

PAPUA NEW GUINEA

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This brief reviews the major investment and institutional trends in public agricultural research in Papua New Guinea since the early 1990s, using recent data collected under the Agricultural Science and Technology Indicators (ASTI) initiative (IFPRI-APAARI 2003-04).¹

INSTITUTIONAL DEVELOPMENTS

Papua New Guinea (or PNG) has an abundant source of natural resources, yet the rugged terrain and the high cost of infrastructure development have hindered its ability to exploit them. Mineral deposits, including oil, copper, and gold, account for nearly three-quarters of the country's export earnings, but agriculture provides subsistence livelihoods to roughly 85 percent of PNG's population of 5.3 million. Agricultural research and development (R&D) consequently plays an important development role for the country. The authors identified ten agencies involved in agricultural R&D, nine of which are included in the sample.² These nine agencies employed a combined total of 115 full-time equivalent (fte) researchers and spent approximately 21 million 2000 kina on agricultural R&D—equivalent to 28 million 2000 international dollars (Table 1).³

PNG's principal agricultural research agency, the National Agricultural Research Institute (NARI), accounted for roughly 30 percent of the country's agricultural researchers and expenditures in 2002. NARI was established in 1996 and became fully operational in June 1998, when it officially took over the research activities of the Department of Agriculture and Livestock (DAL) (See *A Short History of Government-Based Agricultural Research* on page 2). NARI falls under the

Table 1—Composition of agricultural research expenditures and total researchers, 2002

Type of agency	Spending		Researchers ^a (fte's)	Share		Agencies in sample ^b (number)
	2000 PNG kina (millions)	2000 international dollars		Spending (percent)	Researchers	
Public agencies						
NARI	5.7	7.4	37.0	26.4	32.1	1
PNGFRI	1.9	2.4	28.0	8.6	24.3	1
Nonprofit ^c	11.4	14.8	38.2	52.9	33.1	3
Higher education ^d	0.5	0.6	4.2	2.3	3.6	2
Subtotal	19.5	25.2	107.4	91.4	93.1	7
Private enterprises						
Private enterprises	1.8	2.4	8.0	8.6	6.9	2
Total	21.4	27.6	115.4	100	100	9

Sources: Compiled by authors from ASTI survey data (IFPRI-APAARI 2003-04).

^a Includes national and expatriate staff.

^b See note 2 for a list of the nine agencies included in the sample. The Vudal Agriculture University was excluded from this table and further data analysis in this brief because data were unavailable.

^c Fte researcher and expenditure data for OPRA were estimated using 1998/99 data from Ghodake (1999).

^d Expenditures for the higher-education sector in the sample are estimates based on average expenditures per researcher at NARI and PNGFRI. The 14 faculty staff employed in the two higher-education agencies spent 30 percent of their time on research, resulting in 4.2 fte researchers.

KEY TRENDS

- Total agricultural researcher numbers in PNG rose steadily until 2001, but declined in 2002. Agricultural R&D expenditures showed an erratic upward trend until 1998, but in recent years have gradually fallen.
- PNG's main agricultural research agency is the National Agricultural Research Institute (NARI), accounting for roughly one-third of the country's agricultural researchers and a quarter of its agricultural R&D expenditures in 2002.
- In contrast to its predecessor, the current government is fully committed to financial support of NARI; providing 90 percent of its total funding. But it is anticipated that the institute will draw important foreign donor projects and generate substantial internal revenue in the years to come.
- In 2002, PNG's major commodity-specific research agencies, the Cocoa and Coconut Research Institute (CCRI), Coffee Research Institute (CRI), and PNG Oil Palm Research Association (OPRA), were responsible for over 50 percent of the country's agricultural R&D expenditures. Nevertheless, in recent years their combined share has steadily fallen, mostly as a result of reduced donor and government funding and declining income from commodity levies.
- In 2002, 9 percent of PNG's agricultural research was carried out by the private sector.

