheries	17	5.1
		Department of Botany	Botany	14	4.2
Punjab		University of Agriculture, Faisalabad	Crops, livestock, machinery	337.4	119.8
	—	University of Arid Agriculture, Rawalpindi	Crops, livestock, forestry, socioeconomics	71	10.5
	—	University of Veterinary and Animal Science	Dairy, poultry	44	13.2
	Gomal University of D.I.Khan	Faculty of Agriculture	N.A.	50	20.0

Type of agency	Supervising agency	Executing agency	Research focus	Researchers	
				Headcount	fte
Sindh	University of Sindh	Department of Botany, Faculty of Natural Science	Postharvest, natural resources	19	5.7
		Department of Fresh Water Biology and Fisheries	Fisheries	10	3.0
	Bagui Medical University	Bagui College of Veterinary Sciences	Veterinary medicine	8	2.4
	Mehran University of Engineering	Institute of Environmental Engineering and Management	N.A.	7	1.4
	—	Sindh Agricultural University Tandojam	Crops, socioeconomics	242	72.6
NWFP	—	NWFP Agricultural University Peshawar	Crops, livestock	151	15.1
	University of Peshawar	Department of Agricultural Engineering	Natural resources, machinery	13	3.9
		Department of Zoology	Livestock, fisheries	8	1.6

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