AGRICULTURAL SCIENCE
AND TECHNOLOGY INDICATORS

AGRICULTURAL R&D IN THE PHILIPPINES:

POLICY, INVESTMENTS, AND INSTITUTIONAL PROFILE

ASTI Country Report

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and
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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 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: **http://www.asti.cgiar.org**

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LIST OF ACRONYMS

ABM[1]	agency budget matrix
ACIAR	Australian Centre for International Agricultural Research
AFMA	Agriculture and Fisheries Modernization Act
AgGDP	agricultural gross domestic product
AIDA	Abaca Industry Development Authority
ARDP	Agricultural Research Development Project
ARP	Allotment Release Program
ASSP-II	Second Agricultural Support Services Program
BAEcon	Bureau of Agricultural Economics
BAR	Bureau of Agricultural Research
BAI	Bureau of Animal Science
BARC	Bangladesh Agricultural Research Council
BFIS	Bureau of Fiber and Inspection Service
BIOTECH	National Institute of Molecular Biology and Biotechnology
BPI	Bureau of Plant Industry
BSc	Bachelor of Science
CAR	Cordillera Administrative Region
CAS	College of Arts and Sciences
CIMMYT	International Maize and Wheat Improvement Center
CFNR	College of Forestry and Natural Resources
CGIAR	Consultative Group on International Agricultural Research
CIP	International Potato Center
CIRAD	Center of International Agricultural Research Cooperation for Development
CLIARC	Central Luzon Integrated Agricultural Research Center
CS	Cooperating stations
CSIRO	Commonwealth Scientific and Industrial Resources Organization
DA	Department of Agriculture
DANR	Department of Agriculture and Natural Resources
DBCC	Development Budget Coordinating Committee
DBM	Department of Budget and Management
DENR	Department of Environment and Natural Resources
DOH	Department of Health
DOST	Department of Science and Technology
DSWD	Department of Social Welfare and Development
ERDB	Ecosystem Research and Development Board
ESEP	Engineering and Science Education Program
FAO	Food and Agriculture Organization of the United Nations
FFTC	Food and Fertilizer Technology Center
FIDA	Fiber Industry Development Authority

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

LIST OF ACRONYMS (continued)

FMB	Forest Management Bureau
FORI	Forest Research Institute
FTE	full-time equivalent
GAA	General Appropriation Act
GARO	General Allotment Release Order
GC	Governing Council
GDP	gross domestic product
HRDP	Human Resource Development Program
IAARD	Indonesian Agency for Agricultural Research and Development
ICAR	Indian Council for Agricultural Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Centre
IFPRI	International Food Policy Research Institute
IFS	International Foundation for Science
ILRI	International Livestock Research Institute
IPGRI	International Plant Genetic Resources Institute
IRRI	International Rice Research Institute
ISAAA	International Service for the Acquisition of Agri-biotech Applications
ISNAR	International Service for National Agricultural Research
ITCC	International Technical Cooperation Center
JICA	Japan International Cooperation Agency
JIRCAS	Japan International Research Center for Agricultural Sciences
MAF	Ministry of Agriculture and Food
MARDI	Malaysian Agricultural Research and Development Institute
MASTIC	Malaysian Science and Technology Information Centre
MNR	Ministry of Natural Resources
MOA	memorandum of agreement
MOSTE	Ministry of Science, Technology, and Environment
MOU	Memorandum of understanding
MSc	Master of Science
MTPDP	Medium-Term Philippine Development Plan
NAFC	National Agricultural and Fishery Council
NAPHIRE	National Postharvest Institute for Research and Extension
NARS	National agricultural research system
NAST	National Academy of Science and Technology
NCA	Notice of cash allocation
NCRDT	National Commodity Research and Development Teams
NMC	National Mangrove Committee
NMCRDC	National Multi-Commodity Research and Development Center
NSCB	Philippine National Statistical Coordination Board
NSCRDC	National Single-Commodity Research and Development Center
NSDB	National Science Development Board

LIST OF ACRONYMS (continued)

NSTP	National Science and Technology Plan
OECD	Organisation for Economic Co-operation and Development
PA 2020	Philippine Agriculture 2020
PAP	Programs, activities, and plans
PARC	Pakistan Agricultural Research Council
PCA	Philippine Coconut Authority
PCAR	Philippine Council for Agricultural Research
PCAMRD	Philippine Council for Aquatic and Marine Resources Research and Development
PCARRD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PCASTRD	Philippine Council for Advanced Science and Technology Research and Development
PCC	Philippine Carabao Center
PCHRD	Philippine Council for Health Research and Development
PCIERD	Philippine Council for Industry and Energy Research and Development
PhD	Doctor of Philosophy
PhilRice	Philippine Rice Research Institute
PPP	purchasing power parity
PSI	Philippine Sugar Institute
PTA	Philippine Tobacco Administration
R&D	research and development
RDA	Rural Development Administration
RIARC	Regional Integrated Agricultural Research Center
ROI	return on investment
ROSES	research outreach stations
RRDCC	Regional Research and Development Coordinating Council
RTWG	Research and Technology Working Group
S&T	science and technology
SA	specialized agencies
SARO	special allotment release order
SESAM	School of Environmental Science and Management
SMU	Southern Mindanao University
SOCCSKSARGEN	South Cotabato, Cotabato, Sultan Kudarat, Sarangani and General Santos City
SRA	Sugar Regulatory Administration
STMP	Science and Technology Master Plan
TAC	Technical Advisory Committee
TAPI	Technology Application and Promotion Institute
UNESCO	United Nations Educational, Scientific and Cultural Organization
UP	University of the Philippines
USAID	United States Agency for International Development
VISCA	Visayas State College of Agriculture

ABSTRACT

This report presents an overview of the Philippine national agricultural R&D system in the context of the country's wider national science and technology (S&T) policy. The discussion includes institutional developments and recent trends in human and financial resources based on data collected under the Agricultural Science and Technology Indicators (ASTI) initiative.

With a total of close to 4,000 full-time equivalent researchers in 2002, the Philippines has one of the largest agricultural research systems in Asia. But in terms of total agricultural research spending, the Philippines ranks behind more economically advanced Asian countries such as Malaysia and South Korea. Nonetheless, agricultural R&D spending in the Philippines has shown significant growth in recent years. In 2002, the country invested $269 million in agricultural R&D (in 2000 international dollars), which is an increase of two-thirds over the level recorded a decade earlier.

Public agricultural R&D in the Philippines is heavily reliant on government sources of support. In 2002, the Philippine government provided more than 85 percent of funding to the government agencies. In recent years, however, the share of internally generated resources has gradually increased. Foreign donor support plays only a marginal role in the Philippine agricultural R&D system, distinguishing it from some other countries in the region.

The organization of public agricultural R&D in the Philippines is complex. The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) acts as the central coordinating body providing support to 132 implementing R&D agencies collectively called the National Agriculture and Resources Research and Development Network (NARRDN) as well as 14 region-based consortia.

Compared to most countries in the Asia-Pacific region, the private sector plays a relatively important role in conducting agricultural R&D in the Philippines. We estimated that about 18 percent of total (public and private) spending in agricultural R&D was done by the private sector, mostly fruit plantations.

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INTRODUCTION

This paper presents an overview of the Philippine national agricultural R&D system in the context of the country's wider national science and technology (S&T) policy. The discussion includes institutional developments and recent trends in human and financial resources based on data collected under the Agricultural Science and Technology Indicators (ASTI) initiative (IFPRI–PCARRD 2003–05).

Macroeconomic Context

Since attaining independence from the United States in 1946, the Philippines has undergone a mixed history of economic growth and development, taking it from the second-richest country in Asia, after Japan, to one of the region's poorest. Contributing factors in more recent years were the severe recession of 1984–85, which led to a contraction of the economy by more than 10 percent, and the Asian financial crisis of the late 1990s, which wreaked further significant losses. By 2006, the Philippines faced a sluggish economy, rapid population growth, uncontrolled urbanization, inadequate infrastructure, depleted natural resources, and overall environmental degradation.

The services sector dominates the Philippine economy, accounting for 53 percent of gross domestic product (GDP) in 2005. That same year, the industrial sector constituted one-third of GDP, while the agricultural sector (including forestry and fisheries) contributed 14 percent—down from 23 percent in 1982 (NSCB 2006). Agricultural GDP has varied somewhat in recent years because agriculture in the Philippines is highly susceptible to the effects of El Niño–related drought and typhoons. Despite agriculture's relatively low (and declining) share of GDP, the sector is still a priority because it provides employment to 37 percent of the active labor force (NSCB 2006). In fact, roughly three-quarters of the rural poor depend on agriculture for

employment and income. As a result, agricultural research and development (R&D) is granted a priority by the Philippine government.

Arable farmland comprises roughly a quarter of the archipelago's total land area. Although the country is rich in agricultural potential, inadequate infrastructure, lack of financing, and government policies have contributed to falling productivity gains. Philippine farmers produce food crops for domestic consumption and cash crops for export. Rice and maize are the Philippines' principal food crops, with rice being the staple food. Rice is produced extensively on the islands of Luzon and Mindanao and in the Western Visayas, while maize is primarily produced in Mindanao. Coconuts are the country's major export crop. The Philippines is the world's second-largest producer of coconut products after Indonesia. Other major export crops include sugar, bananas, pineapples, mangoes, and coffee. Total agricultural exports declined rapidly in the years immediately following the Asian financial crisis but have subsequently returned to pre-crisis levels (FAO 2006). The country's livestock industry consists primarily of cattle, carabao (water buffalo), hogs, and chickens. Livestock accounted for 13 percent of value-added in the agricultural sector in 2005, similar to the level recorded in 1980 (NSCB 2006).

In 2000, forest land represented 19 percent of Philippine territory, much of it in areas of high elevation and steep slopes (World Bank 2004). In the first three decades after independence, the government facilitated the exploitation of the country's forest resources by implementing low forest charges and export taxes, and by allocating the bulk of unclassified land as public forest land, eligible for logging. As a result, uncontrolled logging and slash-and-burn agriculture in marginal upland areas stripped the forests for decades. The government has instituted conservation programs, but deforestation remains a severe problem (FMB 2006).

With its 7,107 islands (roughly 2,000 of which are inhabited), the Philippines has a diverse range of fishing areas. Until recently, the country benefited from highly productive marine habitats and coastal waters, but aggressive coastal and marine development led to excessive fishing pressure, overfishing, stock depletion, and the destruction of freshwater and marine habitats. In 2003, the fisheries sector accounted for 15 percent of agricultural GDP, down from 21 percent in 1986.

Science and Technology Policies and Investments

Strong empirical evidence indicates that high levels of R&D promote high productivity and, ultimately, increased economic performance (Cororaton 1999). The rapid economic growth achieved by certain Asian countries in the 1990s, for example, can be partially attributed to rapid innovation, including new knowledge, techniques, and technologies. The same is true for the Philippines. In a study by Cororaton (1998), R&D was found to translate into significant rates of return in the primary and service sectors, registering to as high as 60 percent.

The mandate of the Philippine Department of Science and Technology (DOST) is to direct and coordinate the country's science and technology (S&T). DOST formulates S&T policy, programs, and projects in support of national development priorities. In addition, it is responsible for monitoring the country's S&T strategy in the context of national development goals. Over the past two decades, slow economic growth in the Philippines has led to low levels of investment. Resulting inadequate job opportunities in the S&T field have led to "brain drain," with highly qualified research staff seeking opportunities elsewhere. DOST has launched various plans over the years to redress this problem. The Science and Technology Master Plan (STMP) 1991–2000, was an important attempt to institute a comprehensive long-term S&T plan. STMP identified S&T weaknesses, including low levels of investment, lack of well-qualified staff, lack of private-sector participation, inadequate attention to market demand, and lack of technology transfer and commercialization. In response to these deficiencies, STMP proposed bold new measures, including a global technology search, programs to attract expatriate scientists, greater private-sector involvement, and closer collaboration between the private and public sectors. In addition, STMP called for a five-fold increase in R&D investments as a percentage of GDP, from 0.2 in 1991 to 1.0 in 2000. Unfortunately, this was an overly ambitious goal, and the resources necessary were not generated during the period of the plan (DOST 2002).

In fact, total (agricultural and nonagricultural) R&D expenditures as a percentage of GDP dropped sharply during 1992–2003. In 2003, total research spending represented 0.11 percent of GDP, exactly half the 1992 equivalent (DOST 2002; MOSTE 2003). This 2003 ratio was much lower than corresponding ratios in other South East Asian countries,

such as Malaysia (0.69 percent) and Thailand (0.24 percent), but more than twice the corresponding ratio of 0.05 percent recorded in neighboring Indonesia (MASTIC 2004). Like the majority of developing countries, most agricultural R&D is conducted by government agencies. In 1999 (the most recent year for which data were available), roughly 80 percent of total Philippine research investments (for both agricultural and nonagricultural activities) were made by the public sector (DOST 2002).

As a follow-up to STMP, DOST developed the *National Science and Technology Plan* (NSTP), 2002–20, laying out a strategy for S&T–driven economic development. Although NSTP addresses the long term, it includes several short-term components focusing on R&D, technology transfer, human resource development, S&T promotion, information dissemination and advocacy, and networking (DOST 2002). For example, the plan stipulates that the Philippines should be a world-class knowledge provider and user in selected S&T areas by 2010, and that the country should develop a wide range of globally competitive products and services with high technology content by 2020. Twelve priority S&T areas were identified, including various agricultural and biotechnology-related fields. One goal of NSTP is to increase the private-sector share of Philippine R&D to 40 percent by 2020 (DOST 2002).

Despite these ambitious plans, DOST's annual budget declined from 2,857 billion current Philippine pesos in 1994 to 2,620 billion in 2004 (Alabastro 2004), equivalent to a drop of 50 percent in real terms. More alarming, however, is the declining share of DOST's budget as a percentage of the total national budget over this time, from 0.88 in 1994 to only 0.43 in 2004 (Policy Action Group 2004). The exact share of DOST's budget allocated to agricultural R&D is unknown, but agricultural research is certainly a priority for DOST, as is research on information and communication technologies, pharmaceuticals, and the environment.

THE ORGANIZATION OF PHILIPPINE AGRICULTURAL R&D

The organization of public agricultural R&D in the Philippines is complex, partly because of the large number of agencies involved, and partly because of the regional spread of these agencies. The Los Baños–based Philippine Council for Agriculture and Resources Research and Development (PCARRD) is the central coordinating body of

agricultural research activities in the Philippines and falls under the administrative responsibility of DOST.[2]

The Philippine Council for Agriculture and Resources Research and Development

PCARRD was created as an apex organization to establish, support, and manage the operations of a national network of government and higher education agencies involved in crop, livestock, forestry, fisheries, soil and water, mineral resources, and socioeconomic research. The council formulates strategies, policies, and programs for S&T development, allocates government and external funds for R&D, and monitors and evaluates R&D programs and projects. In addition, PCARRD generates external funds for R&D (PCARRD 2005).

PCARRD comprises three main bodies: the Governing Council (GC), the Technical Advisory Committee (TAC), and the Secretariat. The GC has ultimate policy and decision-making authority. It focuses on strategic innovation and planning, along with formulating guidelines to ensure the effectiveness and efficiency of the R&D system. The GC includes private-sector representation to ensure a broad policymaking perspective that extends beyond the concerns of the government sector. TAC is an advisory body that studies the technical aspects of R&D policy and governance and makes appropriate recommendations. In addition, TAC ensures the quality and effectiveness of national R&D policies for S&T development. TAC's wide-ranging membership of research directors, policymakers, and representatives from the private sector and farmer organizations provides a multidisciplinary and multi-agency orientation in research planning, evaluation, and implementation. Finally, PCARRD's Secretariat implements the policies and guidelines formulated by the GC. It comprises both a core staff and a group of support scientists organized into R&D teams focusing on national commodities (NCRDTs) (del Rosario 1999; PCARRD 2005).

PCARRD provides support to the 132 implementing R&D agencies collectively

[2] DOST provides the central direction, leadership, and coordination of R&D related to science and technology in the Philippines through PCARRD and four other planning councils: the Philippine Council for Advanced Science and Technology Research and Development (PCASTRD), the Philippine Council for Health Research and Development (PCHRD), the Philippine Council for Industry and Energy Research and Development (PCIERD), and the Philippine Council for Aquatic and Marine Resources Research and Development (PCAMRD).

called the NARRDN as well as 14 regional consortia. Essentially, PCARRD, the NARRDN, and the regional consortia form the national agricultural research system (NARS) of the Philippines.

National Agriculture and Resources Research and Development Network

NARDDN comprises 4 national multi-commodity centers, 9 national single-commodity centers, 20 regional research centers, 88 cooperating stations, and 9 specialized agencies (see Appendix C).[3] Each R&D agency has a specific commodity and geographical area of responsibility based on the agroecological zone in which it is located.

- The four national multi-commodity R&D centers (NMCRDCs) are based in higher education agencies and conduct basic and applied research on a wide range of economically important commodities and disciplines.
- National single-commodity R&D centers (NSCRDCs) are centers that conduct basic and applied research on a single commodity or theme. Nine such centers contribute to the NARDDN, focusing on cotton, tobacco, coconuts, rice, sugarcane, forest utilization, forest production, ecosystems, and carabao. NSCRDCs implement programs across a broad range of disciplines in coordination with regional R&D centers and cooperating stations.
- The regional R&D centers conduct applied research on commodities of major importance to the regions in which they are located. The regional centers first verify potentially applicable research results from the national R&D centers and then fine-tune technologies to suit regional needs and conditions. Most regional R&D centers are located within higher education agencies, while some fall under the Department of Agriculture (DA).
- Cooperating stations are selected stations under DA, the Department of Environment and Natural Resources (DENR), and higher education or private-sector agencies scattered across the country. They provide facilities for adaptive trials or field experiments, taking micro-environmental differences into account.

[3] This section draws largely on PCARRD (2005) and del Rosario (1999).

- Specialized agencies conduct applied and adaptive R&D on a specific commodity or commodity mix under a given sector and include private-sector agencies with research facilities specializing in a specific commodity.

Directory of Consortia Member Agencies

The 7,107 islands of the Philippines are divided into 15 regions, each administered by a regional R&D consortium charged with developing regional capacity for managing research.[4] Each consortium involves a series of satellite institutions around a base agency. Regional leadership resides in agencies best equipped to operate the consortia based on their facilities and resources. PCARRD currently coordinates 14 of the 15 R&D consortia corresponding to the various regions (Table 1).[5] See Appendix D for a list of consortia and associated agencies included in our survey sample.

BCARRD, the oldest regional consortium, was created in 1976; CCARRD, the youngest, was established in 1996. All 14 consortia are based at universities or state colleges, and each consists of a Regional Research and Development Coordinating Council (RRDCC) and a Research and Technology Working Group (RTWG). The RRDCC is the consortium's policymaking body. It is chaired by one of the heads of the member agencies, as determined by member vote. The chair rotates among the member-agency heads every two to three years. The RTWG is made up of research directors of member agencies, who review the regional R&D programs and budgets for approval prior to passing them to RRDCC or before funding is sought. The RTWG also evaluates regional-level proposals and monitors and evaluates the implementation of R&D projects.

[4] This section draws largely on del Rosario (1999) and PCARRD (2005).

[5] We were unable to receive data from the Autonomous Region of Muslim Mindanao Integrated Agricultural Research Center (ARMMIARC). This consortium is not a PCARRD member and has been excluded from further analysis in this report.

Table 1—*List of agricultural R&D consortia under PCARRD*

Region	Name of consortium	Base location
Region I: Ilocos	Ilocos Agriculture and Resources Research and Development Consortium (ILARRDEC)	Mariano Marcos State University (MMSU)
Region II: Cagayan Valley	Cagayan Valley Agriculture and Resources Research and Development (CVARRD)	Isabela State University (ISU)
Region III: Central Luzon	Central Luzon Agriculture and Resources R&D Consortium (CLARRDEC)	Central Luzon State University (CLSU)
Region IV: Southern Tagalog	Southern Tagalog Agriculture and Resources R&D Consortium (STARRDEC)	University of the Philippines Los Baños (UPLB)
Region V: Bicol	Bicol Consortium for Agriculture and Resources Research and Development (BCARRD)	Bicol University (BU)
Region VI: Western Visayas	Western Visayas Agriculture and Resources Research and Development Consortium (WESVARRDEC)	University of the Philippines in the Visayas (UPV)
Region VII: Central Visayas	Central Visayas Consortium for Integrated Regional Research and Development (CVCIRRD)	Central Visayas Polytechnic College (CVPC)
Region VIII: Eastern Visayas	Visayas Consortium for Agriculture and Resources Program (VICARP)	Leyte State University (LSU)
Region IX: Western Mindanao	Western Mindanao Agriculture and Resources Research and Development Consortium (WESMARRDEC)	Western Mindanao State University (WMSU)
Region X: Northern Mindanao	Northern Mindanao Consortium for Agriculture and Resources Research and Development (NOMCARRD)	Central Mindanao University (CMU)
Region XI: Southern Mindanao	Southern Mindanao Agriculture and Resources Research and Development Consortium (SMARRDEC)	University of the Southeastern Philippines (USEP)
Region XII: SOCCSKSARGEN	Cotabato Agriculture and Resources Research and Development Consortium (CARRDEC)	University of Southern Mindanao (USM)
Region XIII: Caraga	Caraga Consortium for Agriculture, Forestry, and Resources Research and Development (CCARRD)	Northern Mindanao State Institute of Science and Technology (NORMSIST)
Cordillera Administrative Region (CAR)	Highland Agriculture and Resources Research and Development Consortium (HARRDEC)	Benguet State University (BSU)

Note: In reality, there are 15 regional R&D consortia in the Philippines, but the Autonomous Region of Muslim Mindanao Integrated Agricultural Research Center (ARMMIARC) is not a member of PCARRD.