ABOUT ASTI

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

Primary funding for the ASTI initiative's survey round in Asia was provided by the CGIAR Finance Committee/World Bank.

the administrative responsibility of the Ministry of Higher Education, Research, and Technology, and is headquartered in Lae in the province of Morobe. It is governed by a council comprising representatives of various ministries, farmer organizations, and universities (NARI 2004). NARI's research program is separated into two distinct regions, the highlands and the lowlands, and then into agroecological zones, resulting in wet lowland, dry lowland, main highland, and high altitude highland programs. The largest region, the wet lowlands, is further subdivided into mainland and island activities. Development-oriented research on staple foods, emerging cash and food crops, livestock, and resource management issues is conducted at six regional research centers spread across the country.⁴ In addition to research, NARI is responsible for providing technical, analytical, and diagnostic services to PNG's agriculture sector. The institute focuses primarily on semi-subsistence smallholders in the country's rural areas.

The authors identified a second government agency conducting agricultural research in PNG, the Papua New Guinea Forest Research Institute (PNGFRI), which was established in 1989 under the Ministry of Forestry. In 2002, PNGFRI employed 28 fte researchers focusing on forest and timber products. Research activities are structured around four programs: the Natural Forest Management Program, the Planted Forest Programme, the Forest Biology Programme, and the Forest Products Programme. All programs are carried out from PNGFRI's sole station in Lae.

The higher-education sector plays only a limited role in agricultural research in PNG, accounting for only 2 percent of all agricultural research expenditures and 4 percent of fte researchers. The Department of Agriculture at PNG University of Technology offers undergraduate and postgraduate studies in agricultural sciences. In 2002, its 3.3 fte researchers carried out limited research on crops, livestock, and socioeconomics. The Department of Forestry at PNG University of Technology conducts limited research on forestry, forest products, ecology, and biodiversity, employing 0.9 fte researchers in 2002. Limited agricultural research is also conducted at the University of Vudal, but this agency is excluded from the analysis due to data unavailability.

The authors identified three nonprofit institutions conducting agricultural research on PNG's export crops: the PNG Cocoa

and Coconut Research Institute (CCRI), the Coffee Research Institute (CRI), and the Oil Palm Research Association (OPRA).⁵ DAL conducted export crop research until the 1980s, when this responsibility was transferred to respective commodity boards on the recommendation of a research system review (Ghodake 1999). In 2002, these three nonprofit agencies accounted for a third of the country's fte researchers and over half its total R&D expenditures.

CCRI focuses on developing cocoa and coconut production through technologies that sustainably increase the quantity and quality of output, while minimizing inputs. The institute employed 18 fte researchers in 2002, located at its two centers, the Tavilo Research Center and Stewart Research Station. CRI focuses on various aspects of coffee improvement, cultivation, and processing but also conducts research on intercropping for smallholder coffee growers (Ghodake 1999). CRI, headquartered in Aiyura in the Eastern Highlands and operating a substation in Mt. Hagen in the Western Highlands, employed 7 fte researchers in 2002. Since 1980, OPRA has developed new technologies and farm management techniques to improve oil palm production. The agency is based at Dami, in West New Britain, and employed an estimated 13 fte researchers in 2002.

Two private companies conducted agricultural R&D in PNG in 2002; together they accounted for 9 percent of agricultural researchers and R&D expenditures that year. Trukai Industries Limited commenced research operations in PNG in 1994 focusing mainly on rice, peanuts, and beef. Ramu Sugar Limited focuses largely on sugarcane management, cultivation, and yield and quality improvement; soil and plant nutrition; pest and disease control; and weed control (Ghodake 1999).

There is some collaboration among PNG's various agricultural research and extension agencies. Nationally, NARI works closely with CCRI, CRI, OPRA, PNGFRI, the higher-education agencies, and the private sector. International linkages in recent years included collaboration with the Australian Centre for International Agricultural Research (ACIAR), the Pacific Regional Agricultural Program (PRAP), the Australian government's overseas aid program (AusAID), the Commonwealth Scientific and Industrial Research Organisation (CSIRO, Australia), the International Agricultural Research Center for Development (CIRAD, France), the United Nations Development Programme (UNDP), the Food and Agriculture

A Short History of Government-Based Agricultural Research

Agricultural research in PNG began in the late 1920s with the establishment of the first formal agricultural research program at the Lowlands Agricultural Experiment Station, Keravat, in 1928. A second research station was established in the Aiyura Valley after the Second World War. In the 1950s, the Department of Agriculture, Stock, and Fisheries (DASF) took over responsibility for research, and a significant number of crops and livestock from Australia and Asia were introduced. A research system managed mainly by expatriate researchers was developed between 1950 and 1970, emphasizing cash crops. In this way, the sector developed along two separate streams: an expatriate-driven system of cash crops and a village system of food crops. During this time the national government was the primary source of funding for agricultural research, and tree crops were emphasized as a source of cash income through foreign exchange.

A major review in 1982 advocated diversification of the national agricultural research system through the establishment of commodity research programs, the promotion of multidisciplinary field teams to serve farmer needs, and increased administrative autonomy. By 1986/87, the system had been substantially restructured in line with these recommendations. The PNG Oil Palm Research Association (OPRA) was the first commodity agency created, and the Cocoa and Coconut Research Institute (CCRI) and the Coffee Research Institute (CRI) quickly followed. In addition, Ramu Sugar established a sugarcane center in 1991 to breed new varieties. The Department of Agriculture and Livestock (DAL) retained responsibility for research on food crops, alternative cash crops, and livestock. By 1988, the multidisciplinary approach was fully implemented by DAL. Despite this development, research was considerably constrained by lack of funding and trained personnel, bureaucracy, weak management and infrastructure, and ineffective linkages with extension services and farmers. This reality led to the creation of a National Agricultural Research Institute (NARI) in July 1996.

Sources: Ghodake (1999) and Sitapai et al. (1994).

Organization of the United Nations (FAO), various centers of the Consultative General of International Agricultural Research (CGIAR), and a number of international universities (Ghodake 1999). Collaboration ranges from joint projects to contract-based research. PNGFRI has international linkages with the Center for International Forestry Research (CIFOR), the Queensland Forestry Research Institute (QFRI, Australia), CSIRO, the Forest Research Institute of Malaysia (FRIM), the International Tropical Timber Organization (IITO), and the Forest Research Support Programme for Asia and the Pacific (FORSPA) (PNGFRI 1999). CCRI has a joint Cocoa Quality Improvement Project with ACIAR and also works closely with the International Plant Genetic Resources Institute (IPGRI); CRI works with the International Institute of Biological Control (IBC) and CIRAD and has recently commenced collaboration with ACIAR; OPRA reported widespread collaboration with the country's private oil palm sector (Koczberski et al. 2001) and also works closely with ACIAR. The PNG University of Technology is involved in joint research projects with various Australian, European, and Indonesian universities and has memoranda of understanding with DAL and CCRI to undertake joint research activities (Ponzetta 2004). The University also reported collaboration with NARI and Trukai Industries Limited.

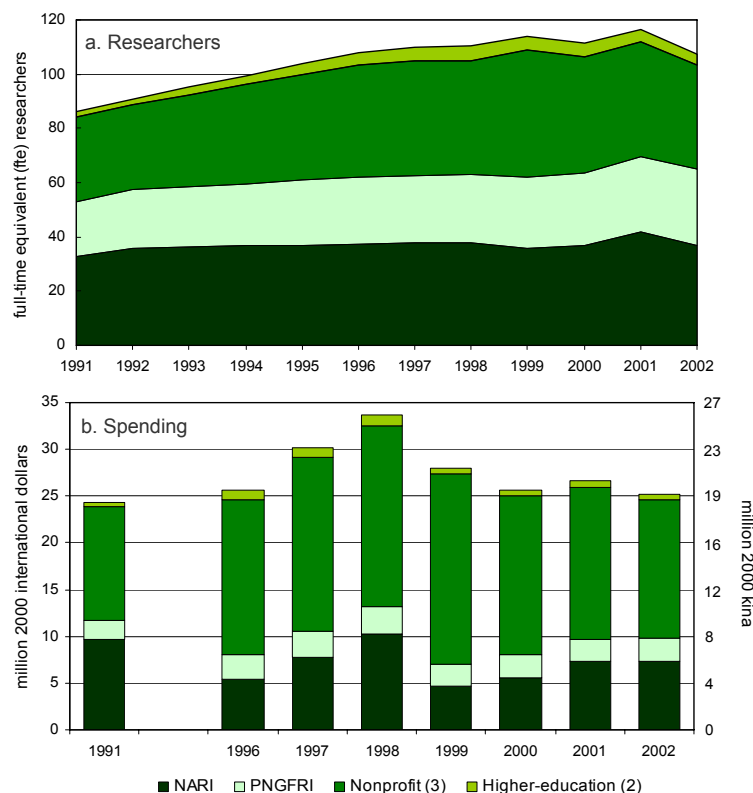
HUMAN AND FINANCIAL RESOURCES IN AGRICULTURAL R&D