Institutional Categories

In this study, Philippine agricultural R&D agencies are categorized as (national and regional) government agencies, nonprofit agencies, higher education agencies, and business enterprises (see *Appendix A* for specific definitions and methodology). We identified around 270 agencies involved in agricultural R&D in the Philippines, including a sizeable number of private-sector agencies. Completed surveys were received for 247 of these entities (79 government agencies, 1 nonprofit agency, 148 higher education

agencies, and 19 business enterprises).[6] In 2002, these 247 agencies employed more than 3,750 full-time equivalent (fte) researchers and spent $257 million on agricultural R&D (in 2000 international prices), the equivalent of more than 2.8 billion Philippine pesos in 2000 constant prices.

The R&D expenditures and research staff for the missing 23 agencies were estimated:

- ARMMIARC is the only government agency excluded from our survey sample. David et al. (1998) calculated that total agricultural R&D spending by ARMMIARC represented about 0.8 percent of the country's total expenditures in 1996. We assumed this share has remained unchanged since.
- Our survey did not cover a number of smaller universities. We estimated their combined share to be about 8 percent of the agricultural research staff working in the Philippine higher education sector (in fte's).
- Based on a complete list of private agricultural R&D agencies in the Philippines by Pray (2001), we estimated that the 19 private companies in our sample represented about 85 percent of the total agricultural researchers (in fte's) working in the private sector in 2002.

Scaling up our sample totals to account for the missing government, higher education, and private-sector agencies brings the total number of fte agricultural researchers in the Philippines to 3,942 and total agricultural R&D expenditures to $263 million in 2000 international prices, or close to 3 billion Philippine pesos in 2000 constant prices (Table 2).[7]

[6] In a few cases, secondary data sources were also used.

[7] Compiling expenditure data for higher education agencies proved difficult. The little data that were available often only included explicit expenditures earmarked for research—such as the operating costs associated with university research or project funds received from external sources—rather than a comprehensive accounting of the costs, including salaries, rent, and utilities appropriately prorated to reflect the share of total faculty time spent on research. To redress these problems, an estimate of total expenditures for the higher education sector was calculated using the average expenditures per researcher for the government agencies scaled according to the number of fte researchers employed in the higher education agencies in our sample.

Table 2—*Composition of agricultural R&D expenditures and researchers, 2002*

Type of agency	Total spending: 2000 Philippine pesos	Total spending: 2000 international dollars	Total researchers	Share: Spending	Share: Researchers	Agencies in sample[a]
	(*millions*)		(*fte's*)	(*percentage*)		(*number*)
Public agencies						
Government agencies[b,c]	1,513.2	137.7	2,070.7	51.1	52.6	80
Nonprofit agencies	21.3	1.9	17.0	0.7	0.4	1
Higher education agencies[d,e]	896.4	81.6	1,227.7	30.3	31.2	159
Subtotal public	*2,430.9*	*221.2*	*3,315.5*	*82.1*	*84.2*	*240*
Private agencies						
Recorded	459.8	41.9	540.5			19
Estimated omitted agencies[f]	69.0	6.3	81.1			n.a.
Subtotal private	*528.8*	*48.1*	*621.6*	*17.9*	*15.8*	*n.a.*
Total	*2,959.7*	*269.3*	*3,937.0*	*100*	*100*	*259+*

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

[a] See Appendix D for a list of the 259 agencies included in our survey sample.

[b] The Autonomous Region of Muslim Mindanao Integrated Agricultural Research Center (ARMMIARC) is included in the government agencies.

[c] Expenditures for a number of government agencies are estimates based on average expenditures per researcher at the remaining government agencies. Staff at the government agencies spent between 10 and 100 percent of their time on research, resulting in 2,070.7 fte researchers.

[d] Estimates were made for 11 higher education agencies for which information was not available. These agencies are the University of La Sallette (Region II), Silliman University (Region VII), the University of the Philippines–Cebu College (Region VII), Occidental Mindoro National College (Region IV), Romblon State College (Region IV), José Rizal Memorial State College (Region IV), Zamboanga del Sur Agricultural College (Region IX), Aklan State University (Region VI), Northern Iloilo Polytechnic State College (Region VI), Western Visayas College of Science and Technology (Region VI), and West Visayas State University (Region VI).

[e] 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 100 percent of their time on research, resulting in 1,227.7 fte researchers.

[f] Expenditures for eight private enterprises are estimates based on average expenditures per researcher for the private enterprises for which data were available. We estimated that our sample included about 85 percent of the fte research staff and spending performed in the private (for profit) sector.

National Government Agencies

The Ecosystems Research and Development Bureau (ERDB) under DENR is the largest national government agency in terms of agricultural research staff and expenditures.[8,9] As the principal research unit under DENR, ERDB is responsible for assembling research results, scientific information, and technologies on the management of various ecosystems and natural resources. In 2002, ERDB's 198 fte researchers worked on issues related to forests, grassland and degraded areas, upland farms, coastal and freshwater areas, and urban ecosystems. ERDB is housed at the forestry campus of UPLB, where it operates laboratories focusing on chemistry, genetics and tissue culture, botany, seed, soil, entomology, and zoology (ERDB 2005).

The Bureau of Agricultural Statistics (BAS) under DA collects, processes, analyzes, and disseminates official statistics on agriculture and fisheries in the Philippines. The bureau plays an important role in enhancing agricultural development by providing the necessary data support for the formulation of plans and policies aimed at promoting agricultural growth (BAS 2005). In 2002, BAS employed 103 fte researchers focusing largely on the development of early warning systems for agricultural commodities, the improvement of rice and corn production, and cost and returns surveys for various crops and fish.

The Bureau of Soils and Water Management (BSWM) under DA advises and renders technical assistance on matters relating to soil and water use. It formulates measures and guidelines for effective soil, land, and water resources utilization. In 2002, BSWM's 98 fte researchers conducted soil and water resources research. The National Fisheries Research and Development Institute (NFRDI) under DA conducts fisheries and marine research, as well as some related social research, on behalf of the Bureau of Fisheries and Aquatic Resources (BFAR). In 2002, NFRDI employed 67 fte researchers. The Bureau of Postharvest Research and Extension (BPRE), formerly the National Postharvest Institute for Research and Extension (NAPHIRE), was established in 1978 and has been administered by DA since 1986. The bureau's researchers (50 fte's in 2002)

[8] See Appendix D for a complete list of government agencies included in our survey sample.

[9] National government agencies are those with a nationwide mandate. Typically, they are based in Metro Manila; are administered by DA, DENR, or DOST; and are responsible for the planning, programming, and coordination of R&D projects.

focus on postharvest interventions related to crops, fisheries, and livestock.

The remaining four national government agencies—BFAR, the Food and Nutrition Research Institute (FNRI), the National Irrigation Authority (NIA), and the Philippine Textile Research Institute (PTRI)—each employed 20 or fewer fte researchers in 2002. The Bureau of Agricultural Research (BAR) is charged with ensuring that agricultural R&D is coordinated and undertaken to meet the needs and objectives of the Philippine agricultural sector. BAR coordinates and funds agricultural R&D activities, develops partnerships with local and international research organizations, strengthens institutional capabilities, manages knowledge, and advocates policies to improve the governance of agriculture and fisheries.[10]

Regional Government Agencies

As previously mentioned, the Philippines is subdivided into 15 administrative regions, 14 of which fall under the influence of PCARRD.[11,12] Each region hosts between three and nine government agencies. Some of these are specific to a single region, whereas others operate across regions. Each region (with the exception of Cordillera Administrative Region) has its own regional integrated agricultural research center (RIARC) under DA. Some RIARCs, however, have multiple locations. In addition, the RIARCs operate 67 research outreach stations (ROSES). In certain regions, ROSES perform purely extension functions. RIARCs have specific agroclimatic objectives and hence organize their research programs following a farming system's approach. RIARCs vary largely in size, from the Central Visayas Integrated Agricultural Research Center (CENVIARC) in Region VII, which employed 76 fte researchers in 2002, to the Central Luzon Integrated Agricultural Research Center (CLIARC) in Region III, which employed only 4 fte researchers that year. Staff at CLIARC are largely involved in coordinating and monitoring research but conduct only limited research themselves. Although there are

[10] Since BAR does not conduct agricultural R&D itself, it is excluded from further analysis in this report.

[11] See Appendix C for a complete list of government agencies included in our survey sample.

[12] Unlike the national government agencies, most regional government agencies are directly involved in R&D programs and projects. These regional government agencies include research institutes and centers, experiment sites, and laboratory/testing areas directly serving beneficiaries like farmers and fishermen in these regions. It is important to note that this study considers agencies like PhilRice, PCC, PCA, and FIDA to be regional government agencies. Strictly speaking, they are NSCRDCs, but because they operate separate research centers in many of the Philippines' individual regions, we collected survey data for these agencies at the regional level.

exceptions, the RIARCs are typically the largest agencies in each region. Together, the 13 RIARCs employed 503 fte researchers in 2002. In addition to the RIARCs, each region also operates an Ecosystem Research and Development Service (ERDS)—the regional equivalent of ERDB. Like ERDB, the ERDSs are administered by DENR. In each region, ERDS verifies promising research results from ERDB of relevance to the region, after which technologies are fine-tuned for application or adaptation to local conditions. In 2002, the 14 ERDSs employed a combined total of 213 fte researchers.

The Philippine Carabao Center (PCC) was established in 1992 and became fully operational in 1993. The center is mandated to conserve, propagate, and promote the carabao as a beneficial source of draft animal power, meat, milk, and hide for rural Philippine farmers (PCC 2003). PCC is headquartered in Muñoz in Nueva Ecija (Central Luzon) alongside the CLSU campus. The center also operates 11 centers across the country, each of which is attached to a regional university. PCC in Ilocos (Region I), for example, is attached to the Don Mariano Marcos Memorial State University (DMMMSU) and PCC in Southern Tagalog (Region IV) is attached to UPLB. Fte researcher totals differ from center to center but in 2002 totaled 98.

PhilRice under DA is a government-owned and controlled corporation mandated to develop high-yielding rice technologies. Its interdisciplinary programs include direct-seeded rice, transplanted irrigated lowland rice, hybrid rice, rice-based farming systems for fragile environments, rice-based products, and policy research, advocacy, and technology promotion related to rice. With these programs, PhilRice aims to develop and promote technologies that are ecosystem-based, location- and problem-specific, and profitable to Philippine farmers. In addition to its headquarters in Muñoz, the institute operates five seed centers nationwide (Ilocos Norte, Region I; Isabela, Region II; Laguna, Region IV; Agusan del Norte, Region X; and North Cotabato, Region XII). In 2002, PhilRice employed 352 fte researchers nationwide.

The Fiber Industry Development Authority (FIDA) under DA was established in 1981, replacing the Abaca Industry Development Authority (AIDA) and the Bureau of Fiber and Inspection Service (BFIS). FIDA promotes the accelerated growth and development of the Philippine fiber industry, including research, production, processing, marketing, and trade regulation. In 2002, FIDA employed 15 fte researchers scattered

across Regions V, VII, IX, and XI. FIDA offices in other regions are primarily involved in extension rather than agricultural R&D.

The Philippine Coconut Authority (PCA) is an international authority focusing on coconut tissue, embryo culture, and coconut biotechnology. Given the importance of coconut products to Philippine exports, coconut research is an important aspect of PCA's work. In 2002, PCA employed 40 fte researchers located in three regions.

The remaining regional government agencies vary in character, research focus, and structure (see Appendix D.1).

Higher Education Agencies[13]

As previously mentioned, four Philippine universities have multi-commodity center status under the NARRDN, and all regional consortia are based at the principal university or state college in each region. State colleges and universities are chartered public higher education institutions established by law, and administered and subsidized by the government. State colleges are normally specialized in certain fields of study and thus offer closely related degrees, although some colleges may offer a few non-allied courses. Universities are generally larger than state colleges and typically comprise several colleges.

Despite the large number of higher education agencies involved in agricultural research in the Philippines, the individual capacity of the majority of them—in terms of fte researcher numbers—is very small. With the exception of the national multi-commodity centers, faculty staff at most higher education agencies spend only a small share of their time on research; teaching is still the main activity for most.

The University of the Philippines System comprises seven autonomous universities located on 10 campuses around the country. Three of these universities have an agricultural focus: UPLB, UPV, and the University of the Philippines in Mindanao (UP Mindanao). UPLB is by far the largest of these and plays a central role in the Philippine agricultural R&D system. The university was established in 1909 with the mandate of providing national leadership in research, training, and extension in agriculture and forestry. Over the years, the university has developed into an internationally renowned agricultural training and research center. It has a combined area

[13] See Appendix D for a complete list of all higher-education agencies included in our survey sample.

of nearly 15,000 hectares, which includes experiment farms and forest reserves. Agricultural R&D at UPLB is undertaken at 26 units within the College of Agriculture (CA), the College of Forestry and Natural Resources (CFNR), the College of Engineering and Agro-Industrial Technology (CEAT), the College of Veterinary Medicine (CVM), the College of Arts and Sciences (CAS), the School of Environmental Science and Management (SESAM), and the National Institute of Molecular Biology and Biotechnology (BIOTECH). In 2002, these 26 agencies employed 261 fte researchers. UPV is much smaller. In 2002, 32 fte researchers were employed within five units at this Iloilo-based university, concentrating mainly on fisheries and aquatic resources. UP Mindanao was established in 1995, making it the youngest university in the University of the Philippines System. Nine fte researchers at two colleges concentrated largely on crop, livestock, and postharvest research.

Other major agricultural universities include MMSU, LSU, DMMMSU, and the Mindanao State University (MSU), all of which employed 25 or more fte's in agricultural research in 2002. MMSU, located in Ilocos Norte (Region I) has three units involved in agricultural R&D, which collectively employed 66 fte researchers in 2002. The 65 fte researchers at LSU in Baybay in the Visayas (Region VIII) were spread across nine units and focused primarily on root crops, abaca, and coconuts. LSU is currently broadening its activities incorporating agricultural and industrial biotechnology and information technology into its research agenda, as mandated under the Agriculture and Fisheries Modernization Act.[14] In 2002, 31 fte researchers were active at the La Union-based DMMMSU in Ilocos Sur (Region I). The university has three campuses: one in North La Union, one in Mid La Union, and one in South La Union. Sericulture and apiculture research is prominent at DMMMSU. The MSU system consists of seven autonomous campuses in strategic locations across Mindanao (Regions IX, X, and XII). The main campus is in Marawi City, but most agricultural research activities are undertaken by the Institute of Fisheries Research and Development (IFRD), in Nawaan, and the Iligan Institute of Technology (IIT)—both in Northern Mindanao (Region X). The university

[14] The main objective of the 1997 Act was to modernize the agriculture and fisheries sectors. This involved shifting from a resource-based to a technology-based focus and enhancing incomes and profits, particularly for small farmers and fishers.

employed 28 fte's in agricultural research in 2002. That year, the remaining higher education agencies each employed 25 of fewer fte's in agricultural research based in locations throughout the archipelago.

Nonprofit Agencies

Only one nonprofit agency was identified as conducting agricultural research in the Philippines, accounting for a negligible share of total agricultural research staff and expenditures in 2002. The Philippine Sugar Research Institute Foundation (PHILSURIN) was established in 1997 when it acquired the sugarcane development unit of Victorias Milling Company. The agency aims to provide appropriate and cost-effective R&D support to the Philippine sugar industry to both improve its competitiveness and enable the industry to attain self-sufficiency. PHILSURIN employed 17 fte researchers in 2002.

Private-Sector Agencies

Our survey sample includes 19 business enterprises, including both locally owned and foreign companies. Private agricultural R&D in the Philippines is discussed separately later in this report.

International Linkages and Cooperation

Philippine agricultural R&D agencies collaborate at national, regional, and international levels. PCARRD maintains linkages with the private sector primarily in the areas of staff training, project monitoring and evaluation, technical assistance, publication sales, technology promotion, and the distribution of plant materials. Most international collaborations involve the exchange of expertise, germplasm, technologies, and research findings; the provision of funding and technical assistance; the development of human resources; and the supply of equipment. Relationships with international agencies are formalized through memoranda of agreement or understanding (MOAs or MOUs) and implemented through official workplans (Del Rosario 1999). With the exception of the MOA with the Indian Council for Agricultural Research (ICAR), which was signed in 1976, all PCARRD partnerships with other principal agricultural research agencies in Asia were established in the early 1990s. To date, PCARRD has instituted or at least initiated linkages with seven agencies: ICAR, the Bangladesh Agricultural Research Council (BARC), the Malaysian Agricultural Research and Development Institute (MARDI), the Pakistan Agricultural Research Council (PARC), the Indonesian Agency

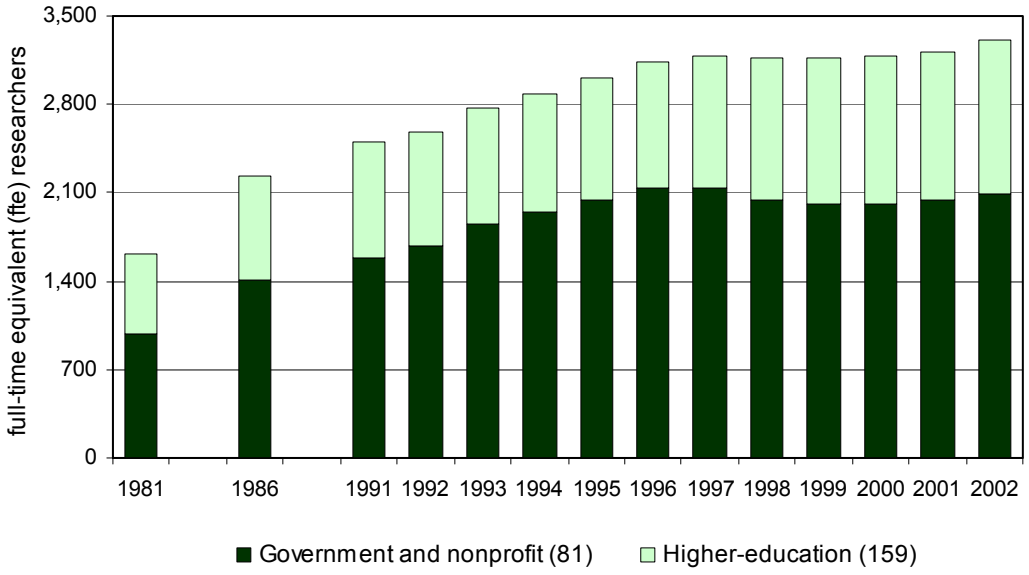
for Agricultural Research and Development (IAARD), the Japan International Research Center for Agricultural Sciences (JIRCAS), and the International Technical Cooperation Center–Rural Development Administration (ITCC-RDA, South Korea). PCARRD also maintains important ties with various international agricultural research centers, including the International Plant Genetic Resources Institute (IPGRI), the International Service for the Acquisition of Agri-biotech Applications (ISAAA), the International Livestock Research Institute (ILRI), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and the International Maize and Wheat Improvement Center (CIMMYT). PCARRD also maintains links with the Australian Centre for International Agricultural Research (ACIAR), the Commonwealth Scientific and Industrial Resources Organization (CSIRO), the International Development Research Centre (IDRC), the Food and Fertilizer Technology Center (FFTC), and the Center of International Agricultural Research Cooperation for Development (CIRAD, France). In establishing these partnerships, PCARRD carefully reviews the needs of the prospective partners, as well as assessing the availability of experts and facilities in the partner country.

In addition to these PCARRD–level linkages, important cooperation also occurs at the agency-level. PhilRice, for example, reported widespread collaboration with the Los Baños-headquartered International Rice Research Institute (IRRI), the International Foundations for Science (IFS), and a large number of foreign and Philippine universities. In addition, PCC works closely with the Food and Agriculture Organization of the United Nations (FAO), the Japan International Cooperating Agency (JICA), and the Philippine universities that host PCC laboratories in the regions. UPLB maintains close ties with ERDB, IRRI, the International Potato Center (CIP), and many foreign universities.

HUMAN RESOURCES IN PUBLIC AGRICULTURAL R&D

During 1981–2002, the total number of agricultural researchers in a sample of 231 public agencies grew by 3.4 percent per year on average (Figure 1). More specifically, agricultural researcher numbers grew rapidly from 1981 to 1996, but largely stalled thereafter, with shares at the government and higher education agencies remaining relatively stable at about two-thirds and one-third, respectively.

Figure 1—*Composition of public agricultural researchers, 1981–2002*



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

Notes: See Table 2. Figures in parentheses indicate the number of agencies in each category. The category "Government and nonprofit" consists of 80 government agencies and 1 nonprofit agency. Expenditures for the higher education sector in our sample are estimates based on average expenditures per researcher at the government agencies. Underlying data are available at the ASTI website (www.asti.cgiar.org).

The distribution of the 247 R&D units in our sample is skewed toward agencies with fewer than 5 fte researchers: more than 40 percent of the agricultural agencies fall within this category (Table 3). Most government agencies, however, employed 10–19 fte researchers. In 2002, just one public agricultural research agency employed more than 200 fte researchers (PhilRice, with 282 fte's), while two employed between 100 and 200 fte researchers. The individual capacity of the majority of higher education units remains very small. More than half of the 148 higher education units—many being university faculties and departments—employed fewer than 5 fte researchers. The research capacity

of many private sector agencies is also small: of the 19 identified agencies in our sample, 7 employed less than 5 fte researchers.

Table 3—*Size distribution of agricultural R&D agencies, 2002*

Number of fte researchers	Government	Higher education	Nonprofit	Private	Total
			(*number of agencies*)		
Less than 5	14	82	0	7	103
5–9	14	30	0	3	47
10–19	23	24	1	3	51
20–49	16	10	0	4	30
50–99	9	2	0	0	11
100–200	2	0	0	2	4
Greater than 200	1	0	0	0	1
Total	*79*	*148*	*1*	*19*	*247*

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

Note: Includes regional sub-agencies and higher education faculties and units.