Overall Trends

The total number of public agricultural researchers increased steadily by 2.9 percent per year—from 86 in 1991 to 117 in 2001—but declined by 7.9 percent in 2001/02 (Figure 1a).⁶ Until the mid-1980s, the vast majority of PNG's crop and livestock research was carried out by DAL. During the years immediately following the creation of the commodity-based research institutes, agricultural research expenditure and capacity increased rapidly (Ghodake 1999). This rise continued until 2001, although at a lesser rate than in the 1990s. The 2002 drop in total fte researcher numbers—which was reported across all three institutional categories—occurred because research agencies began retrenching less effective research staff who were unable to adapt to a new R&D ethos.

Total agricultural R&D expenditures in PNG followed a steep upward trend from 1996, the year NARI was established, until 1998, when NARI took over DAL's research activities (Figure 1b). Between 1999 and 2002, however, PNG's annual agricultural research expenditures declined by 2.7 percent on average. This decline was largely the result of diminishing expenditures at CCRI (given cuts in government and donor funding and reduced income from levies) and at CRI (given cuts in government funding). NARI's extremely low 1999 expenditure levels resulted from lack of support from the national government at that time due to its decision to abolish the institute. The subsequent (and current) government, which came to power in July 1999, advocated the continuation of NARI, hence expenditures rebounded during 1999–2002 at a rate of 17.7 percent per year.

Figure 1—Public agricultural R&D trends, 1991-2002

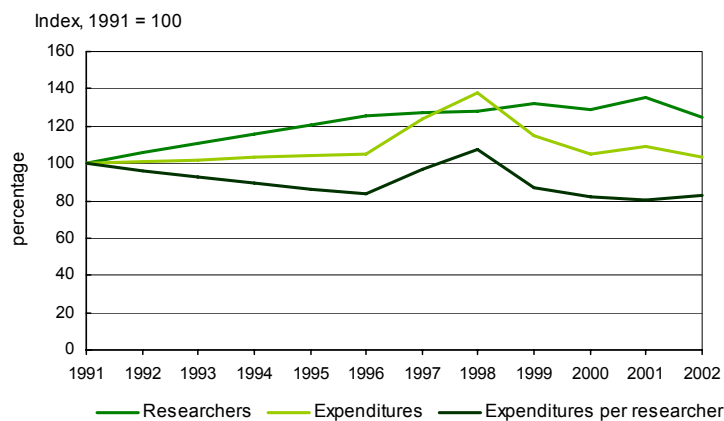


Sources: Compiled by authors from ASTI survey data (IFPRI–APAARI 2003-04); Ghodake (1999); and Sitapai (1992).

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

Average expenditures per researcher rose rapidly following the establishment of NARI, peaking at \$304,000 in 1998 (Figure 2). In the subsequent three years, however, this figure fell by nearly \$80,000. By 2002, average expenditures per researcher rebounded somewhat, to \$239,000, because of the sharp drop in researcher numbers and the stabilization of spending levels. On the whole, spending per researcher is relatively high in PNG compared with other developing countries in the region.

Figure 2—Trends in public expenditures, researchers, and expenditures per researcher, 1991-2002

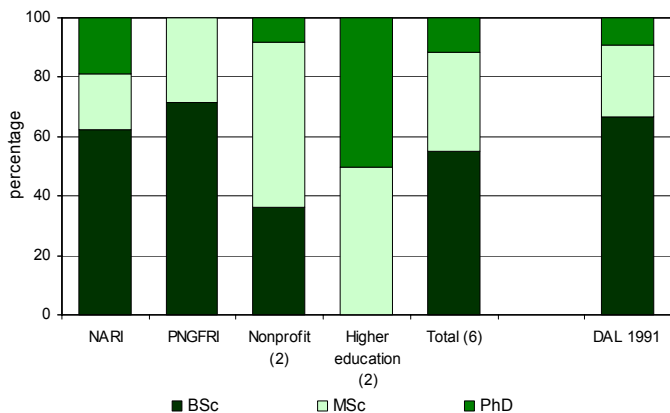


Source: Figure 1. 1992-95 expenditure data were interpolated.

Human Resources

In 2002, 45 percent of 94 fte researchers in a six-agency sample in PNG were trained to the postgraduate level and 12 percent held PhD degrees (Figure 3). Research staff at the higher-education agencies were considerably better qualified compared with staff at NARI and the private and nonprofit organizations, which is a consistent finding in the higher-education sector worldwide. Only about 40 percent of NARI's researchers were qualified beyond the BSc level in 2002—a reflection of the low priority given to training by NARI's predecessor DAL. When NARI became fully operational, new training programs were created, including formal academic training within and outside PNG for senior staff, and on-the-job training for junior scientists and support staff (NARI 2000). Five NARI staff were scheduled to undertake overseas training during 2000–04, and 30 staff were scheduled for in-country training (NARI 2000). As of 2002, two of NARI's researcher technicians had completed BSc training and four researchers had completed MSc degrees. Notably, no PNGFRI researchers held doctorate degrees in 2002.

Figure 3—Educational attainment of researchers, 1991 and 2002

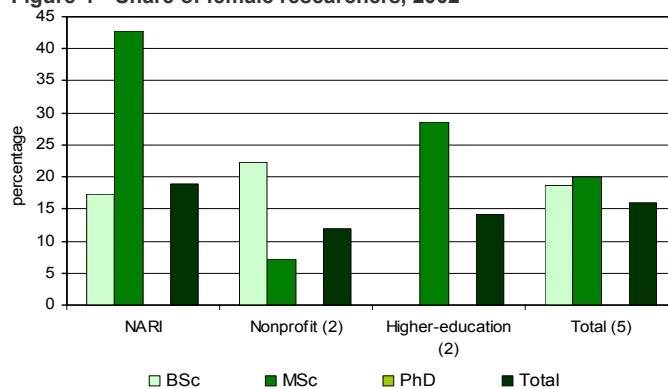


Source: Compiled by authors from ASTI survey data (IFPRI–NARI 2003-04).
Note: Figures in parentheses indicate the number of agencies in each category.

Based on a five-agency sample, 16 percent of all researchers in 2002 were female (Figure 4). With 7 of 37 fte researchers being female, NARI's share was the highest. The female researcher share was lower in the higher-education and nonprofit sectors, at 12 and 14 percent, respectively. In terms of qualifications, nearly 20 percent of fte researchers with BSc and MSc degrees were women; however, none of researchers in PNG in 2002 with doctorate degrees were female.

In 2002, the average number of support staff per scientist in a five-agency sample was 9.1, comprising 1.4 technicians, 0.7 administrative personnel, and 7.0 other support staff such as laborers, guards, and drivers (Figure 5). The ratio at the nonprofit institutions, at 13.0, was higher than the ratio at NARI (7.1) and much higher than the higher-education agencies (2.9), largely because of labor-intensive nature of coffee and cocoa production, requiring high numbers of other support staff. Unsurprisingly, support-staff-per-scientist ratios are traditionally lower in higher-education sectors (worldwide) because activities tend to be researcher-based with minimal requirements for other support staff. Average 2002 numbers at NARI reflect an increase from 4.9 in 1998, mainly caused by an increase in the other-support-staff category (from 149 to 215).