The aforementioned aggregates mask important differences within categories (Table 4). Total researcher numbers at BPRE and BAS, for example, roughly tripled during 1981–2002 because of the implementation of significant new research programs at each of these agencies. NIA, BSWM, and PTRI, on the other hand, experienced reductions in total researcher numbers throughout this period as a result of a growing focus on technology transfer (as opposed to research) and the completion of many sizable research programs. Among the regional government agencies, PhilRice grew the fastest in terms of researcher numbers. The agency experienced tremendous growth in its first decade (1985–94), but researcher numbers fell sharply from 1997 onward due to declining government funding. Total staff at the 14 RIARCs and 14 ERDS also rose steadily from 1981 until 1996, but like many other agencies in the country they have shown little (or negative) growth in recent years due to funding constraints stemming from the Asian financial crisis of 1997.

Table 4—*Long-term composition of agricultural R&D staff of national and regional government agencies, 1981, 1991, and 2002*

Agency	Agricultural research staff			Annual growth rate	
	1981	1991	2002	1981–91	1991–2002
	(fte researchers)			*(percentages)*	
Federal government agencies (9)	437.8	464.8	569.6	0.6	1.9
Regional government agencies					
RIARCs-DA (13)	166.0	295.4	502.6	5.8	4.0
ERDS-DENR (14)	83.6	197.8	212.6	9.6	0.8
FIDA (4)	11.2	16.3	14.6	3.9	–0.7
PCA (3)	42.0	50.0	40.0	1.9	–2.4
PHILRICE (6)	10.7	269.2	351.7	47.6	1.0
PCC (12)	–	–	98.4	–	–
BPI (5)	59.1	56.9	87.0	–0.4	3.5
CODA (3)	17.9	26.9	7.8	4.0	–12.4
Other regional (10)	150.3	195.3	174.4	2.6	–0.9
Subtotal (70)	540.8	1,107.8	1,489.2	7.9	1.9
Total (79)	*978.5*	*1,572.6*	*2,058.7*	*5.0*	*1.9*

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

Notes: See Appendix D.1 for a full list of agencies included in each category. The numbers in parentheses indicate the number of agencies in each category. Annual growth rates were calculated using the least-squares regression method, which takes into account all observations in a period. This results in growth rates that reflect general trends that are not disproportionately influenced by exceptional values, especially at the end point of the period.

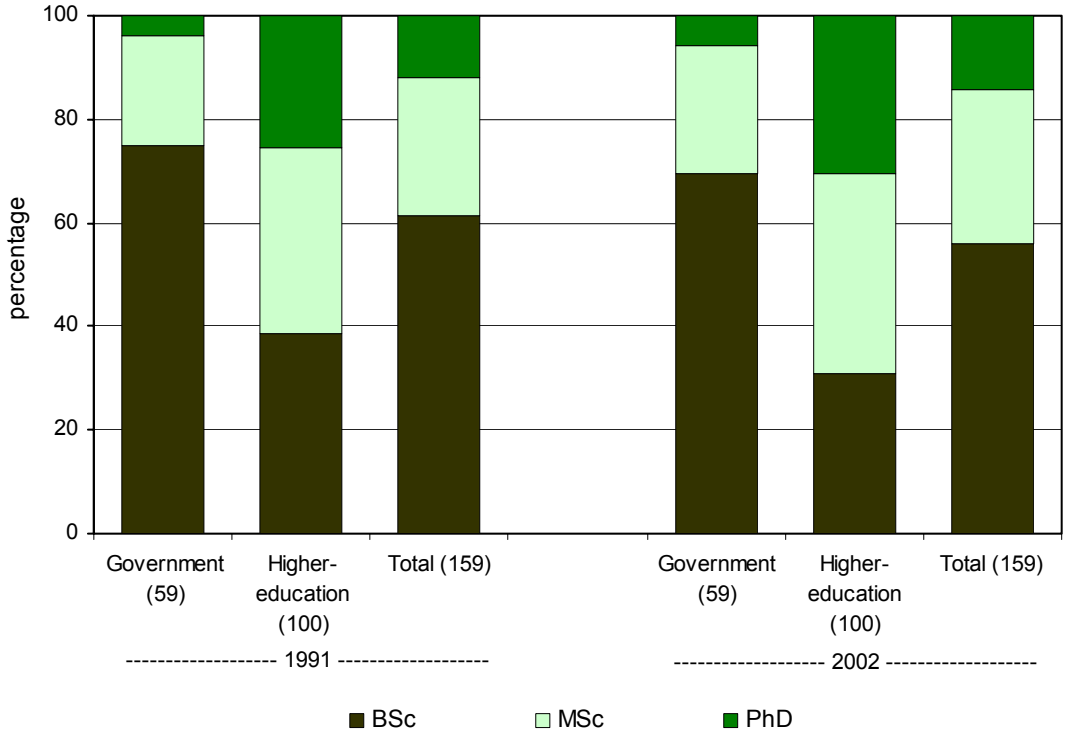
Looking at the agencies by region, Southern Tagalog (Region IV))— home to the country's principal agricultural university (UPLB)—is the largest region in terms of agricultural research staff (Appendix E.1). In 2002, 493 fte researchers (or close to one-fifth of the Philippine total) were active in this region. With 397 and 259 fte researchers, respectively, Central Luzon (Region III) and Ilocos (Region I) were the second- and third-largest regions in terms of researcher numbers, primarily due to the presence of other large agricultural universities. The remaining regions employed between 100 and 200 fte researchers in 2002, with the exception of Caraga (Region XIII) (42 fte), which was not established until 1996. The regional distribution of agricultural R&D by higher education agencies did not change much between 1981 and 2002. However, at the government level, important shifts were reported. Central Luzon (Region III) accounted for just 1 percent of regional agricultural R&D conducted by government agencies in 1981. By 2002, this share had risen to 22 percent, mainly due to the establishment of PhilRice and PCC headquarters in this region. In contrast, the share of government-based agricultural R&D in Southern Tagalog (Region IV) fell by half, from 24 to 12 percent

during 1981–2002, despite an increase in the total number of fte researchers in this region over this period.

Degree Status

In 2002, 14 percent of the 2,349 fte researchers in a 159-agency sample of public agricultural R&D agencies held PhD degrees, 30 percent held MSc degrees, and 56 percent held BSc degrees (Figure 2). The share of Philippine researchers trained to the postgraduate level (MSc or PhD) is much lower than the comparable share for Malaysia (69 percent) and Indonesia (55 percent), but higher than shares in other countries in the region, such as Vietnam (36 percent) (Stads et al. 2005; Stads et al. 2007; Stads and Nguyen 2006).

Figure 2—*Educational attainment of research staff by institutional category, 1991 and 2002*



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

Overall, the degree levels of agricultural researchers in the Philippines increased throughout 1991–2002. In 2002, 44 percent of the researchers in a 159-agency sample held postgraduate degrees (MSc or PhD) compared with just 39 percent in 1991. It is a consistent finding worldwide that higher education agencies in developing countries have higher shares of researchers with postgraduate degrees compared with the principal government agencies, and the Philippines is no exception. In 2002, close to 70 percent of researchers in the higher education agencies held MSc or PhD degrees compared with only 31 percent in the government agencies. Nevertheless, a wide gap was reported among agencies in the higher education sector. For example, UPLB alone employed half of the 250 PhD-qualified fte researchers employed in the higher education sector in 2002. Further, almost half the scientists employed at UPLB were PhD-qualified, which is much higher than the average share for the sector as a whole (32 percent). Similarly, in the government sector, PCC had a higher average share of staff trained to the PhD level.

PCARRD has implemented a capacity-development program since 1973 to address the shortage of well-trained staff in agricultural R&D, reduce the disparity in staff qualifications across the country's institutions and regions, and prepare the regional and local research stations to take on a more active role in rural development. Degree and nondegree level training is provided as part of the capacity-development program. By 2004, the council's Human Resource Development Program (HRDP) had provided 758 scholarship grants to recipients throughout the agencies represented by NARRDN. About 25 percent of the grants went to the national multi-commodity R&D centers, 17 percent to the national single-commodity R&D centers, 18 percent to the regional R&D centers, and 17 percent to cooperating stations; the remaining grants went to specialized agencies and other institutions (PCARRD 2004). The most significant period of development under HRDP was the implementation of the USAID-funded Agricultural Research Development Project (ARDP). The first phase of this project (1976–80) awarded 295 scholarships, while the second phase (1980–86) awarded 265. These numbers fell sharply, however, after the termination of ARDP (PCARRD 2004). Roughly three-quarters of the scientists that participated in HRDP received MSc training, about one-fifth received PhD-level training, and the remainder received BSc training.

Other national and international agencies also support degree-level training in the

Philippines and abroad. During 1993–97, various DOST programs were implemented to build the capacity of S&T staff through the provision of scholarship grants. A total of 5,651 scientists were assisted under the Engineering and Science Education Program (ESEP) in 1997, while between 200 and 600 undergraduates per year were supported under the S&T Scholarship Act of 1994 during 1994-2001. The scholarships were distributed throughout the country's regions.

These national-level training programs have made a significant contribution to improving the qualifications of Philippines scientists. In addition, individual R&D agencies such as PhilRice, UPLB, and the RIARCs also stimulate degree-level training for their scientists, either in the Philippines or abroad, depending on funding availability. Most scientists pursue training at Philippine universities, although many have undertaken degree-level training in Australia, Japan, the United States, and Europe either as institution-based scholars or as a result of project-related scholarships. PhilRice, for example, implemented its own staff development program in 1988 (largely financed by the Japanese government). As part of this program, about 70 PhilRice scientists received degree- and nondegree-level training, mainly at UPLB. Five PhilRice scientists were sent to Japan for training in the 1990s for periods ranging from two to nine months.

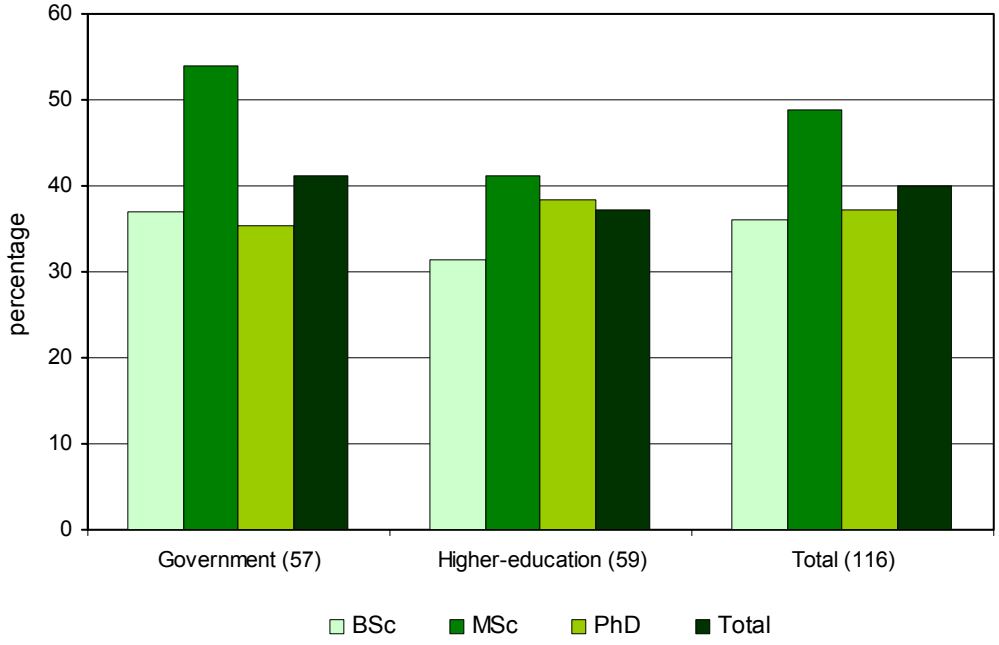
About 70 percent of postgraduate degrees of Philippine public research staff were obtained in the Philippines. This ratio is lower for PhD degrees and as high as 80 percent for MSc degrees. Not surprisingly, UPLB is the single largest source of graduate training for Philippine agricultural researchers. The contributions of other local universities are far lower. By the end of the 1990s, more than two-fifths of PhD degrees in agriculture were obtained from foreign universities, predominantly in the United States (about half), Japan, and Australia (David et al. 1998).

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). The Philippines is something of an exception to this rule, since women have traditionally held important positions in the country. Philippine society has greater gender equality than other parts of Southeast Asia. Education and literacy levels in the

late 1990s were higher for women than for men, and the country has one of the highest ratios of female agricultural researcher in the world. In 2002, based on a sample of 116 agencies, 40 percent of all researchers in the Philippines were female (Figure 3).[15] By comparison, the corresponding ratios for Malaysia, Vietnam, and Indonesia were 34, 31, and 28 percent, respectively, during the same year (Stads et al. 2005; Stads and Nguyen 2006; Stads et al. 2007). In 2002, nearly half the Philippine researchers were qualified to the MSc level were female, while the shares of female researchers with PhD and BSc degrees were 37 and 36 percent, respectively. Notably, the national government agencies employed comparatively fewer female researchers than their regionally based counterparts, while the government agencies employed moderately higher numbers of female researchers (41 percent) than the higher education agencies (37 percent).

Figure 3—*Share of female researchers, 2002*

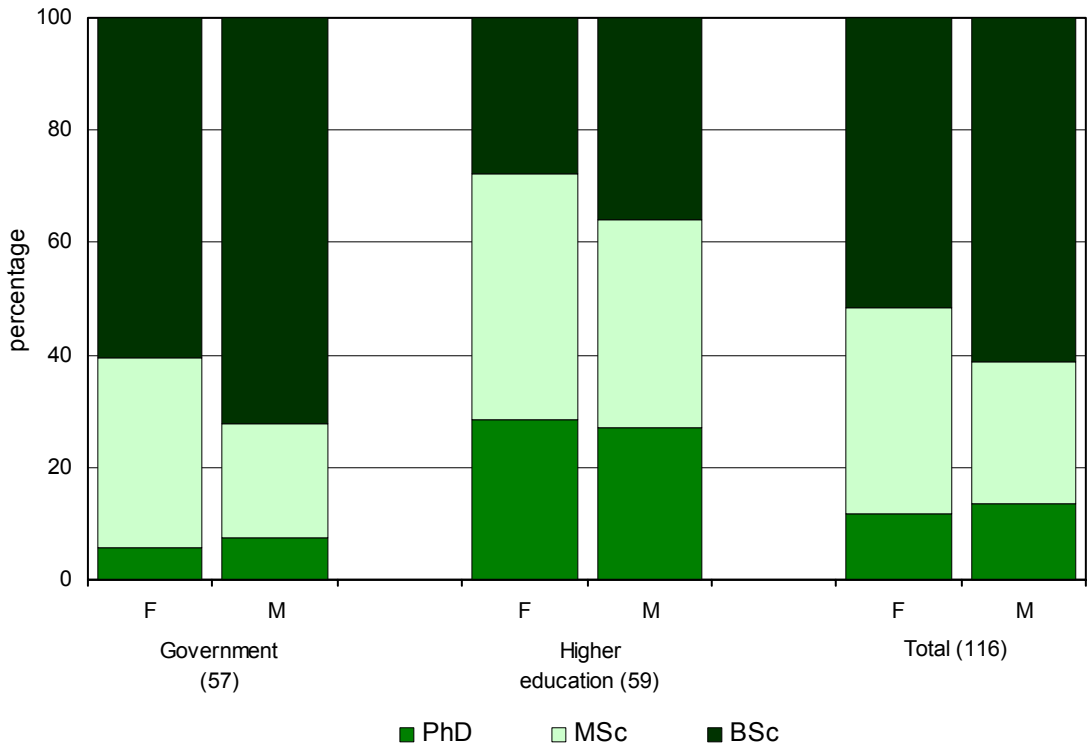


Source: Compiled by authors from ASTI survey data (IFPRI–PCARRD 200305).
Note: Figures in parentheses indicate the number of agencies in each category.

[15] A 1995 study found that 54 percent of agricultural research staff in the Philippines was female, and that women were increasingly replacing men who were leaving the public sector for career opportunities in the private sector (Brush et al. 1995). The share reported in our study is substantially lower, which can potentially be explained by the larger number of agencies included in the survey sample.

It also warrants mention, however, that the share of female researchers with postgraduate degrees (MSc or PhD) is higher than the corresponding share of male researchers with postgraduate degrees in all three subcategories. In 2002, 48 percent of all female researchers in the Philippines were trained to the postgraduate level compared with just 39 percent of male researchers (Figure 4). The share of men holding PhD degrees, however, at 13 percent, was slightly higher than the corresponding share for women that year (12 percent).

Figure 4—*Degree levels of male and female researchers, 2002*

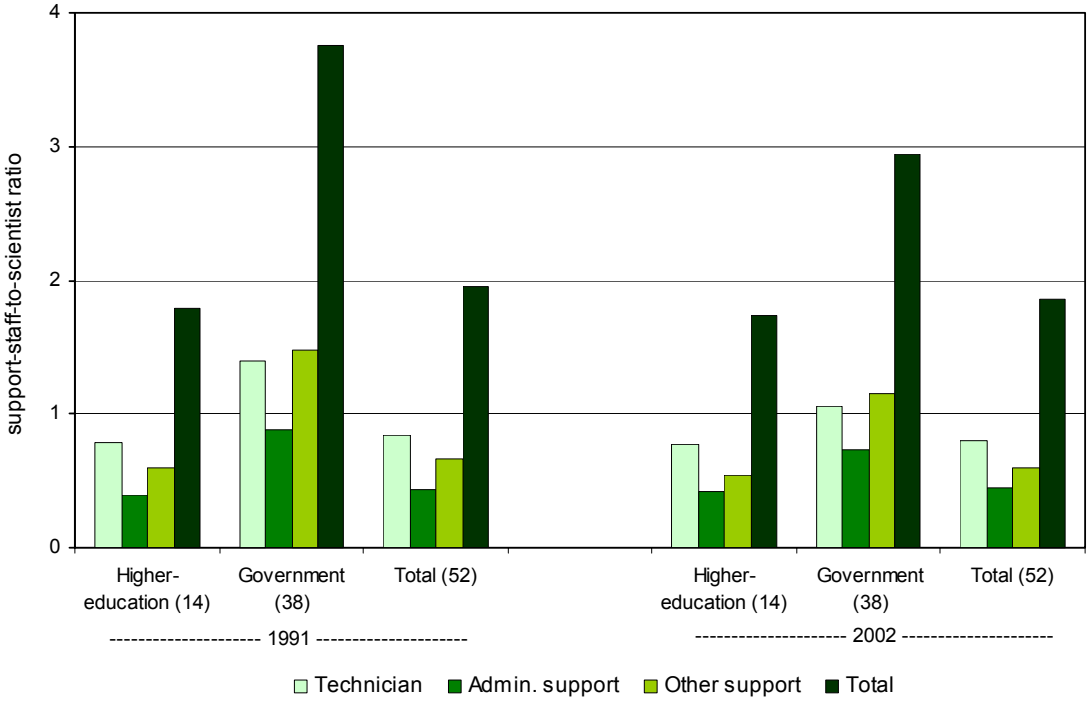


Source: Compiled by authors from ASTI survey data (IFPRI–PCARRD 2003–05).
Note: Figures in parentheses indicate the number of agencies in each category.

Support Staff

In 2002, the average number of support staff per scientist in a 52-agency sample of government agencies was 1.9—comprising 0.8 fte technicians, 0.5 fte administrative personnel, and 0.6 fte other support staff such as laborers, guards, drivers, and so on (Figure 5). Eleven years earlier, in 1991, the support-staff-to-researcher ratio in the Philippines was marginally higher (2.0).

Figure 5—*Support-staff-to-researcher ratios, 1991 and 2002*

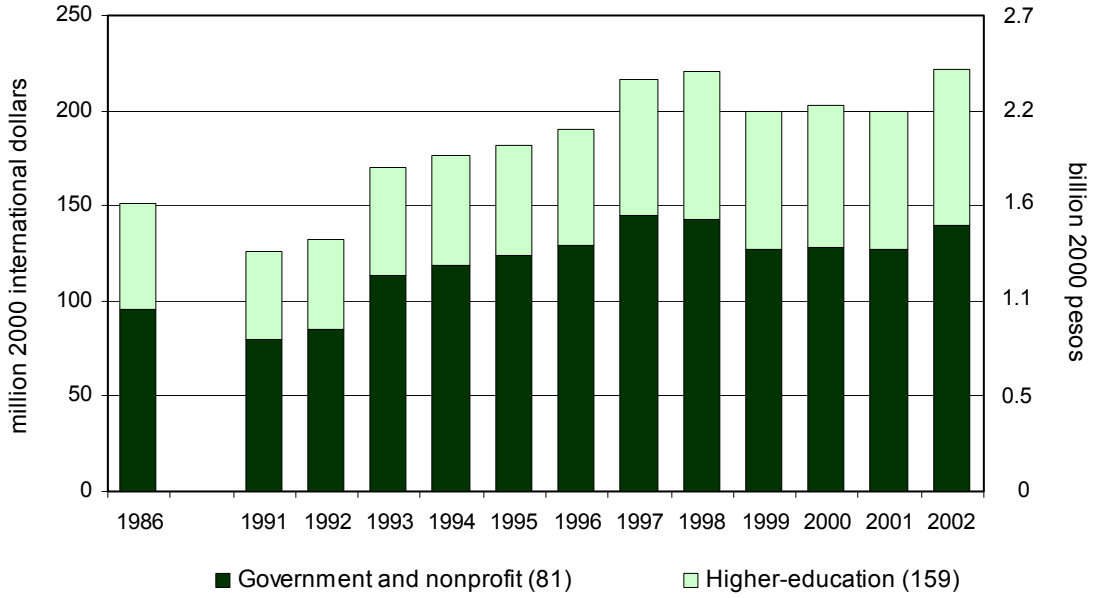


Source: Compiled by authors from ASTI survey data (IFPRI–PCARRD 2003–05).
Note: Figures in parentheses indicate the number of agencies in each category.

PUBLIC AGRICULTURAL R&D INVESTMENT TRENDS

Agricultural R&D investments for our sample of 228 agencies (excluding the private sector) grew substantially during 1986–2002 at an average rate of 4.7 percent per year (Figure 6). Total spending levels declined slightly during 1986–91, as a result of the fiscal restraint implemented by the Aquino administration when it took over in 1986 after years of economic crisis under President Marcos. However, R&D expenditures rose rapidly in the early 1990s when PCC was founded and PhilRice intensified its research spending. In 1992, public agricultural R&D expenditures in the Philippines totaled $128 million. Five years later, this level had increased to $210 million, after which it stabilized somewhat. Government spending was particularly high during 1997–98 as a result of high operating and capital spending at national government agencies such as BSWM and ERDB–DENR. Nonetheless, spending by national government agencies fell sharply during 1986–2002. This fall was offset by a steady rise in expenditures by the regional government agencies.

Figure 6—*Composition of public agricultural R&D spending, 1986–2002*



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

Notes: See Table 2. Figures in parentheses indicate the number of agencies in each category. The category "Government and nonprofit" consists of 80 government agencies and 1 nonprofit agency. Expenditures for the higher education sector in our sample are estimates based on average expenditures per researcher at the government agencies. Underlying data are available at the ASTI website (www.asti.cgiar.org).

Once again, the average annual growth rates by institutional category mask important differences among the agencies in each category. NIA was the only national government agency to experience consistent growth in agricultural R&D expenditures throughout 1986–2002 due to a change of the agency's charter, widening its authority. ERDB–DENR, BSWM, BFAR, and NFRDI, on the other hand, all reported negative spending growth, in excess of 10 percent per year, due to a decline in funding from the central government. In 2002, ERDB–DENR had the highest agricultural R&D expenditures of the national government agencies ($6.2 million), followed by BPRI ($4 million), and BSWM ($4 million). The RIARCs and ERDS reported steady spending growth. Agricultural R&D spending by the 14 RIARCs totaled $28.1 million in 2002, while the 14 ERDS spent a total of $8.7 million that year (Table 5). The single largest funding allocation to a Philippine research agency was received by PhilRice, which is unsurprising given the importance of rice to the country's agricultural sector. Total spending at PhilRice doubled during 1996–2002 and totaled $41.9 million in 2002. The

relatively high allocation of funding to PCC, on the other hand, is somewhat surprising, given the relatively limited importance of carabao to the Philippine agricultural sector. The center's capital investments were high during the first three years of its operation (1993–96) but fell subsequently, explaining the drop in total PCC spending. The capacity for generating resources on the part of the leaders of PhilRice and PCC has also contributed to the high capital investments of their respective agencies. In 2002, the 12 PCC centers combined spent $15.8 million. The four FIDA agencies and three PCA agencies experienced declining spending growth rate in excess of 5 percent per year during 1996–2002.

Table 5—*Long-term composition of agricultural R&D spending of national and regional government agencies, 1991 and 2002*

Agency	Total spending		Annual growth rate
	1991	2002	1991–2002
	(in million 2000 international dollars)		*(percentages)*
Federal government agencies (9)	21.9	21.7	1.1
Regional government agencies			
RIARCs-DA (13)	18.4	28.1	3.3
ERDS-DENR (14)	5.7	8.7	3.3
FIDA (4)	0.6	0.5	–0.8
PCA (3)	5.8	5.2	–0.9
PHILRICE (6)	7.2	42.0	15.0
PCC (12)	—	15.8	—
BPI (5)	3.9	4.8	1.5
CODA (3)	1.0	1.1	2.4
Other regional agencies (10)	15.0	9.0	–4.2
Subtotal (70)	57.6	115.0	4.7
Total (79)	*79.5*	*136.8*	*4.4*

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

Notes: See Appendix D.1 for a full list of agencies included in each category. The numbers in parentheses indicate the number of agencies in each category. Annual growth rates were calculated using the least-squares regression method, which takes into account all observations in a period. This results in growth rates reflecting general trends that are not disproportionately influenced by exceptional values, especially at the end point of the period.

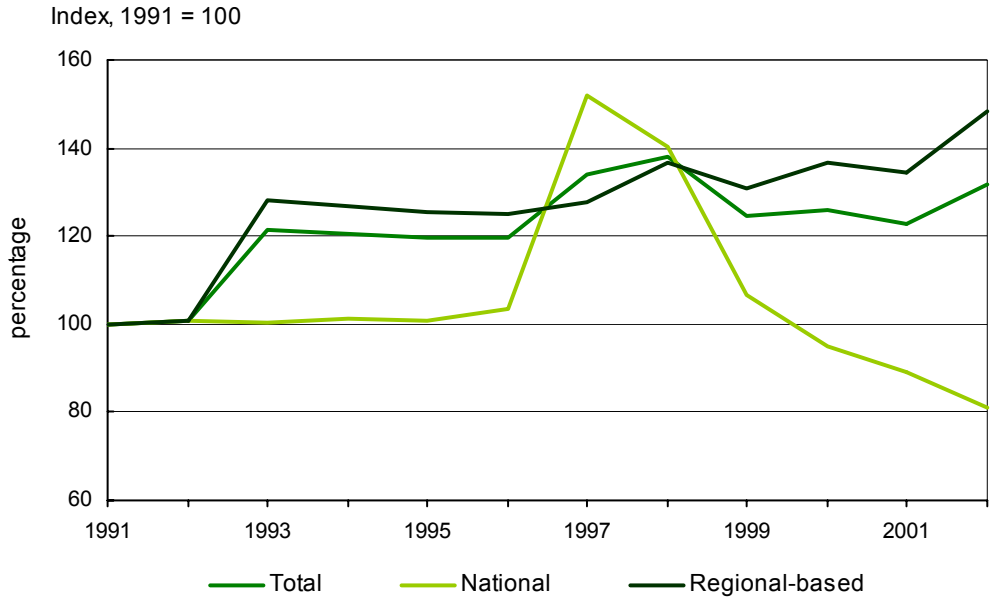
From a regional perspective, research spending was highly divergent (Appendix F). Though Southern Tagalog (Region IV) employed more fte researchers, Central Luzon (Region III) was the region with the highest expenditures in 2002, largely due to the high average spending rates at PCC and PhilRice compared with other government agencies. This region spent $43 million in 2002, compared with $33 million in Southern Tagalog

and $16 million in Ilocos (Region I). The remaining regions each spent between $4 million and $10 million in 2002.

Spending per Scientist

Agricultural R&D expenditures per researcher in the Philippines for an 80-agency sample excluding the higher education and private sector agencies rose from $51,000 in 1991 to $67,000 in 2002 (Figure 7). In 2002, average spending at the regional government agencies was considerably higher compared with their colleagues at the national government agencies. Average spending levels at the national government agencies were particularly high during 1997–98 due to important capital investments by BSWM, but fell rapidly thereafter. There were large differences in the 2002 spending-per-scientist levels among the various national and regional government agencies, ranging from $12,000 at BAS to $160,000 at PCC. Unsurprisingly, average 2002 spending levels per scientist also varied across regions. They were highest in Central Luzon (Region III) ($107,000) because both PCC and PhilRice are headquartered there. By comparison, average spending-per-scientist levels were only about half that amount in the Cordillera Administrative Region (Region CAR) the same year ($55,000).

Figure 7—*Trends in expenditures per researcher, 1991–2002*



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

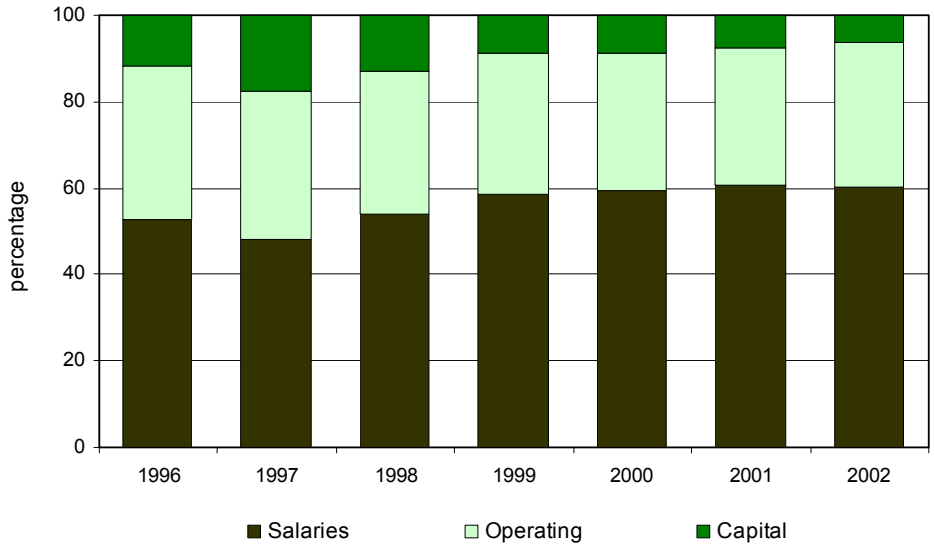
Notes: See Figure 1b. Total expenditures per researcher include the higher education sector.

Cost Structures

The allocation of research budgets across salaries, operating costs, and capital costs affects the efficiency of agricultural R&D; hence, detailed data on cost categories were collected as part of this study. In 2002, the 56 government agencies for which cost category data were available spent 61 percent on salaries, 33 percent on operating costs, and 6 percent on capital investments. Time series data were available for 38 of these 56 agencies. The cost structures for the government agencies were comparatively stable over the 1996–2002 period (Figure 8). The relatively lower salary shares in 1997 and 1998 reflect the substantial capital investments made by FNRI, BSWM, and PTRI during those years.

The exact budget allocated to each of the Philippine R&D agencies is centrally determined through annual general appropriations. The General Appropriations Act (GAA) specifies the amounts allocated to salaries, wages, and personnel benefits; maintenance and other operating expenses; and capital outlays for the implementation of various programs/projects in a given year. Before it can be implemented, the GAA needs to be passed by both the House of Representatives and the Senate. Further, a salary standardization law provides the salary rates for all government employees.

Figure 8—*Cost category shares of government agency expenditures, 2002*



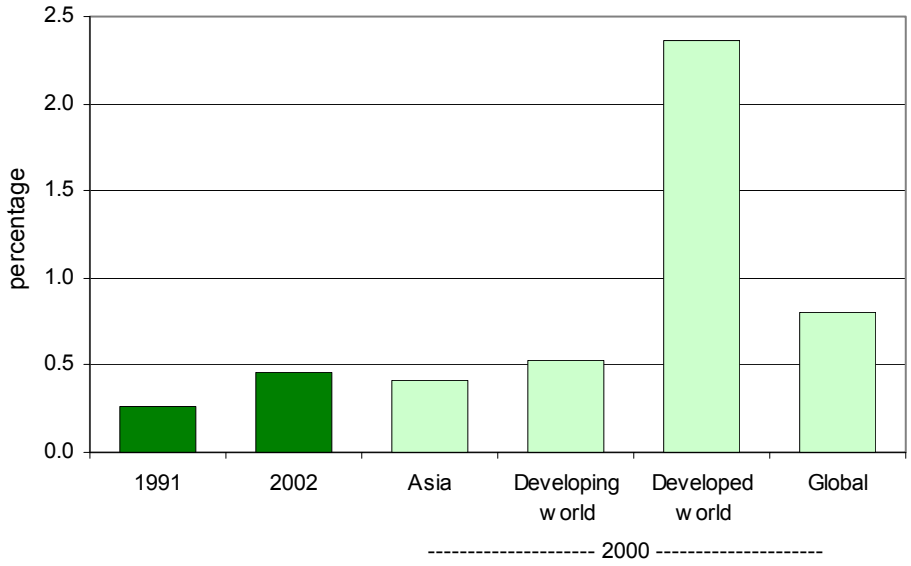
Source: Compiled by authors from ASTI survey data (IFPRI–PCARRD 2003–05).

Notes: Sample includes 38 government agencies (7 federal and 31 regional). Combined, these 38 agencies accounted for 88 percent of total government-sector spending in 2002.

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 agriculture R&D spending in an internationally comparable context. According to our estimates, adjusted for agencies missing from our sample, the public-sector intensity ratio for the Philippines was 0.46 percent in 2002 (Figure 9). If private-sector agricultural R&D investments were included, the 2002 intensity ratio would be about 0.54 percent. The intensity with which the Philippines invested in agricultural research in 2002 was higher than in Southeast Asian countries such as Vietnam (0.17), Indonesia (0.22), and Laos (0.24), but lower than in Malaysia (1.92), which is not surprising given that Malaysia has reached a much higher state of economic development than the other countries and an intensity ratio nearing the developed world average (2.36). The 2002 ratio for the Philippines was slightly above the overall average for Asia (0.41) in 2000, but lower than the corresponding ratio for the developing world as a whole (0.53) that year.

Figure 9—*Agricultural research intensity compared regionally and globally*



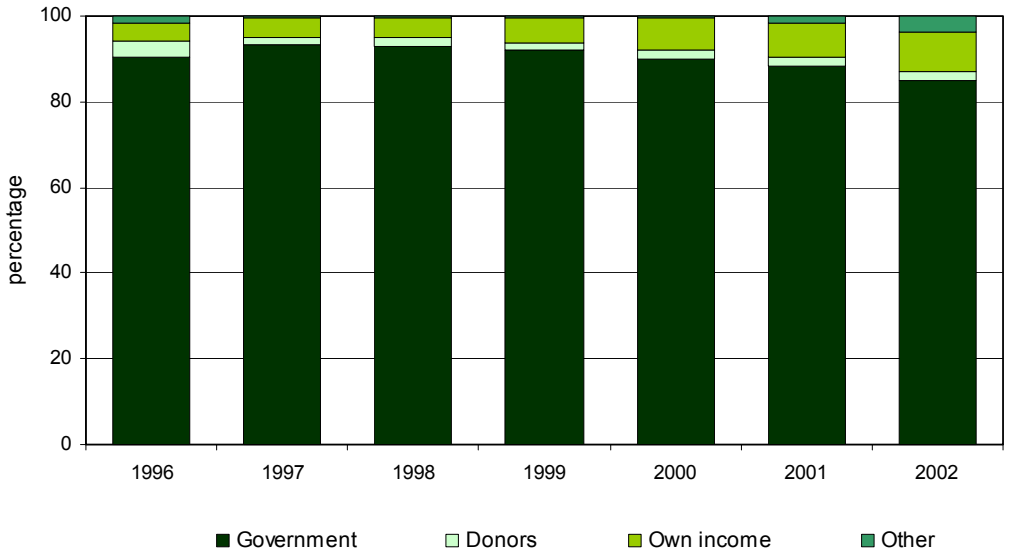
Sources: Philippine data were compiled from Table 2 and Figure 1b; AgGDP data are from World Bank (2005); Asia, developing world, and global data are from Pardey et al. (2006).

FINANCING PUBLIC AGRICULTURAL R&D

Over the past decade, funding for agricultural research in the Philippines has come from a number of sources, principally the national government, internally generated resources, and foreign donors. During 1996–2002, 90 percent of the combined budget of 43 government agencies for which time series data were available (accounting for close to 80 percent of total government spending) was derived from the national government, 6 percent from internally generated sources, 2 percent from donors, and the remainder from public and private enterprises and other sources (Figure 10). The relative share of government support remained more or less stable—and above the 90 percent-mark—during 1996–99. After 1999, however, this share decreased gradually in favor of other sources, most notably internally generated resources.

The national government agencies were more dependent on government support than the regional agencies. During 1996–2002, an average of 97 percent of funding for a sample of 7 national government agencies was provided by the national government, compared with 88 percent for a sample of 36 regional government agencies. These averages also mask considerable variation across agencies. In 2002, for example, more than 80 percent of the research funding at the Sugar Regulatory Administration (SRA) in the Western Visayas (Region VI) was generated internally through the sale of sugar.

Figure 10—*Funding sources of 43 government agencies, 1996–2002*



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

Notes: Sample includes 43 government agencies (7 federal and 36 regional). Combined, these 43 agencies accounted for 79 percent of total government-sector agricultural R&D spending in 2002.

Public agricultural R&D agencies in the Philippines are primarily financed by the national government through a dual funding system. The central government provides direct support (core funding) for each public agricultural R&D agency and channels project funding for strategic research via specialized government agencies, such as DA, DOST, PCARRD, DENR, and BAR.[16] During 1996–2002, core funding constituted 69 percent of government funding for a sample of 29 government agencies and the remainder represented project funding (Table 6). Most of these project funds were provided by DA, BAR, and DOST. Notably, BAR's funding share has increased over the years, while DOST funding has steadily declined.

[16] Many government R&D agencies in the Philippines are attached to a public higher education institution or university to which public funds are directly allocated by the national government in accordance to the GAA. The university, in effect, is the one that allocates funds to its attached R&D agencies.

Table 6—*Shares of various sources of government funding for government agencies, 1996–2002*

	1996	1997	1998	1999	2000	2001	2002
				(percentage)			
Core budget	66.9	60.6	76.0	74.4	75.7	67.5	62.6
Other government							
National							
DA	17.4	34.2	17.2	19.9	16.7	21.8	27.4
DOST	6.9	0.8	3.5	1.8	1.1	2.0	0.8
TAPI	—	—	—	0.1	0.2	0.1	—
PCARRD	0.9	0.2	0.3	0.3	0.5	0.5	0.4
PCIERD	—	0.1	0.2	0.3	—	0.1	0.1
PCHRD	—	—	—	—	—	0.2	—
DOH	—	—	0.2	0.1	—	—	—
DSWD	—	—	—	—	0.9	1.3	0.2
BAR	0.6	1.3	1.2	1.8	2.3	5.5	6.6
DENR	1.3	1.2	0.5	0.6	0.6	0.5	1.0
NAFC	5.7	0.8	0.8	0.3	0.7	—	—
Other	0.1	0.6	0.1	0.5	1.1	0.4	1.0
Subtotal	*33.1*	*39.4*	*24.0*	*25.6*	*24.3*	*32.5*	*37.4*
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*

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

Notes: Sample includes 29 government agencies (5 federal and 24 regional). Combined, these 29 agencies accounted for 56 percent of total government-sector spending in 2002. Core funding is allocated by the central government. Government departments such as DA, DOST, DOH, DSWD, and DENR allocate funds to specific priority programs that are in line with the central government's development agenda. BAR and NAFC are specialized agencies under DA. TAPI, PCARRD, and PCIERD are placed under DOST.

As previously mentioned, GAA is the legislative authorization that allocates funds to essentially all government-led operations. The process of determining allocations begins each year with a "budget call" issued by the Department of Budget and Management (DBM) to all government departments, agencies, and bureaus. This call defines the guidelines and procedures, technical instructions, and timetable for budget preparation, from which government agencies prepare detailed budget estimates. DBM then conducts budget hearings in which agencies are asked to justify their proposals before a technical panel. Each proposal is subsequently presented to the Development Budget Coordinating Committee (DBCC), an inter-agency body, for endorsement, after which the proposed budget is reviewed by the president and cabinet. Once the budget is approved, DBM prepares an Agency Budget Matrix (ABM) in consultation with each agency, which disaggregates the programmed appropriations into expenditure categories.

DBM also prepares an Allotment Release Program (ARP), which specifies the guidelines in prioritizing funding releases. Based on ARP, DBM issues either a General Allotment Release Order (GARO) or a Special Allotment Release Order (SARO) to authorize government agencies to incur obligations. The DBM then releases Notice of Cash Allocation (NCA) on a monthly or quarterly basis, specifying the maximum amount of withdrawal that an agency can make from a government bank for the period indicated. From there, government agencies can utilize their budget in accordance to the authorized allotment. GAA provides flexibility to government agencies, including PCARRD, in determining how to subdivide their funds, as long as they do not exceed the authorized allotment for a specific purpose.

In addition to core funding by the central government, Philippine agriculture R&D agencies also receive funding from a number of specialized government agencies such as DOST, DA, PCARRD, and DENR. These agencies allocate funds to specific priority programs that are in line with the central government's development agenda as stipulated in the Medium-Term Philippine Development Plan (MTPDP). Most specialized government agencies anchor their medium-term plans on MTPDP. Each of these specialized government agencies identifies the R&D agencies best suited to implement priority programs (or program components) and allocates funds accordingly. For example, in its Corporate Plan 2005-10 and its Integrated Science and Technology Agenda 2006-10, PCARRD has identified priority projects that will be pursued up to 2010 and the implementing agencies best suited to carry out these projects. In addition, most specialized government agencies also allocate R&D funds by providing matching grants (which require counterpart funding) to project proposals that are in line with their priority programs.

Compared with some of the other countries in the region, Philippine agricultural R&D is far less dependent on foreign donors. As mentioned, just 2 percent of all funding allocated to agricultural R&D was derived from foreign donors during 1996–2002. Over the past decades, PCARRD has received substantial funding from the United States Agency for International Development (USAID), the Ford Foundation, FAO, IDRC, the Center of International Agricultural Research Cooperation for Development (CIRAD, France), ACIAR, certain institutes under the Consultative Group on International

Agricultural Research (CGIAR), and the South Korean RDA, but in recent years donor support has represented only a very small share of total funding for Philippine agricultural R&D.

Currently, the largest foreign donors to Philippine agricultural R&D agencies are JICA and ACIAR. The Philippines is one of the largest recipients of technical cooperation provided by the government of Japan through JICA. In the past 10 years, more than half of all irrigation projects in the Philippines were funded by Japan, resulting in an estimated 129,000 hectares of irrigated farmland, along with the extension of a significant amount of credit to farmers. Similarly, Japan supports the Philippine government in various environmental management projects, such as reforestation, solid waste management, and air quality improvement in Manila. Several agricultural R&D agencies, including DMMMSU and PhilRice, among others, have also been strengthened with the support of Japanese aid through the provision of infrastructure. The 1992–2002 JICA grant for PhilRice, for example, involved both the long- and short-term dispatch of Japanese experts to collaborate with Philippine counterparts; the training of Philippine scientists and technicians in Japan; and the provision of equipment and materials needed by the Japanese experts and their Philippine counterparts in the pursuit of their research. Aside from the PhilRice project, JICA has supported various degree and nondegree training programs at other Philippine R&D agencies as well.

ACIAR has collaborated in the Philippines since 1983. At the outset, the program consisted of various projects focusing on soil management research. Research on postharvest storage of grain also represented an important component. During the 1990s, research cooperation between Australia and the Philippines shifted toward livestock management and biotechnology. There was also a shift in the location of many of the ACIAR–funded projects. The poorer areas in Mindanao, the Visayas, and Luzon were increasingly emphasized, while strong links to R&D experts in Manila and Los Baños were maintained. All new projects aim to involve and address the needs of the end-users of the research. In 2005, ACIAR (in cooperation with AusAID) financed 21 bilateral and 3 multilateral agricultural research and extension projects in the Philippines. The total cost of its Philippines program was AU$3 million in 2005 (roughly US$2.2 million), encompassing a wide range of projects, including crops, fisheries, and livestock research

(ACIAR 2005).

Loans by development banks represented an important source of external funding for R&D and other S&T activities during PCARRD's early years. However, since the closure of the last World Bank–funded loan project in 1988—the Second Agricultural Support Services Program (ASSP-II)—the Philippine government has refrained from seeking new loans in view of the country's deteriorating debt status.

More and more regionally based agricultural R&D agencies generate their research funds internally. In 1996, the government agencies' own income accounted for 5 percent of total R&D funding compared with 9 percent in 2002 (Figure 9). Most government agencies are mandated to generate resources internally as part of their function. However, income that is internally generated, such as through the sale of publications, the provision of S&T services, and the conduct of training programs, is generally channeled back into the national treasury. These funds can only be used by the agencies themselves if the agencies submit a request and justify the intended use. This practice discourages many agencies from increasing the share of internally generated revenue. Unlike the government agencies, the higher education agencies can keep any income generated from their R&D activities.

There is little difference between the R&D funding for government and higher education agencies. Although the government policy is to diminish the financial support for R&D conducted by higher education agencies long term, to date the GAA provides funding for the maintenance and operation of the higher education agencies that are part of NARRDN. UPLB receives the dominant share of the government research budget granted to universities and state colleges. It is estimated that its research budget is equal to or even higher than the combined total of all the other higher education agencies. Not surprisingly, the UP system has generated the highest external funding support, both in absolute and relative terms, in part because of the strength of its research capacity and infrastructure.

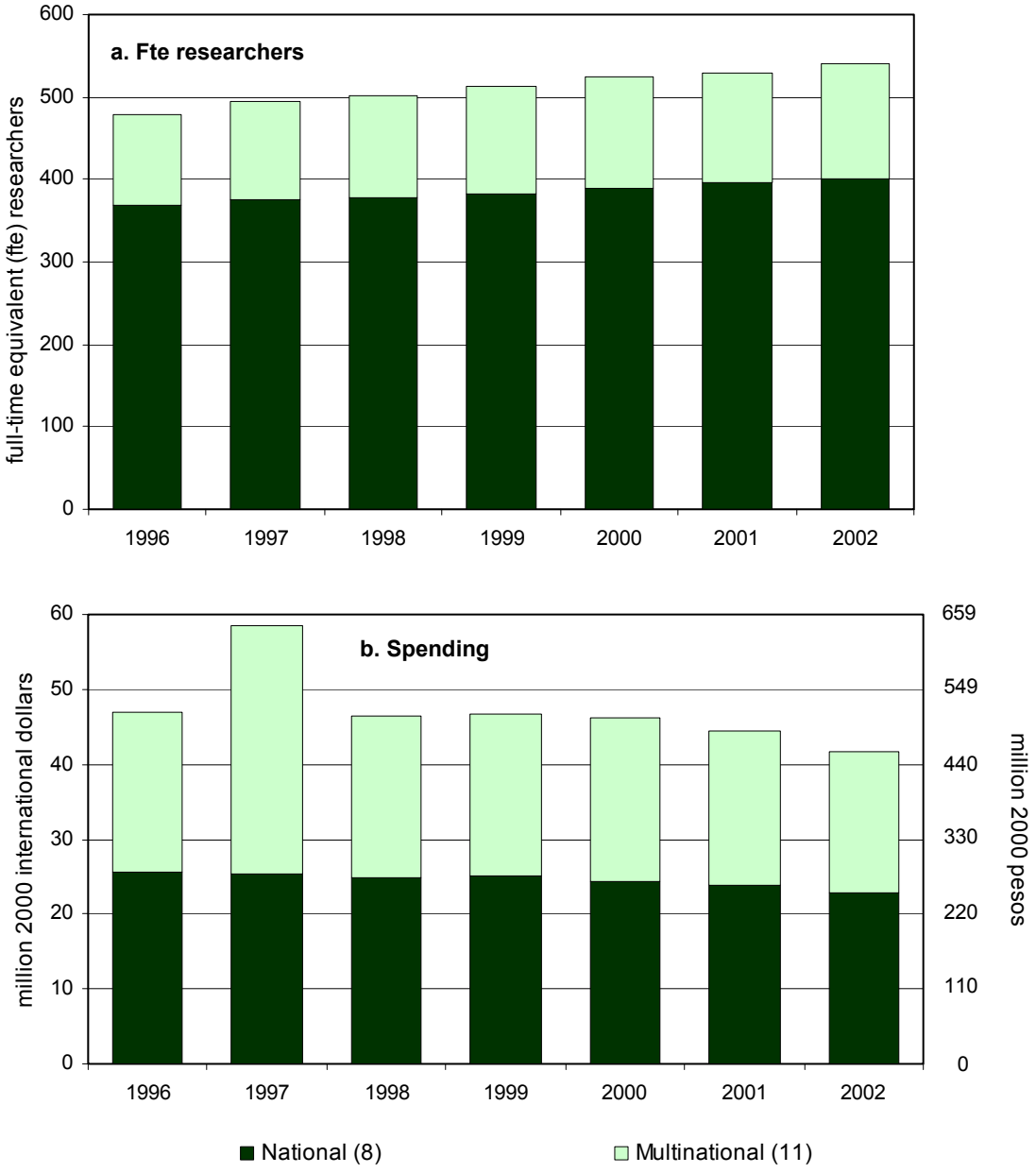
PRIVATE AGRICULTURAL R&D

Compared with most countries in Southeast Asia, the private sector accounts for a sizable share of agricultural R&D in the Philippines.[17] As previously mentioned, 19 private-sector agencies responded to our survey request, though some were reluctant to provide information on their financial and human resources. Based on the sample agencies for which data were available, we attributed 14 percent of the country's total agricultural research staff and 16 percent of its agricultural R&D spending to the private sector. Compensating for the omitted agencies, we estimate that the private-sector share of agricultural research expenditures would increase to about 18 percent in 2002 (see Table 2 on page 18).

Agricultural research staff in the Philippine private sector exhibited consistent growth during 1996–2002 (Figure 11a). During this period, total staff of the 19 sample agencies rose by 13 percent, which was higher than the overall growth in the public sector throughout the same period (5 percent). Total agricultural research spending for the same sample followed a different trend. Private-sector expenditures rose rapidly from $47 million in 1997 to $59 million in 1998 (in 2000 prices), but contracted to $42 million by 2002 (Figure 11b). The peak in 1998 was due to short-term investments by Dolefil in new headquarters. A distinction was made between agencies headquartered in the Philippines and those headquartered abroad. Eight of the 19 agencies were headquartered in the Philippines, and the remaining agencies were foreign-owned. In 2002, these eight local agencies accounted for three-quarters of private research staff and 55 percent of private agricultural R&D expenditures. Average R&D expenditures per researcher for the locally owned companies ($64,000 on average during 1996–2002) were similar to those of the government agencies (Figure 12). In contrast, foreign-owned companies spent nearly three times as much per researcher over the same period ($184,000).

[17] See Appendix E for a complete list of the private-sector agencies included in our sample.

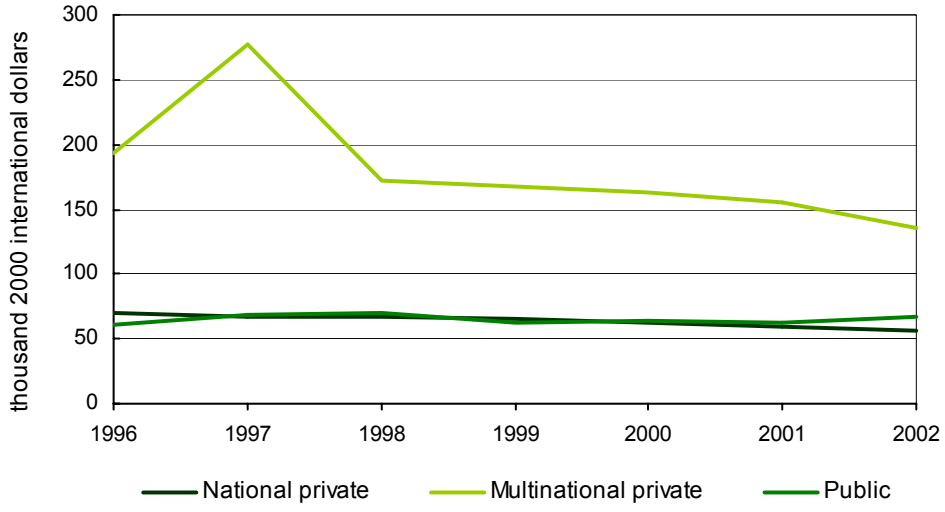
Figure 11—*Long-term composition of agricultural R&D staff and spending in the private sector, 1996–2002*



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

Note: Marsman, headquartered in the Philippines but majority foreign-owned, is treated as a national company in this sample.

Figure 12—*Trends in expenditures per researcher, public and private sector, 1991–2002*



Source: Compiled by authors from ASTI survey data (IFPRI–PCARRD 2003–05).
Notes: See Figures 1 and 11.

The Philippines is the world's leading exporter of (cavendish) bananas. The vast majority of private-sector agencies focus their research efforts on plantation crops, notably bananas, with research on pineapples accounting for an important share as well. Nearly all large banana and pineapple plantations are located on the southern island of Mindanao. This island is endowed with fertile soil, has ample evenly distributed rainfall, and—unlike the rest of the Philippines—is free of typhoons. Many of these plantations employ thousands of field laborers. In recent years, however, research activities in most companies have decreased because the Philippines is slowly losing ground to Latin American countries (especially Ecuador). Multinational fruit growers are increasingly relocating their research to Latin America and, according to some, the Philippine government is taking insufficient measures to redress this.

The Marsman-Drysdale Biotech and Research Corporation (MDBRC) is by far the largest private-sector agency in terms of R&D spending. In 2002, the Mindanao-based corporation alone accounted for 40 percent of our sample's total private-sector agricultural research expenditures. During that year, the company employed 140 fte researchers (95 percent of whom held BSc degrees) and spent $16 million on agricultural R&D (down from $20 million in 1996). MDBRC leads the way in biotechnology and

organic farming for the Philippine cavendish banana export industry. It operates a large tissue culture laboratory and a nursery that has been supplying quality seedlings to large banana plantation companies such as Lapanday Foods Corporation and Del Monte. In addition, MDBRC is also involved in limited research on asparagus, okra, and mango. Until 1999, the corporation was a division of the Marsman Estate Plantation, which has invested heavily in its research and technology facilities. The company is headquartered locally with a majority of foreign ownership.

Other Mindanao-headquartered banana plantations with an important R&D unit include Lapanday Foods Corporation and Tadeco. Lapanday is the country's largest private-sector agricultural research agency in terms of research staff. In 2002, the company employed 181 fte researchers. The company's commercial tissue culture laboratory, inaugurated in 1998, is the largest in the Philippines. Its chemistry laboratory, licensed as a soils laboratory by the Department of Agriculture, tests and analyzes soil, plant tissue, fertilizers, and water sources. The 35 fte researchers at Tadeco focus largely on soils, plant pathology, entomology, water management, and agronomy. The company began in 1969 as a grower for multinational companies such as Dole and Del Monte, but developed as an independent plantation over the years. Manila-headquartered Cornworld Breeding Systems, established in 1989, conducts research on hybrid corn and rice. In 2002, the company employed 28 fte researchers. The remaining nationally headquartered private-sector agencies each employed 9 fte researchers or fewer.

The largest company affiliated with a foreign company headquartered elsewhere is the U.S. company Del Monte. The Philippine headquarters of the company are in Mindanao, and it has two divisions: Del Monte Fresh (44 fte researchers in 2002) and Del Monte Philippines (10 fte researchers in 2002). The company does not have its own banana and pineapple plantations but instead contracts growers such as Lapanday and Tadeco. Dole Philippines, on the other hand, operates its own large plantations in Southern Mindanao. The company has two divisions involved in research. The 17 fte researchers at Dolefil are involved in pineapple research, and the 11 fte researchers at Stanfilco conduct banana research. The 2003 merger of Stanfilco with Tropifresh (involved in asparagus, cut flowers, mangoes, papayas, and vegetables) prompted the creation of Dole Fresh, which recently became operational.

The Netherlands-headquartered East West Seed Company has been active in the Philippines since 1982 and focuses on the development of improved vegetable varieties for the Philippine market. The company's 32 fte researchers operate two research farms. Most other multinational companies that operate a R&D unit were involved in pesticide, herbicide, and fertilizer research for rice, vegetables, and fruit crops. These companies include Syngenta, BASF, Bayer Crop Science, and Dupont. All these companies employed between 2 and 7 fte researchers in 2002.

Specific government policies designed to stimulate private-sector research appear to have had limited impact in the Philippines. DOST established a number of programs to stimulate private-sector R&D, but the funding for these programs has generally been too small to have had much of an impact. DOST is currently developing a venture capital fund in collaboration with the government-owned development bank. Though government-guaranteed loans from banks have been available for some time, equity financing institutions for small businesses are almost nonexistent. DOST also oversees the Technology Application and Promotion Institute (TAPI), which aims to promote the transfer and commercialization of technologies and to market the services of other operating units/agencies of DOST. To this end, TAPI offers a range of services, which include enterprise development, technology promotion, consultancy services, and assistance to investors.

PCARRD also encourages the participation of the private sector in various stages of technological development and utilization. The modes by which PCARRD encourages this involvement include membership by particular private-sector representatives to PCARRD's commodity teams, technical advisory committee, and governing council; inviting business entrepreneurs and farmer leaders to scientific symposia, workshops, and forums; joint R&D undertakings in pilot/action projects in the region; co-financing of R&D projects; and networking arrangements for technology promotion to end-users.

RESEARCH ORIENTATION

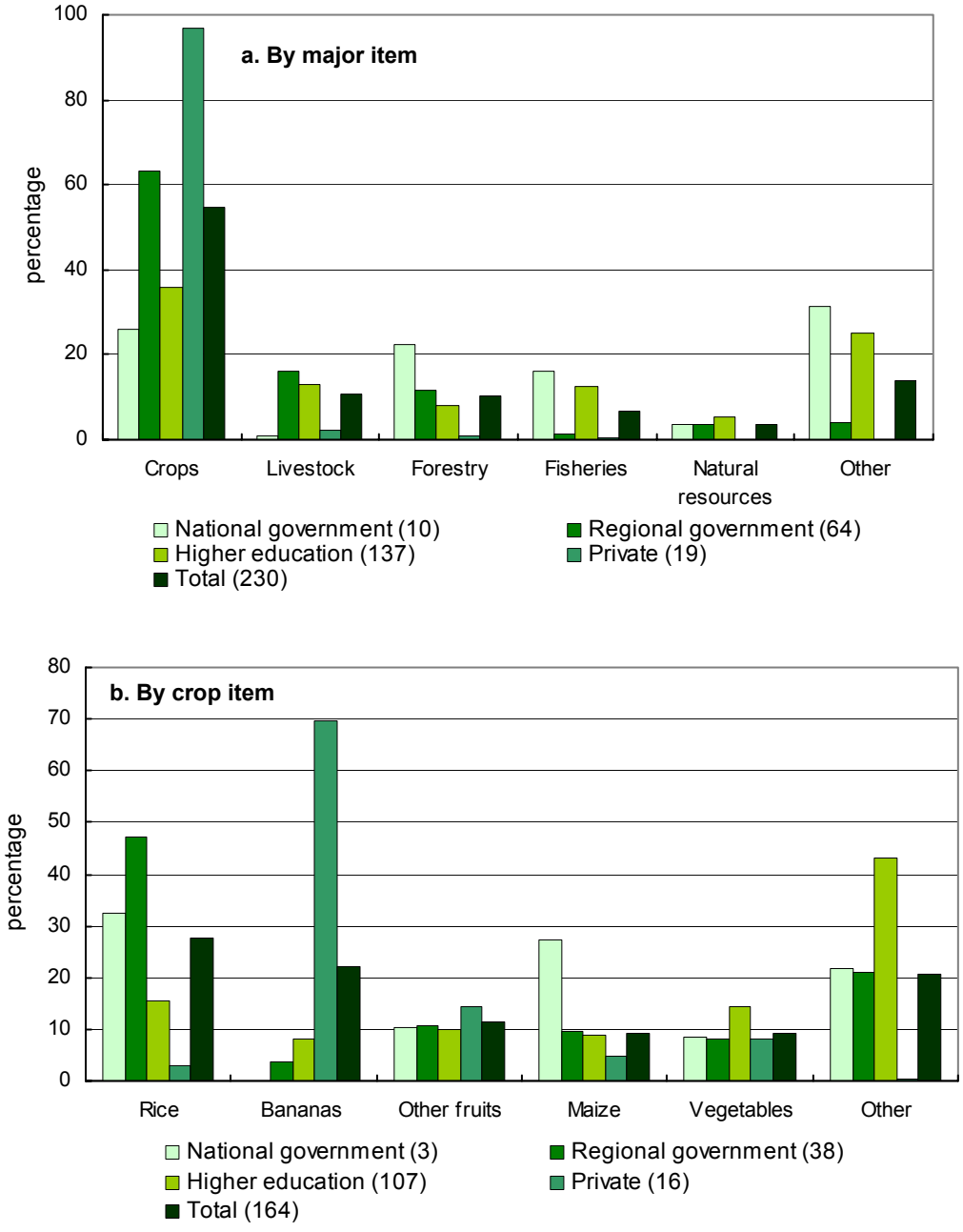
The allocation of resources among various lines of research is a significant policy decision, and so detailed information was collected on the number of fte researchers working in specific commodity and thematic areas.

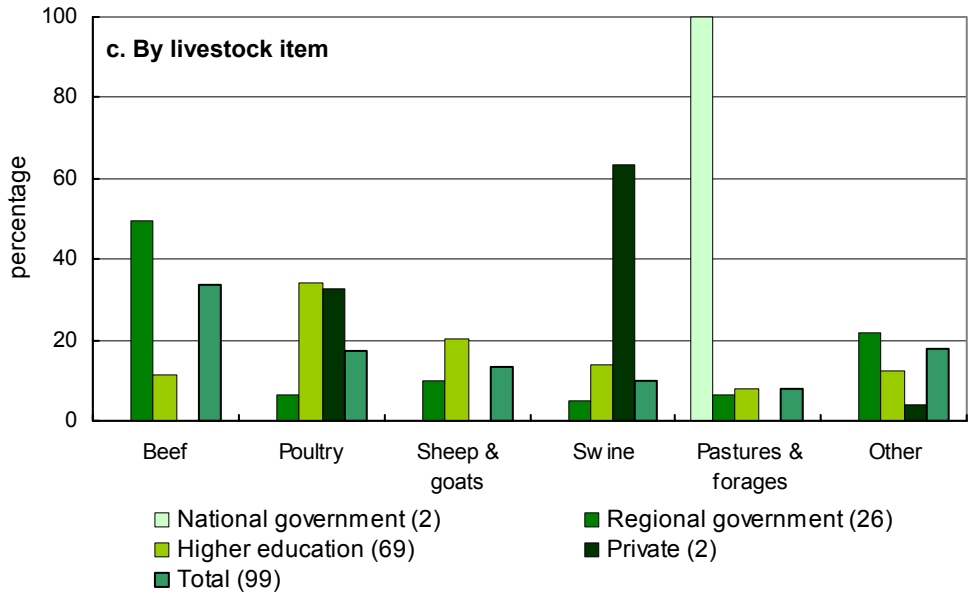
Commodity Focus

More than half of the 3,459 fte researchers in a sample of 229 agencies conducted crop research in 2002 (Figure 13a). Livestock and forestry research accounted for 11 percent each, and fisheries and natural resources research accounted for 7 and 4 percent, respectively. Research staff at the government agencies spent relatively more time on crops and forestry than their counterparts in the higher education agencies. The higher education agencies, on the other hand, focused more on fisheries and livestock research than their counterparts in other institutional categories. Given the strong private-sector focus on bananas and other fruits, private-sector researchers concentrated almost exclusively on crops.

In 2002, rice accounted for close to 30 percent of the research conducted on crops, while bananas accounted for 22 percent, and other fruits (mainly pineapple and mango) for 11 percent (Figure 13b). Other important crops were maize and vegetables, accounting for 9 percent each. One-third of livestock researchers focused on beef in 2002 (Figure 13c). Poultry research represented 17 percent and research on sheep and goats 14 percent. Swine and pastures and forages research accounted for 10 and 8 percent, respectively. The high share of swine research by the private sector is due to the Pig Improvement Company (PIC).

Figure 13—*Commodity focus, 2002*





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

Notes: Figures in parentheses indicate the number of agencies in each category. Figure 12b only includes agencies involved in crop research; Figure 12c 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.[18]

[18] It is important to note, as described in Alston et al. (1998), that the model overlooks key factors affecting the pay-off to R&D, such as the differences in probability of research success, likely adoption rates, and the likely extent of research-included productivity gains. In addition, the model does not account for technology spill-ins from other countries, or differences in cost per scientist among different R&D areas.

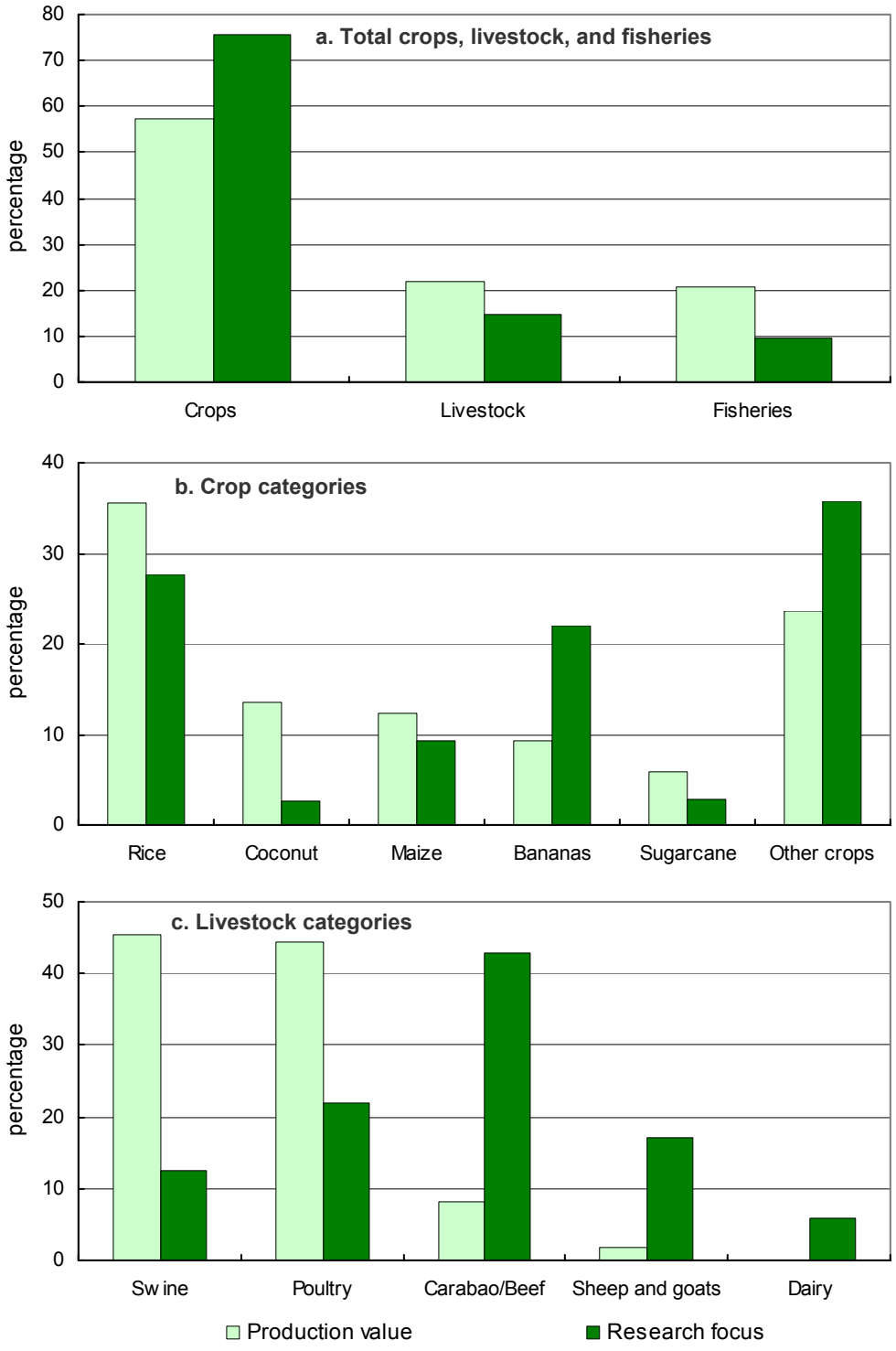
Figure 14a shows the shares of crops, livestock, and fisheries in gross value of agricultural production with the corresponding share of research staff in these areas. In 2002, 78 percent of the researchers in our subsample (which excludes forestry and natural resources research) undertook crops research—significantly higher than the share of crops in the total value of production (58 percent). This has been a common finding in most other countries in the region. In contrast, the share of livestock researchers was lower than its share in total production value, resulting in a congruency ratio of 0.7. The congruency ratio for fisheries was very low at 0.3.

There were major incongruencies between the shares of researchers and output values revealed at the individual crop level (Figure 14b). Coconut, for example, accounted for 14 percent of the total value of crop production in 2004, but only 2.5 percent of the 1,924 fte crop researchers in the sample conducted coconut research (resulting in a congruency ratio of 0.2). The congruency ratio for sugarcane was also comparatively low at 0.5, and the ratios for the Philippine's staple crops (rice and maize) were also below 1.0. For bananas, the congruency ratio was 2.4, indicating a more intensive research effort than a consideration of crop values alone would justify. As mentioned previously, most of the research on bananas is carried out by the private sector.

There were also significant incongruencies between fte researcher and value-of-output shares for particular lines of total fte livestock researchers in 2002. None of the specified livestock items had congruency ratios close to 1.0 (Figure 14c). The shares of swine and poultry were considerably smaller than their corresponding shares of total value of livestock production. In contrast, the share of beef, sheep and goats, and dairy production in total value of livestock production were much higher. For example, carabaos account for less than 5 percent of the total value of livestock production. Nevertheless, PCC employed 84 fte researchers in 2002 (or 22 percent of all livestock researchers in the Philippines).

So, while the congruence rule is both useful for allocating resources and a distinct improvement over precedence and other shortcut methods, ratios that differ from 1.0 are not necessarily a cause for concern.

Figure 14—*Congruence between agricultural R&D and production value, 2002–03*



Sources: Compiled by authors from ASTI survey data (IFPRI–PCARRD 2003–05). Production values are from Bureau of Agricultural Statistics (2006).

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

Thematic Focus

In 2002, 16 percent of the 3,207 fte researchers in our 230-agency sample were working on crop pest and disease control, 12 percent on crop genetic improvement, and 19 percent on other crop-related themes (Table 7). The remainder of the researchers focused on livestock and natural resource-related themes, while only a small portion of researchers focused on postharvest, soil, and water themes. Research on crop genetic improvement was relatively more important research theme for the government agencies than for the other two categories of institutions. Close to three-quarters of research staff at the 19 private-sector agencies focused on crop-related themes, with crop pest and disease control accounting for 39 percent.

Table 7—*Thematic focus, 2002*

	Government		Higher		
	Federal	Regional	education	Business	Total
Number of agencies in sample	9	64	137	19	230
Number of researchers			*(fte researchers)*		
Crop genetic improvement	25.5	222.4	64.8	53.8	373.2
Crop pest and disease control	8.1	197.0	104.6	205.6	520.4
Other crop	0.4	260.4	205.0	130.8	600.0
Livestock genetic improvement	0.0	77.7	48.4	4.6	130.7
Livestock pest and disease control	0.4	46.0	38.4	0.7	85.4
Other livestock	3.9	104.5	101.5	6.8	216.6
Soil	9.0	44.7	19.9	61.9	135.5
Water	24.9	35.5	33.1	4.7	98.3
Other natural resources	104.8	47.4	77.4	0.0	229.6
Postharvest	4.1	79.3	45.3	55.8	184.5
Other	54.4	273.2	295.5	8.5	633.2
Total	*235.5*	*1,387.9*	*1,033.8*	*533.1*	*3,207.3*
Shares by research theme			*(percentages)*		
Crop genetic improvement	10.8	16.0	6.3	10.1	11.6
Crop pest and disease control	3.5	14.2	10.1	38.6	16.2
Other crop	0.2	18.8	19.8	24.5	18.7
Livestock genetic improvement	0.0	5.6	4.7	0.9	4.1
Livestock pest and disease control	0.2	3.3	3.7	0.1	2.7
Other livestock	1.6	7.5	9.8	1.3	6.8
Soil	3.8	3.2	1.9	11.6	4.2
Water	10.6	2.6	3.2	0.9	3.1
Other natural resources	44.5	3.4	7.5	0.0	7.2
Postharvest	1.7	5.7	4.4	10.5	5.8
Other	23.1	19.7	28.6	1.6	19.7
Total	*100*	*100*	*100*	*100*	*100*

Source: Compiled by authors from ASTI survey data (IFPRI–MARDI 2003–04).

CONCLUSION

Agricultural researcher totals in the Philippines have increased gradually over the past two decades. In fact, with close to 4,000 fte researchers in 2002, the Philippines has one of the largest agricultural research systems in Asia. Nevertheless, average scientific qualifications of Philippine agricultural research staff are relatively low: less than half of all agricultural researchers held postgraduate degrees in 2002. In terms of total agricultural research spending, the Philippines ranks behind more economically advanced Asian countries. Nonetheless, agricultural R&D spending in the Philippines has shown significant growth in recent years. In 2002, the country invested $269 million in agricultural R&D (in 2000 international dollars), which is an increase of two-thirds over the level recorded a decade earlier.

The organizational structure of agricultural R&D in the Philippines is highly complex with two separate but closely linked networks existing side by side: NARRDN and the regional consortia. Both systems comprise a large number of national government, regional government, and higher education agencies, each with its own commodity focus and area of responsibilities. What distinguishes the Philippines from many of its Southeast Asian neighbors is the important role the higher education sector (mainly UPLB) plays in agricultural R&D. All four NMCRDCs are based at large agricultural universities, and most of the regional activities of large government agencies, such as PhilRice and PCC, take place at universities. Despite its intricate and extremely decentralized R&D structure, agricultural R&D in the Philippines is still dominated by the public sector. By our estimates, private-sector agencies accounted for 18 percent of the country's agricultural R&D expenditures in 2002, which is higher than in most countries in the Asia–Pacific region. This share has actually declined in recent years, due to a more rapid growth in public-sector research spending.

Public agricultural R&D in the Philippines is heavily reliant on government sources of support. In 2002, the Philippine government provided more than 85 percent of funding to the government agencies. In recent years, however, the share of internally generated resources has gradually increased. Foreign donor support plays only a marginal role in the Philippine agricultural R&D system, distinguishing it from some other countries in the region. In terms of the public-sector intensity of investment in

agricultural R&D, the Philippines rates slightly above the Asian average. In 2002, the Philippines invested $0.46 for every $100 of agricultural output, which was more than 70 percent higher than the equivalent ratio recorded a decade earlier.

REFERENCES

ACIAR (Australian Centre for International Agricultural Research). 2005. *Country profile Philippines*. Canberra.

Alabastro, E. F. 2004. *Science and technology*. Paper presented at the 3rd UP public lectures on the Philippine presidency and administration, held at UP Diliman, Quezon City, February 27.

Alston, J. M., G. W. Norton, and P. G. Pardey. 1998. *Science under scarcity: Principles and practice for agricultural research evaluation and priority setting*. Wallingford, U.K.: Cab International.

BAS (Bureau of Agricultural Statistics). 2005. Bureau of Agricultural Statistics. <http://bas.gov.ph> (accessed September 2005).

Brush, E. G., D. Merrill-Sands, D. P. Gapasin, and V. L. Mabesa. 1995. *Women scientists and managers in agricultural research in the Philippines.* Research Report No. 7. The Hague: International Service for National Agricultural Research.

Cororaton, C. B. 1998. *Rates of return to R&D investment in the Philippines*. Makati City: Philippine Institute for Development Studies.

_____. 1999. *R&D gaps in the Philippines*. In *Journal of Philippine Development*, No. 48, Vol. 26 (2): 47–65.

David, C. C., E. R. Ponce, S. C. Halos, and C. B. Lamug. 1998. *Philippine national agricultural and natural resources research system: Resource allocation issues and directions for reforms*. PIDS Discussion Paper No. 99–33. Manila: Philippine Institute for Development Studies.

Del Rosario, B. P. 1999. *The Philippine national agricultural resources research and development system: A broadened NARS*. In *National agricultural research systems in the Asia-Pacific region—A perspective*. Bangkok: Asia-Pacific Association of Agricultural Research Institutions.

DOST (Department of Science and Technology). 2002. *National science and technology plan 2002–2020*. <http://www.dost.gov.ph/downloads/NSTP0220.pdf> (accessed September 2005).

ERDB (Ecosystems Research and Development Bureau). 2005. About ERDB. <http://erdb.denr.gov.ph> (accessed September 2005).

FAO (Food and Agriculture Organization of the United Nations). 2006. FAOSTAT statistical databases. <http://faostat.fao.org/default> (accessed January 2006).

FMB (Forest Management Bureau). 2006. Philippine Forestry Statistics. <http://forestry.denr.gov.ph/Stat%2003/03-603-GVA%20in%20Agri,Fishery%20and%20Forestry.xls> (accessed February 2006).

Gomez, A. A. 1986. *Philippines and the CGIAR centers: A study of their collaboration in agricultural research*. CGIAR Study Paper No. 15. Washington, D.C: World Bank.

IFPRI–PCARRD (International Food Policy Research Institute and Philippine Council for Agriculture and Resources Research and Development). 2003-05. Agricultural Science and Technology Indicators (ASTI) survey for the Philippines. Unpublished surveys. IFPRI and PCARRD, Washington, D.C.

MAF (Ministry of Agriculture and Food). 1985. *Report of the agricultural research review team on the Ministry of Agriculture and Food research system*. Quezon City, Philippines.

MASTIC (Malaysian Science and Technology Information Centre). 2004. *National Survey of Research and Development: 2004 report*. Putrajaya, Malaysia.

MOSTE (Ministry of Science, Technology, and Environment). 2003. *The second national S&T policy and plan of action*. Kuala Lumpur.

NSCB (Philippine National Statistical Coordination Board). 2006. Gross national product and gross domestic product by industrial origin. 1st Qtr 2003–4th Qtr 2005 (in million PhP). <http://www.nscb.gov.ph/secstat/d_accounts.asp> (accessed February 2006).

OECD (Organisation for Economic Co-operation and Development). 2002. *Frascati manual: Proposed standard practice for surveys on research and experimental development.* Paris.

REFERENCES (continued)

Pardey, P. G., and N. M. Beintema. 2001. *Slow magic: Agricultural R&D a century after Mendel*. IFPRI Food Policy Report. Washington, D.C.

PCARRD (Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development). 2004. *Performance Review and Assessment of the PCARRD GIA Program on Human Resource Development*. Los Baños, Philippines.

_____. 2005. PCARRD. <http://www.pcarrd.dost.gov.ph> (accessed September 2005).

PCC (Philippine Carabao Center). 2003. *Isang Dekadang Kabalikat ng Magsasaka: 10th Anniversary.* Science City of Muñoz, Nueva Ecija, Philippines.

Policy Action Group. 2004. *Productivity crisis in Philippine agriculture: A reflection of R&D underinvestment*. PAG Working Paper No. 2004-01. Los Baños, Philippines.

Pray, C. E. 2001. Philippines. In *Private investments in agricultural research and international technology transfer in Asia*, edited by C. E. Pray and K. O. Fuglie. Agricultural Economics Report No. 805. Washington, D.C.: United States Department of Agriculture.

Sheridan, B. 1998. *Strangers in a strange land: A literature review of women in science.* CGIAR Gender Program Working Paper No. 17. Boston, Mass., and Washington, D.C.: Simmons Institute for Leadership and Change and CGIAR Secretariat.

Stads, G. J., and H. V. Nguyen. 2006. *Vietnam.* ASTI Country Brief No. 33. Washington, D.C.: IFPRI and Ministry of Agriculture and Rural Development.

Stads, G. J., A. Tawang, and N. M. Beintema. 2005. *Malaysia*. ASTI Country Brief No. 30. Washington, D.C.: IFPRI and Malaysian Agricultural Research and Development Institute.

Stads, G. J., Haryono, and S. Nuryajanti. 2007 *Indonesia*. ASTI Country Report. Washington, D.C.: IFPRI and Indonesian Agency for Agricultural Research and Development.

UNESCO (United Nations Educational, Scientific and Cultural Organization), Division of Statistics on Science and Technology. 1984. Manual for statistics on scientific and technological activities. UNESCO, Paris. Mimeo.

World Bank. 2005. *World development indicators 2005*. Washington, D.C. CD-ROM.

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. Nonprofit 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 onfarm 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 expenditures of two countries side by side is particularly difficult, given that roughly two-thirds of research expenditures are 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 is converted from different countries 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 in Kenya 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 (Philippine pesos). 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

The national agricultural research and natural resource system of the Philippines has experienced substantial changes in structure and distribution of funds since the establishment of the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) in 1972. Consequently, this section will first describe the system in the pre-PCARRD period and then outline the major changes initiated by PCARRD in the structure of the national agricultural R&D system.

Agricultural R&D before 1972

The first signs of agricultural research in the Philippines were seen under Spanish reign, when in 1877, the country suffered from common diseases and epidemics. That year, *the Laboratorio Municipal* was established to undertake pathological studies of infectious diseases, and in 1901 the Philippine Commission created the Bureau of Government Laboratories to further study tropical diseases. Agricultural research in the Philippines gained prominence in the first half of the 20th century. Most research conducted in that period involved the acquisition, improvement through conventional breeding methods, and field testing of new plant materials necessary to support the country's emerging plantation economy. Agricultural R&D focused largely on plantation crops for export, such as coconut, sugarcane, and tobacco (Del Rosario 1999).

In the 1960s, the development of high-yielding varieties and the improvement of crop production management led to the so-called Green Revolution across Asia. This enabled countries to move beyond subsistence agriculture and increase farm productivity. Similarly, policy- and decisionmakers began to realize the importance of agricultural R&D in averting food shortages and starvation. Consequently, a boost in human and financial resources was committed to agricultural R&D and the orientation and structure of most research institutes in the region in general and the Philippines in particular was transformed (Del Rosario 1999).

Before 1972, the organization of agricultural R&D in the Philippines was characterized by limited coordination and planning at the national level. Research was spread among a limited number of agencies, and research resources were inefficiently used and distributed. As a result, research had little impact on economic growth despite the substantial support by the national government (MAF 1985). During that time, there

were essentially three groups of public agencies conducting agricultural research in the Philippines: the Department of Agriculture and Natural Resources (DANR), the National Science Development Board (NSDB), and the agricultural colleges and universities. DANR was part of the executive branch of the national government and was mandated to carry out research activities related to agriculture and forestry. Its primary research units were the Bureau of Plant Industry (BPI) for crops, the Bureau of Animal Science (BAI) for livestock and small animals, the Bureau of Soils, the Bureau of Agricultural Economics (BAEcon), the Philippine Sugar Institute (PSI), the Philippine Tobacco Administration (PTA), the Abaca and other Fibers Board, and the Philippine Coconut Authority (PCA). NSDB was the national coordinating agency for research, but it also operated its own research units, including the National Institute of Science and Technology, which in turn oversaw the Food and Nutrition Research Council and the Agricultural Research Center; the Philippine Atomic Energy Commission, which operated a section dealing with agriculture; the Philippine Coconut Research Institute; and the Forest Products Industry Development Commission. NSDB was largely unsuccessful in the field of research coordination because it was not authorized to control the activities of research agencies administered by other bodies. In addition, it tended to favor its own research units when distributing research funds (Gomez 1986).

Originally, the agricultural colleges and universities in the Philippines were established as institutions for higher education, and their primary role was offering degree programs in agriculture and related fields. However, with the availability of highly trained personnel and the need for research in support of teaching, these institutions found themselves increasingly participating in agricultural R&D. Although the Philippines currently has over 50 agricultural colleges and universities, the University of the Philippines at Los Baños (UPLB) has traditionally dominated the country's agricultural training and research. By the early 1970s, more than 50 percent of the country's 246 graduates holding PhDs in agricultural sciences were employed at UPLB (Gomez 1986).

Agricultural R&D After 1972

As a result of the ineffectiveness of NSDB, the Philippine Council for Agricultural Research (PCAR) was established under DANR in 1972 to address the deficiencies in the organization and management of agricultural R&D undertaken by the various agencies and the weak linkages between agricultural R&D and extension. This meant that the research agencies existing under DANR at the time were organized to form a national agricultural research network, along with the state colleges and universities. When DANR was split to form the Ministry of Agriculture and Food (MAF) and the Ministry of Natural Resources (MNR), PCAR was renamed PCARRD and placed under the Department of Science and Technology (DOST). PCARRD's responsibility was limited to agriculture and forestry and the council's responsibility for fisheries shifted to a new council called the Philippine Council for Agricultural and Marine Resources Research and Development (PCAMRD). A policy was also introduced making the Los Baños-based International Rice Research Institute (IRRI) the primary provider of the country's rice-related research—a somewhat controversial decision because it left the country dependent on an external agency for the generation of technologies for its staple food crop. Meanwhile, MAF was mandated to focus mainly on technology transfer and extension (David et al. 1998).

During the 1970s, under PCARRD's leadership, the Philippine agricultural research system underwent rapid transformation. The system was totally restructured to ensure that each institution had well-defined roles and functions. PCARRD developed a set of research priorities that also determined funding allocation. Financial support to agricultural R&D programs was increased. Training was a high priority under PCARRD. During 1971–81, the council funded advanced degree training for 130 researchers, and nondegree courses and in-service training for an additional 787 researchers. It also funded the infrastructure and research facilities of four multi-commodity research centers (Gomez 1986).

In the meantime, MAF research capacity became increasingly isolated from the country's mainstream agricultural R&D programs. This was reflected in MAF's declining share of public research budgets. By the mid-1980s, the flaws in the Philippine national agricultural research system had become apparent. The 1986 Agenda for Agricultural

Policy Reform enumerated the system's fragmentation, weak research and extension, and lack of accountability of the system (David et al. 1998). Because of widespread opposition to a recommended move of PCARRD and PCAMRD from DOST to the Department of Agriculture, the Bureau of Agricultural Research (BAR) was established under the Department of Agriculture in 1987. BAR's mandate was to reinforce, coordinate, and monitor agricultural R&D within the department, essentially duplicating the tasks of PCARRD and PCAMRD. BAR's main focus was developing the Philippine Rice Research Institute (PhilRice) to reduce the country's dependence on IRRI, and strengthening the 15 regional integrated agricultural research centers (RIARCs) (David et al. 1998).

In 1986, as part of its overall reorganization, the Department of Environment and Natural Resources (DENR, formerly the Ministry of Natural Resources) strengthened its R&D efforts through the creation of the Ecosystem Research and Development Board (ERDB) at the national level and the Ecosystem Research and Development Service (ERDS) at the regional level (David et al. 1998). ERDB was established in 1987 through the merger of the Forest Research Institute (FORI) and the National Mangrove Committee (NMC).

By the early 1980s, agricultural universities and colleges other than UPLB had improved their research capabilities to a great extent, diminishing the dominance of UPLB in agricultural sciences in the higher education sector. The institutions that underwent the greatest change over this time were the Central Luzon State University (CLSU), the Visayas State College of Agriculture (VISCA), and the Southern Mindanao University (SMU) (Gomez 1986). These three higher education agencies became multi-commodity research centers when PCARRD was established (see section on *Current Structure of Philippine Agriculture R&D*), which significantly increased their respective research activities. The General Appropriation Act (GAA) of 1999 transformed VISCA into Leyte State University (LSU).

The general structure of the Philippine agricultural research system has changed little since 1986–87. As of 2006, PCARRD is the central agency coordinating agricultural R&D in the country. The council recently initiated a long-term strategic plan for Philippine agriculture—the Philippine Agriculture 2020 (PA 2020)—in association with

the National Academy of Science and Technology (NAST). The plan, which envisions a robust agricultural and natural resources production system with ecosystem services that improve and sustain human well-being, is the first attempt to integrate the agricultural, environment, and natural resources sectors.

APPENDIX C. Overview of the National Agricultural and Resources Research and Development Network

National Multi-Commodity Centers

Central Luzon State University	CLSU
University of the Philippines Los Baños	UPLB
University of Southern Mindanao	USM
Leyte State University	LSU

National Single-Commodity Centers

Cotton Development Administration	CoDA
National Tobacco Administration	NTA
Forest Products Research and Development Institute	FPRDI
Ecosystems Research and Development Bureau	ERDB
Philippine Coconut Authority–Zamboanga Research Center	PCA-ZRC
Philippine Coconut Authority–Albay Research Center	PCA-ARC
Sugar Regulatory Administration–La Granja Experiment Station	SRA-LGES
Philippine Rice Research Institute	PHILRICE
Philippine Carabao Center	PCC

Regional Research Centers

Mariano Marcos State University	MMSU
Benguet State University	BSU
Isabela State University	ISU
State Polytechnic College of Palawan	SPCP
Camarines Sur State Agricultural College	CSSAC
DA–BPI La Granja National Crops Research and Development Center	LGNCRDC
Central Mindanao University	CMU
DA–BPI Davao National Crops Research and Development Center	DNCRDC
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region I	DENR-ERDS Region I
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region II	DENR-ERDS Region II
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region III	DENR-ERDS Region III
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region IV	DENR-ERDS Region IV
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region V	DENR-ERDS Region V
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region VI	DENR-ERDS Region VI
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region VII	DENR-ERDS Region VII
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region VIII	DENR-ERDS Region VIII
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region IX	DENR-ERDS Region IX
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region X	DENR-ERDS Region X
Department of Environment and Natural Resources–Ecosystems Research and Development Sector–Region XI	DENR-ERDS Region XI

Department of Environment and Natural Resources—Ecosystems Research and Development Sector–Region XII	DENR-ERDS Region XII

Cooperating Stations

Cordillera Administrative Region (CAR)

Abra State Institute of Science and Technology	ASIST
Ifugao State College of Agriculture and Forestry	ISCAF
Kalinga Apayao State College	KASC
DA–BPI National Crops Research and Development Center	BNCRDC
DA–Cordillera Integrated Agricultural Research Center	DA-CIARC
DA–Cordillera Integrated Agricultural Research Center–Research Outreach Station for Lowland Development	DA-CIARC-ROS

Region I

DA–Ilocos Integrated Agricultural Research Center–Outreach Station for Irrigated Lowland and Livestock Development	DA-ILIARC-ROS
Don Mariano Marcos Memorial State University	DMMMSU
Pangasinan State University	PSU
Ilocos Sur State Polytechnic College	ISSPC

Region II

Cagayan State University	CSU
DA–Experiment Farm for Crops	
DA–Cagayan Valley Integrated Agricultural Research Center	DA-CVIARC
DA–Cagayan Valley Integrated Agricultural Research Center–Research Outreach Station for Rainfed/Irrigated Lowlands	DA-CVIARC-ROS
DA–PhilRice Outreach Station	
DA–BSWM Isabela soil and Water Conservation Demo Station	
DA–National Irrigation Administration	DA-NIA
Nueva Vizcaya State Institute of Technology	NVSIT
Quirino State College	QSC

Region III

DA–BSWM San Ildefonoso Soil and Water Research Station	
DA–Central Luzon Integrated Agricultural Research Center for Rainfed/Irrigated Lowlands	DA-CLIARC-ROS
DA–Central Luzon Integrated Agricultural Research Center for Lowland	DA-CLIARC-ROS
DA–NIA–Upper Pampanga River Integrated Irrigation System	DA-NIA-UPRIIS
Pampanga Agricultural College	PAC
Tarlac College of Agriculture	TAC
Ramon Magsaysay Technological University	RMTU
Bureau of Postharvest Research and Extension	BPRE
Bulacan National Agricultural School	BNAS

Region IV

Cavite State University	CavSU
DA–Southern Tagalog Integrated Agricultural Research Center	DA-STIARC
DA–BPI Los Baños National Crops Research and Development Center, Southern Tagalog Integrated Agricultural Research Center for Upland Development	DA-STIARC-ROS
DA–Experimental Farm for Crops Mindoro Horticultural Center	
DA–BAI Animal Products, By-Products Training Center	

DA–BAI Alabang Stock Farm	
DA–Agribusiness Division	
Region V	
Bicol University, College of Agriculture	BUCA
DA–Bicol Integrated Agricultural Research Center	DA-BIARC
DA–Bicol Integrated Agricultural Research Center for Upland Plain and Coastal/Marine Fisheries	DA-BIARC-ROS
DA–Bicol Integrated Agricultural Research Center for Upland Rainfed and Marine Fisheries	DA-BIARC-ROS
Dr. Emilio B. Espinosa, Sr. Memorial State College of Agriculture and Technology	DEBESMSCAT
DA–BSWM Camarines Sur Soil and Water Conservation Demonstration Station	
DA–BAI Milagros Livestock Production Center	
Fiber Industry Development Authority	FIDA
Region VI	
DA–Western Visayas Integrated Agricultural Research Center	DA-WESVIARC
DA–Western Visayas Integrated Agricultural Research Center for Upland and Plantation Crops (Fruits)	DA-WESVIARC-ROS
DA–Western Visayas Integrated Agricultural Research Center for Cattle, Swine, Pasture, and Forage	DA-WESVIARC-ROS
DA–Western Visayas Integrated Agricultural Research for Hillyland and Upland Farming Systems	DA-WESVIARC-ROS
DA–Experimental Farm of Upland Crops	
National Irrigation Administration	NIA
Panay State Polytechnic College	PSPC
West Visayas State University	WVSU
University of the Philippines Los Baños College of Agriculture-Research and Training Center	UPLBCA-RTC
Aklan State College of Agriculture	ASCA
University of the Philippines-Visayas	UPV
Central Philippine University	CPU
Region VII	
DA–Central Visayas Integrated Agricultural Research Center for Rainfed Lowlands	DA-CENVIARC-ROS
DA–Central Visayas Integrated Agricultural Research Center for Hillyland	DA-CENVIARC-ROS
DA–Central Visayas Integrated Agricultural Research Center for Livestock Hillyland Development	DA-CENVIARC-ROS
DA–Central Visayas Integrated Agricultural Research Center for Irrigated Lowlands	DA-CENVIARC-ROS
Region VIII	
DA–Eastern Visayas Integrated Agricultural Research	DA-EVIARC
DA–Eastern Visayas Integrated Agricultural Research Center for Livestock Development	DA-EVIARC-ROS
DA–Eastern Visayas Integrated Agricultural Research Center for Upland Farming System Development	DA-EVIARC-ROS
DA–Eastern Visayas Integrated Agricultural Research Center for Postharvest and Technology Development	DA-EVIARC-ROS
DA–Eastern Visayas Integrated Agricultural Research Center for Lowlands Farming Systems Development	DA-EVIARC-ROS
University of Eastern Philippines	USEP

Eastern Samar State College	ESSC
Fiber Industry Development Authority	FIDA

Region IX

DA–Western Mindanao Integrated Agricultural Research Center	DA-WESMIARC
DA–Western Mindanao Integrated Agricultural Research Center for Hillyland and Vegetables	DA-WESMIARC-ROS
DA–Western Mindanao Integrated Agricultural Research Center for Upland	DA-WESMIARC-ROS
DA–BAI Asian Sheep and Goat Development Center	
Western Mindanao State University	WMSU

Region X

DA–Northern Mindanao Integrated Agricultural Research Center	DA-NOMIARC
DA–Northern Mindanao Integrated Agricultural Research Center for Rainfed Lowland Development	DA-NOMIARC-ROS
DA–Northern Mindanao Integrated Agricultural Research Center for Upland/ Lowland Development	DA-NOMIARC-ROS
DA–Bukidnon Soil and Water Conservation and Demo Station	
Misamis Oriental State College of Agriculture and Technology	MOSCAT
Xavier University	XU
National Irrigation Administration–Region X	NIA-Region X
DA–PhilRice Remedios T. Romualdez	PhilRice

Region XI

DA–Southern Mindanao Agricultural Research Center for Crop Development	DA-SMIARC-ROS
DA–Davao Soil and Water Conservation and Demo Station	
University of the Southeastern Philippines	USEP
Fiber Industry Development Authority, Manambulan	FIDA
Fiber Research and Trial Station	

Region XII

DA–PhilRice	PhilRice
DA–Central Mindanao Integrated Agricultural Research	DA-CEMIARC-ROS
Center for Irrigated Lowlands	

Autonomous Region of Muslim Mindanao (ARMM)

Mindanao State University	MSU

Specialized Agencies

Bureau of Plant Industry	BPI
Bureau of Soils and Water Management	BSWM
Bureau of Agricultural Statistics	BAS
Philippine Textile Research Institute	PTRI
Agricultural Credit Policy Council	ACPC
Philippine Institute of Pure and Applied Chemistry	PIPAC
Twin Rivers Research Center	TRRC
Paper Industry Corporation of the Philippines	PICOP
ANSA Crops and Cattle Farms	

APPENDIX D. Agencies included in survey sample, 2002

Appendix Table D.1—*Government agencies*

Type of agency/region	Executing agency	Research focus	Researchers	
			Headcount	Fte's
National government agencies	Bureau of Agricultural Statistics (BAS)	Socioeconomics	492	103.0
	Bureau of Post-harvest Research and Extension (BPRE)	Postharvest	67	50.3
	Bureau of Soils and Water Management (BSWM)	Natural resources	298	98.3
	Food and Nutrition Research Institute (FNRI)	Crops	155	15.5
	National Irrigation Authority (NIA)	Irrigation	10	10.0
	Bureau of Fisheries and Aquatic Resources (BFAR)	Fisheries	20	20.0
	National Fisheries Research and Development Institute (NFRDI)	Fisheries	67	67.0
	Ecosystems Research and Development Bureau (ERDS)	Forestry, natural resources	198	198.0
	Philippine Textile Research Institute (PTRI)	Fiber crops	34	7.5
Regional government agencies				
Region I (Ilocos)	National Apiculture Research, Training and Development Institute (NARTDI)	Apiculture	7	1.8
	Cotton Development Authority (CODA)	Cotton	21	6.3
	Ilocos Integrated Agricultural Research Center (ILIARC/DA-I)	Crops, livestock	32	32.0
	Ecosystems Research and Development Service (ERDS/DENR-I)	Forestry, natural resources	29	29.0
	National Tobacco Administration (NTA)	Tobacco	24	23.0
	Philippine Carabao Center, Mariano Marcus State University (PCC-MMSU)	Livestock	9	2.7
	Philippine Carabao Center, Don Mariano Marcos University (PCC-DMMSU)	Livestock	7	7.0
	Philippine Rice Research Institute –Batac (PhilRice-B)	Rice	8	8.0
	Sericulture Research and Development Institute (SRDI)	Sericulture	34	34.0
Region II (Cagayan Valley)	Cagayan Valley Integrated Agricultural Research Center (CVIAR/DA-II)	Crops, livestock	80	60.0
	Ecosystems Research and Development Service (ERDS/DENR II)	Forestry, fisheries	25	12.0
	Mines and Geo-Sciences Bureau (MGSB-DENR)	Natural resources	21	2.9
	Philippine Carabao Center–Region II (PCC-III)	Livestock	7	7.0
	Philippine Rice Research Institute–Cagayan Valley Experiment Station (LBNCRDC/BPI)	Rice	28	28.0
Region III (Central Luzon)	Central Luzon Integrated Agricultural Research Center (STIARC/DA-IV)	Crops, livestock	38	3.8
	Ecosystems Research and Development Service (ERDS/DENR-IV)	Forestry, natural resources	15	15.0
	Philippine Carabao Center–Region III (PCC-III)	Livestock	27	27.0
	Philippine Rice Research Institute–Region III (PhilRice-III)	Rice	372	272.0
Region IV (Southern Tagalog)	Los Baños National Crops R&D Center (LBNCRDC/BPI)	Crops	19	13.3
	Southern Tagalog Integrated Research Center (STIAR/DA-IV)	Crops, livestock	76	53.2

Type of agency/region	Executing agency	Research focus	Researchers	
			Headcount	Fte's
	Ecosystems Research and Development Service (ERDS-DENR-IV)	Forestry, fisheries	22	22.0
	Forest Products R&D Institute (FPRDI)	Forestry	93	65.1
	Philippine Carabao Center–Region IV (PCC-IV)	Livestock	11	11.0
	Philippine Rice Research Institute–Region IV (PhilRice-IV)	Rice	15	15.0
Region V (Bicol)	Bicol Integrated Agricultural Research Center (BIARC/DA-V)	Crops, livestock	87	62.0
	Ecosystems Research and Development Service (ERDS/DENR-V)	Forestry, natural resources	23	18.0
	Fiber Industry Development Authority (FIDA-V)	Fiber crops	9	4.0
	Albay Research Center, Philippine Coconut Authority(ARC/PCA-V)	Coconuts	12	10.0
Region VI (Western Visayas)	National Mango R&D Center (NMRDC/BPI)	Mangoes	20	20.0
	La Granja National Crops R&D Center (LGNCRDC/BPI)	Crops	20	20.0
	Western Visayas Integrated Agricultural Research Center (WESIARC/DA-VI)	Crops, livestock	17	11.9
	Ecosystems Research and Development Service(ERDS)	Forestry	15	15.0
	Philippine Carabao Center (PCC- WVSU)	Livestock	6	6.0
	Philippine Carabao Center, La Carlota Stock Farm (LCSF)	Livestock	9	2.7
	Sugar Regulatory Administration (SRA-VI)	Sugarcane	31	31.0
	Cotton Development Administration, Visayas Field Operation Center (CODA-VFOC)	Cotton	1	0.3
Region VII (Central Visayas)	Central Visayas Integrated Agricultural Research Center (CENVIARC/DA-VII)	Crops, livestock	223	76.0
	Ecosystems Research and Development Service (ERDS/DENR-VII)	Forestry	12	12.0
	Fiber Industry Development Authority (FIDA-VII)	Fiber crops	1	1.0
	Philippine Carabao Center–Region VII (PCC-VII)	Livestock	8	8.0
Region VIII (Eastern Visayas)	Eastern Visayas Integrated Agricultural Research Center (EVIAR/DA-VIII)	Crops, livestock	124	33.0
	Ecosystems Research and Development Service (ERDS-DENR-VIII)	Natural resources, forestry	19	14.0
	Eastern Visayas Regional Fiber Experiment Station (EVRFES/FIDA-VIII)	Fiber crops	7	0.6
	Philippine Carabao Center–Region VIII (PCC-VIII)	Livestock	3	3.0
Region IX (Western Mindanao)	Western Mindanao Integrated Agricultural Research Center (WESMIARC/DA-IX)	Crops, livestock	41	28.7
	Ecosystems Research and Development Service (ERDS/DENR-IX)	Forestry, post-harvest	12	8.4
	Fiber Industry Development Authority (FIDA-IX)	Fiber crops	14	4.2
	Zamboanga Research Center, Philippine (ZRC/PCA-IX)	Coconuts	9	9.0
	Philippine Carabao Center – Region IX (PCC-IX)	Livestock	6	6.0
Region X (Northern Mindanao)	Northern Mindanao Integrated Agricultural Research Center (NOMIARC/DA-X)	Crops, livestock	59	59.0
	Ecosystems Research and Development Service (ERDS/DENR-X)	Forestry	24	15.0
	National Irrigation Administration (NIA-X)	Irrigation	4	4.0
	Philippine Carabao Center–Region X (PCC-X)	Livestock	8	8.0
Region XI (Southern Mindanao)	Davao National Crops R&D Center (DNCRDC/BPI)	Crops	59	17.7

Type of agency/region	Executing agency	Research focus	Researchers	
			Headcount	Fte's
	Southern Mindanao Integrated Agricultural Research Center (SMIARC/DA-XI)	Crops, livestock	25	25.0
	Ecosystems Research and Development Service (ERDS/DENR-XI)	Forestry	13	11.0
	Fiber Industry Development Authority (FIDA-XI)	Fiber crops	9	6.3
	Davao Research Center, Philippine Coconut Authority (DRC/PCA)	Coconuts	21	21.0
	Cotton Development Administration, Mindanao Field Operations Center (CODA-MFOC)	Cotton	4	1.2
Region XII (SOCCSKSARGEN)	Central Mindanao Integrated Agricultural Research Center (CEMIARC/DA-XII)	Crops, livestock	49	49.0
	Ecosystems Research and Development Service (ERDS/DENR-XII)	Natural resources	17	17.0
	Philippine Rice Research Institute, Midsayap (PhilRice-RTR)	Rice	16	10.7
	Philippine Carabao Center, Region XII (PCC-XII)	Livestock	10	10.0
Region XIII (Caraga)	Caraga Integrated Agricultural Research Center (CARIARC/DA-XIII)	Crops	23	9.0
	Ecosystems Research and Development Service (ERDS-DENR-XII)	Forestry	11	11.0
	Philippine Rice Research Institute, Remedios T. Romualdez (PhilRice-RTR)	Rice	8	8.0
Cordillera Administrative Region (CAR)	Baguio National Crops R&D Center (BNCRDC/BPI)	Crops	45	16.0
	Highland Integrated Agricultural Research Center (HIARC/DA-CAR)	Crops, livestock	15	9.8
	Ecosystems Research and Development Service (ERDS-DENR-CAR)	Natural resources	22	13.2
	Cotton Development Administration (CODA)	Cotton	1	0.3
Nonprofit agencies	Philippine Sugar Research Institute Foundation (PHILSURIN)	Sugarcane	17	17.0

Appendix Table D.2—*Higher-education agencies*

Type of agency/region	Executing agency		Research focus	Researchers	
				Headcount	Fte's
Region I (Ilocos)	Ilocos Sur Polytechnic State College (ISPSC)	College of Agriculture (CA)	Crops, livestock	25	7.5
	Don Mariano Marcos Memorial State University (DMMSU)	Institute of Agro forestry and Watershed Management (IAWM)	Forestry, livestock	18	18.0
		Institute of Environmental Studies (IES)	Natural resources	5	5.0
		Institute of Veterinary Medicine (IVM)	Livestock	8	8.0
	Mariano Marcos State University (MMSU)	Pangasinan State University (PSU)	Crops, livestock	29	7.3
		College of Agriculture and Forestry (CAF)	Crops, livestock, forestry	69	20.7
		College of Fisheries (CF)	Fisheries	10	3.0
		Research and Development Directorate (RDD)	Crops, livestock, fisheries	43	43.0
	University of Northern Philippines (UNP)	Center for Environmental Education and Sustainable Development (CEESD)	Crops, natural resources	6	1.8
Region II (Cagayan Valley)	Cagayan State University (CSU)		Livestock, fisheries, crops	N.A.	20.0
	Isabela State University (ISU)		Crops, livestock, forestry	N.A.	28.0
	Quirino State College (QSC)		Crops	58	5.8
Region III (Central Luzon)	Aurora State College of Technology (ASCOT)	Department of Agriculture and Aquatic Sciences (DAAS)	Crops, livestock, fisheries	19	1.9
		Department of Forestry and Environmental Sciences (DFES)	Forestry, natural resources	4	1.2
	Bataan State College (BSC)		Crops	7	2.1
	Central Luzon State University (CLSU)	Research Office (RO)	Livestock, crops, fisheries	17	4.3
		Freshwater Aquaculture Center (FWAC)	Fisheries	12	8.4
		Small Ruminant Center (SRC)	Livestock	6	2.4
		Armando Espino Jr. Water Resource Management Center (AEWRMC)	Natural resources	11	5.5
		Nueva Ecija Fruit and Vegetables Seed Center (NEFVSC)	Crops	21	10.5
		Ramon Magsaysay Technological University (RMTU)	Crops	8	2.8
		Philippine Sino Center for Agricultural Technology (PHILSCAT)	Postharvest	41	20.5

Type of agency/region	Executing agency		Research focus	Researchers	
				Headcount	Fte's
	Nueva Ecija University of Science and Technology (NEUST)	R&D Gabaldon Campus	Crops, livestock	11	1.1
		Pampanga Agricultural College (PAC)	Crops, natural resources	165	16.5
	Tarlac College of Agriculture (TAC)	Institute of Agriculture and Forestry (IAF/TCA)	Crops, forestry	39	11.7
		Institute of Arts and Science (IASC)	Postharvest	40	12.0
Region IV (Southern Tagalog)	Cavite State University (CSU)	College of Veterinary Medicine (CVM)	Livestock	12	2.4
		College of Agriculture, Forestry, Environment, and Natural Resources (CAFENR)	Crops	32	6.4
	Mindoro State College of Agriculture and Technology (MSCAT)		Crops, postharvest	10	10.0
	Rizal Technological University (RTU)		Crops, postharvest	N.A.	16.0
	Southern Luzon Polytechnic College (SLPC)	School of Agriculture (SA)	Crops, natural resources	19	1.9
	Western Philippines University (WPU)	Institute of Agriculture (IA)	Crops	29	8.7
		Institute of Environment (IE)	Natural resources	7	2.1
		Institute of Rural Studies and Development (IRSD)	Socioeconomics	9	2.7
		Institute of Engineering and Technology (IET)	Postharvest	8	2.4
	University of the Philippines Los Baños (UPLB)	Department of Agronomy, College of Agriculture (DACA)	Crops	17	5.1
		Dairy Training and Research Institute, College of Agriculture (DTRI/CA)	Livestock, socioeconomics	4	4.0
		Institute of Food Science and Technology, College of Agriculture (IFST/CA)	Crops	13	6.5
		Institute of Plant Breeding, College of Agriculture (IPB/CA)	Crops	12	12.0
		National Crop Protection Center, College of Agriculture (CPC/CA)	Crops	42	42.0
		Department of Plant Pathology, College of Agriculture (DPP/CA)	Crops	12	3.6
		Post harvest Horticulture Training and Research Center (PHTRC/CA)	Crops, socioeconomics	9	2.7

Type of agency/region	Executing agency		Research focus	Researchers	
				Headcount	Fte's
		Instruction Division, College of Agriculture (ID/CA)	Crops, socioeconomics	10	5.0
		Institute of Animal Sciences, College of Agriculture (IAS/CA)	Livestock	26	18.2
		Department of Entomology, College of Forestry and Natural Resources (DE/CFNR)	Crops, biodiversity	13	3.9
		Institute of Agro forestry, College of Forestry and Natural Resources (IAF/CFNR)	Forestry	6	6.0
		Makiling Center for Mountain Ecosystems College of Forestry and Natural Resources (MCME/CFNR)	Forestry, natural resources	11	11.0
		Institute of Renewable Natural Resources, College of Forestry and Natural Resources (IRNR/CFNR)	Forestry	23	11.5
		Department of Forest Biological Sciences, College of Forestry and Natural Resources (DFBS/CFNR)	Forestry	13	3.9
		Department of Forest Products and Paper Science, College of Forestry and Natural Resources (DFBS/CFNR)	Forestry	10	3.0
		Forest Development Center, College of Forestry and Natural Resources (FDC/CFNR)	Socioeconomics	18	18.0
		Department of Social Forestry and Forestry Governance, College of Forestry and Natural Resources (DSFFG/CFNR)	Forestry	10	3.0
		Agricultural and Bio-Process Division, College of Engineering and Agro-Industrial Technology (ABPD/CEAT)	Crops, postharvest	6	1.8
		Department of Chemical Engineering, College of Engineering and Agro-Industrial Technology (DCE/CEAT)	Crops	17	5.1
		Agricultural Mechanization Development Program, College of Engineering and Agro- Industrial Technology (AMDP/CEAT)	Crops	11	3.3
		Land and Water Resources Division,	Natural resources	10	3.0

Type of agency/region	Executing agency		Research focus	Researchers	
				Headcount	Fte's
		Institute of Agricultural Engineering, College of Engineering and Agro-Industrial Technology (LWRD/CEAT)			
		Agro meteorology and Farm Structures Division, Institute of Agricultural Engineering, College of Engineering and Agro-Industrial Technology (AFSD/CEAT)	Postharvest	5	1.5
		College of Veterinary Medicine (CVM)	Livestock	42	12.6
		School of Environmental Science and Management (SESM/UPLB)	Natural resources	7	2.1
		National Institute of Molecular Biology and Biotechnology (NIMBB)	Natural resources, crops, postharvest, livestock	63	63.0
		Institute of Biological Sciences (IBS/UPLB)	Crops, natural resources	81	8.1
Region V (Bicol)	Bicol University (BU)	College of Agriculture and Forestry (CAF)	Fisheries, livestock, crops, forestry	10	3.0
	Camarines Norte State College (CNSC)	College of Agriculture and Natural Resources (CANR)	Crops, postharvest	49	4.9
	Catanduanes State College (CSU)	College of Agri-Fisheries (CAF)	Socioeconomics, postharvest	14	1.7
	Camarines Sur State Agricultural College (CSSAC)		Socioeconomics, crops	162	32.4
	College of Agricultural Technology (CAT)		Crops, livestock	17	1.7
	Don Emilio B. Espinosa Sr. Memorial State College of Agriculture and Technology (DEBESMAC)	College of Agricultural Engineering (AE)	Crops, livestock	5	0.5
	Partido State University (PSU)	Research and Development Council (RDC)	Crops, fisheries	20	4.0
	Sorsogon State College (SoSC)	School of Agriculture and Agriculture-Based Technology (SAABT)	Natural resources, postharvest	N.A.	18.0
		School of Fisheries and Fishery-Based Technology (SFFBT)	Fisheries	N.A.	15.0
Region VI (Western Visayas)		Carlos C. Hilado Memorial State College (CHMSC)	Crops	N.A.	9.0
	Central Philippine University	College of Agriculture (CA)	Postharvest, crops, livestock	9	2.3

Type of agency/region	Executing agency		Research focus	Researchers	
				Headcount	Fte's
	Iloilo State College of Fisheries (ISCF)		Fisheries	40	10.0
	Negros State College of Agriculture (NSCA)		Crops	80	8.0
	University of the Philippines in the Visayas (UPV)	Institute of Fisheries Policy and Development College of Fisheries and Ocean Sciences (IFPDS)	Fisheries	1	1.0
		Institute of Marine Fish and Oceanology, College of Fisheries and Ocean Sciences (IMFO)	Fisheries	8	5.6
		Institute of Fish Processing Technology, College of Fisheries and Ocean Sciences (IFPT)	Fisheries	8	8.0
		Institute of Aquaculture, College of Fisheries and Ocean Sciences (IA)	Fisheries	15	15.0
		School of Technology (SOTEC)	Fisheries, socioeconomics	9	2.7
	Capiz State University (CSU)		Crops, livestock	N.A.	2.0
Region VII (Central Visayas)	Cebu State College of Science and Technology (CSCT)	College of Agriculture (CA)	Crops, livestock	48	14.4
		Agro-Industrial and Forestry College (AIFC)	Forestry, socioeconomics	14	1.4
	Central Visayas Polytechnic College (CVPC)	College of Agriculture and Forestry (CAF)	Crops	7	2.1
	Siquijor State College (SiSC)	Research, Development, Planning, Evaluation and Extension Services (RDPEES)	Forestry, socioeconomics	5	3.5
	University of San Carlos (USC)	Department of Biology (DB)	Natural resources, fisheries, crops	18	2.7
Region VIII (Eastern Visayas)	Eastern Samar State College (ESSC)	College of Agriculture and Natural Resources (CANR)	Crops, livestock	38	3.8
	Leyte State University (LSU)	Philippine Root crops Research and Training Center (PRRTC)	Crops	18	16.0
		National Abaca Research Center (NARC)	Fiber crops	7	6.0
		National Coconut Research Center (NCRC)	Coconuts	6	5.0

Type of agency/region	Executing agency		Research focus	Researchers	
				Headcount	Fte's
		Farm and Resource Management Institute (FARM)	Postharvest, natural resources	5	5.0
		College of Agriculture (CA)	Crops	N.A.	21.8
		College of Forestry (CF)	Forestry	8	2.0
		College of Veterinary Medicine (CVM)	Livestock	8	2.5
		College of Engineering (CE)	Postharvest	14	4.5
		College of Environmental and Agricultural Technology (CEAT)	Natural resources	N.A.	2.0
	Samar State Polytechnic College (SaSPC)	College of Fisheries and Marine Sciences, (CFMS)	Fisheries	5	1.5
	—	University of Eastern Philippines (UEP)	Livestock, crops	N.A.	54.0
	—	Tiburcio Tancinco Memorial Institute of Science and Technology (TTMIST)	Socioeconomics	1	1.0
	Leyte Institute of Technology (LIT)	College of Agriculture (CA)	Crops	18	1.8
		Carigara College of Fisheries (CCF)	Fisheries	23	2.3
Region IX (Western Mindanao)	Katipunan National Agricultural School (KNAS)		Crops, livestock	41	12.3
	Tawi-Tawi College of Technology and Oceanography (TCTO)	College of Fisheries (CF)	Fisheries	32	6.4
		College of Oceanography Studies (COS)	Fisheries	6	1.2
		Research Department (RD)	Fisheries, socioeconomics	20	10.0
	Tawi-Tawi Regional Agricultural College (TRAC)		Fisheries, crops	62	2.5
	Western Mindanao State University	College of Agriculture (CA)	Crops, socioeconomics	22	2.2
		College of Forestry (CF)	Forestry	16	1.6
		College of Technology and Oceanography (CTO)	Fisheries	20	2.0
		College of Agriculture (CA)	Crops, livestock	15	4.5
		College of Agri-Business (CA)	Crops, livestock	9	2.7
		Department of Research and Development (DRD)	Crops, livestock	17	8.5
	Mindanao State University (MSU)	Naawan Fisheries high School (NFHS)	Fisheries	37	3.7
	Mindanao Polytechnic State College (MPSC)		Crops	N.A.	3.3
	Zamboanga State College of Marine Science and Technology (ZSCMST)		Fisheries	120	2.4

Type of agency/region	Executing agency		Research focus	Researchers	
				Headcount	Fte's
Region X (Northern Mindanao)	Central Mindanao University (CMU)	College of Agriculture (CA)	Crops	69	13.8
		College of Veterinary Medicine (CVM)	Livestock	15	3.0
		College of Forestry (CF)	Forestry, natural resources	18	3.6
	Mindanao State University (MSU)	Iligan Institute of Technology (IIT)	Socioeconomics, fisheries	3	3.0
		Institute of Fisheries Research and Development (IFRD)	Fisheries	42	25.2
	Misamis Oriental State College of Agriculture and Technology (MOSCAT)	Institute of Agriculture (IA)	Crops, forestry	16	4.8
	Xavier University (XU)	College of Agriculture (CA)	Crops, socioeconomics	21	2.1
Region XI (Southern Mindanao)	Davao del Norte State College (DNSC)	Institute of Fisheries Technology (IFT)	Fisheries	6	1.8
	Davao Oriental State College of Science and Technology (DOSCST)	Agriculture and Food Technology Department (AFTD)	Crops, fisheries, livestock	25	25.0
	Southern Philippines Agribusiness and Marine and Aquatic School of Technology (SPAMAST)		Fisheries, livestock, socioeconomics	75	15.0
	University of the Philippines in Mindanao (UPM)	College of Science and Mathematics (CSM)	Crops, livestock, postharvest	36	7.2
		College of Humanities and Social Sciences (CHSS)	Crops, livestock, postharvest	11	2.2
	University of Southeastern Philippines (USP)	College of Agriculture (CA)	Crops, livestock, postharvest	26	6.5
		College of Forestry (CF)	Forestry	2	0.5
Region XII (SOCCSKSARGEN)	Cotabato Foundation College of Science and Technology (CFCST)	College of Agriculture (CA)	Crops, livestock	6	1.5
	Mindanao State University—General Santos City (MSU-GSC)	College of Agriculture (CA)	Crops, livestock	12	1.2
		College of Fisheries (CA)	Fisheries	22	2.2
	Mindanao State University—Marawi City (MSU-MC)	College of Agriculture (CA)	Crops, livestock	44	4.4
		College of Fisheries (CF)	Fisheries	22	2.2
		College of Forestry and Environmental Science (CFES)	Crops, livestock	25	2.5
	Notre Dame of Marbel University (NDMU)	Department of Agriculture, College of Science and Technology (DA/CST)	Crops	12	3.6

Type of agency/region	Executing agency		Research focus	Researchers	
				Headcount	Fte's
	Sultan Kudarat Polytechnic State College (SKPSC)	Institute of Agriculture (IA)	Crops, postharvest	24	2.4
		Institute of Fisheries (IF)	Fisheries	18	1.8
	Surallah National Agricultural College (SUNAC)		Crops, livestock	31	6.2
	University of Southern Mindanao (USM)	Research Department (RD)	Crops, livestock, socioeconomics	12	12.0
Region XIII (Caraga)	Agusan del Sur State College of Agriculture and Technology (ASCAT)	Institute of Agriculture (IA)	Crops, livestock	18	1.8
	Surigao del Norte College of Agriculture and Technology (SNCAT)		Crops, livestock, fisheries	35	7.0
	Surigao del Sur Polytechnic College (SuSPC)		Crops	15	1.5
	Northern Mindanao State Institute of Sciences and Technology (NORMISIST)	College of Agricultural Sciences and Natural Resources (CASNR)	Crops, socioeconomics	26	3.4
Cordillera Administrative Region (CAR)	Abra State Institute of Science and Technology (ASIST)		Crops, livestock, forestry	35	10.5
	Apayao State College (ASC)	Faculty of Agriculture (FA)	Crops, livestock	33	3.3
		Faculty of Forestry (FF)	Forestry	9	0.9
	Benguet State University (BSU)		Crops, socioeconomics	68	20.4
	Ifugao State College of Agriculture and Forestry (ISCAF)		Crops, forestry, socioeconomics	59	17.7
	Kalinga-Apayao State College (KASC)		Forestry, postharvest, crops	30	9.0
	Mountain Province State Polytechnic College	College of Forestry	Forestry	12	4.8

Appendix Table D.3—*Business enterprises*

Company name	Executing division	Location of R&D division	Majority ownership	Research focus	Researchers	
					Total	Fte's
Planters Agri-Chemical Corporation	—	Makati City	Local	Crops	5	4.0
Vitarich Corporation	R&D Feeds	Bulacan	Local	Livestock, fisheries	9	9.0
Lapanday Agricultural and Development Corporation	Lapanday Research Department	Davao City	Local	Fruit	181	181.0
Puentespina Orchids and Tropical Plants	—	Davao City	Local	Ornamentals	4	0.8
Tagum Agricultural and Development Corporation, Inc. (TADECO)	—	Davao del Norte	Local	Fruit	35	35.0
Cornworld Breeding Systems Corporation	Research and Seed Plant	Isabela	Local	Corn, rice	30	30.0
Marsman-Drysdale Agri-Holdings, Inc. (MDAHI)	Marsman-Drysdale Biotech and Research Corporation (MDBRC)	Davao del Norte	Foreign	Fruit	136	136.0
Provident Tree Farms, Inc. (PTFI)	—	Agusan del Sur	Local	Forestry	4	4.0
Fresh Del Monte Produce, Inc.	—	Davao del Norte	Foreign	Fruit	44	44.0
Del Monte Philippines, Inc.	Agricultural Research Department	Bukidnon	Foreign	Fruit	10	10.0
Pig Improvement Company (PIC) Philippines, Inc.	—	Luzon, Mindanao	Foreign	Livestock	17	3.4
Dole Philippines, Inc. (Dolefil)	Agri-Research Dolefil	South Cotabato	Foreign	Fruit	17	17.0
Stanfilco, Dole Philippines	Agricultural Development and Research Division	South Cotabato	Foreign	Fruit	11	11.0
East-West Seed Co., Inc.	R&D Division	Bulacan	Foreign	Vegetables	32	32.0
DuPont Far East, Inc.	DuPont Crop Protection Products, Registration and Development Team	Laguna	Foreign	Crops	2	2.0
BASF, Inc.	BASF Agricultural Research Foundation	Laguna	Foreign	Crops	6	6.0
Syngenta Philippines, Inc.	Technical and Development Department	Laguna	Foreign	Crops	7	4.2
Bayer CropScience, Inc.	Southeast Asia Field Research and Development Center	Laguna	Foreign	Crops	9	2.7
	Technical Services Department	Laguna	Foreign	Crops	2	2.0

Notes: Data for MDBRC are for 2003. The total researcher number for this corporation dropped sharply in 2004 to 72.

APPENDIX E—SUPPLEMENTARY TABLES

Appendix Table E.1—*Long-term composition of public agricultural R&D staff at regional agencies, 1981, 1991, and 2002*

Agency	Sample size	Research staff			Shares		
		1981	1991	2002	1981	1991	2002
		(fte researchers)			*(percentage)*		
Regional government agencies							
Bicol (Region V)	4	31.2	61.6	94.0	5.8	5.6	6.3
SOCCSKSARGEN (Region XII)	4	44.4	69.7	86.7	8.2	6.3	5.8
Caraga (Region XIII)	3	0.0	1.0	28.0	0.0	0.1	1.9
Central Luzon (Region III)	4	7.7	230.1	327.8	1.4	20.8	22.0
Cagayan Valley (Region II)	5	36.8	79.5	109.9	6.8	7.2	7.4
Central Visayas (Region VII)	4	39.3	73.7	96.1	7.3	6.7	6.5
Cordillera Admin. Region (Region CAR)	4	15.9	29.9	39.3	2.9	2.7	2.6
Ilocos (Region I)	9	33.4	104.9	145.7	6.2	9.5	9.8
Northern Mindanao (Region X)	4	9.0	20.0	86.0	1.7	1.8	5.8
Southern Mindanao (Region XI)	6	51.8	76.3	82.2	9.6	6.9	5.5
Southern Tagalog (Region IV)	6	129.8	194.8	179.6	24.0	17.6	12.1
Eastern Visayas (Region VIII)	4	14.5	30.5	50.6	2.7	2.7	3.4
Western Mindanao (Region IX)	5	34.1	42.5	56.3	6.3	3.8	3.8
Western Visayas (Region VI)	8	92.9	93.3	106.9	17.2	8.4	7.2
Subtotal	70	540.8	1,107.8	1,489.2	100	100	100
Higher education agencies							
Bicol (Region V)	8	26.0	44.3	57.3	4.4	5.2	5.0
SOCCSKSARGEN (Region XII)	11	25.1	38.5	39.6	4.3	4.5	3.5
Caraga (Region XIII)	4	4.5	8.9	13.7	0.8	1.0	1.2
Central Luzon (Region III)	13	27.1	38.3	69.3	4.6	4.5	6.1
Cagayan Valley (Region II)	3	35.3	45.2	53.8	6.0	5.3	4.7
Central Visayas (region VII)	5	18.2	17.6	24.1	3.1	2.1	2.1
Cordillera Admin. Region (Region CAR)	7	14.0	50.1	64.2	2.4	5.9	5.6
Ilocos (Region I)	9	74.6	95.7	113.7	12.7	11.2	10.0

Northern Mindanao (Region X)	7	39.8	50.9	55.5	6.8	6.0	4.9
Southern Mindanao (Region XI)	7	2.3	14.0	58.2	0.4	1.6	5.1
Southern Tagalog (Region IV)	35	184.9	252.2	313.4	31.4	29.6	27.6
Eastern Visayas (Region VIII)	15	64.6	93.8	129.1	11.0	11.0	11.4
Western Mindanao (Region IX)	14	50.2	60.3	81.5	8.5	7.1	7.2
Western Visayas (Region VI)	10	21.8	41.2	63.6	3.7	4.8	5.6
Subtotal	148	588.4	850.9	1,136.8	100	100	100

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

Notes: See Appendix D for a full list of agencies included in each region.

Appendix Table E.2—*Long-term composition of public agricultural R&D spending at regional government agencies, 1991 and 2002*

Agency	Sample size	Total spending				Shares	
		1991	2002	1991	2002	1991	2002
		(in million 2000 pesos)		*(in million 2000 international dollars)*		*(percentage)*	
Regional government agencies							
Bicol (Region V)	4	38.8	70.0	3.5	6.4	6.1	5.5
SOCCSKSARGEN (Region XII)	4	44.2	59.4	4.0	5.4	7.0	4.7
Caraga (Region XIII)	3	1.7	33.3	0.2	3.0	0.3	2.6
Central Luzon (Region III)	4	58.3	417.9	5.3	38.0	9.2	33.1
Cagayan Valley (Region II)	5	21.6	70.1	2.0	6.4	3.4	5.5
Central Visayas (Region VII)	4	54.8	86.8	5.0	7.9	8.6	6.9
Cordillera Admin. Region (Region CAR)	4	14.9	15.8	1.4	1.4	2.4	1.3
Ilocos (Region I)	9	68.7	97.8	6.2	8.9	10.8	7.7
Northern Mindanao (Region X)	4	7.5	52.6	0.7	4.8	1.2	4.2
Southern Mindanao (Region XI)	6	58.7	72.8	5.3	6.6	9.3	5.8
Southern Tagalog (Region IV)	6	158.7	137.1	14.4	12.4	25.1	10.8
Eastern Visayas (Region VIII)	4	17.7	34.4	1.6	3.1	2.8	2.7
Western Mindanao (Region IX)	5	45.8	52.5	4.2	4.8	7.2	4.2
Western Visayas (Region VI)	8	42.2	63.7	3.8	5.8	6.7	5.0
Total	70	633.5	1,264.2	57.7	115.1	100	100

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

Note: See Appendix D for a full list of agencies included in each region.

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