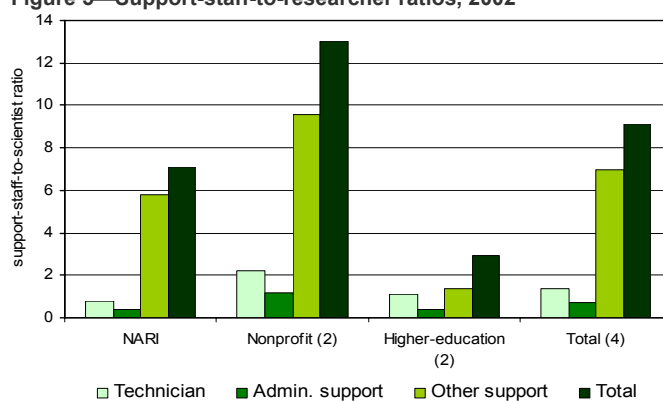
Figure 4—Share of female researchers, 2002



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

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

Figure 5—Support-staff-to-researcher ratios, 2002



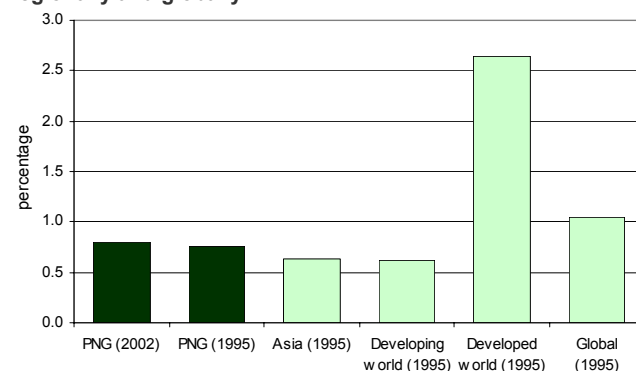
Source: Compiled by authors from ASTI survey data (IFPRI–NARI 2003-04).

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

Spending

Total public spending as a percentage of agricultural output (AgGDP) is a common research investment indicator used to compare a country's agricultural R&D spending with international equivalents. In 2002, PNG invested \$0.79 for every \$100 of agricultural output, which was moderately higher than the country's 1995 ratio of 0.72 (Figure 6). In turn, this 1995 ratio was moderately higher than the equivalent ratios for the Asia and Pacific region (0.63), excluding China and the developing world (0.62) that year.

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

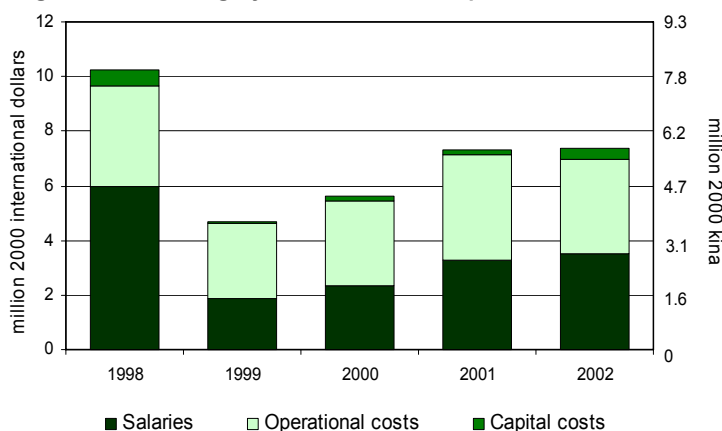


Sources: PNG compiled from Figure 1b; AgGDP data from World Bank (2004); other intensity ratios from Pardey and Beintema (2001). The intensity ratio for Asia excludes China.

During 1998–2002, salary and operating expenses each accounted for 48 percent of NARI's total expenditures, with capital costs making up the remaining 4 percent (Figure 7). Throughout this period, total salary and capital expenditures varied widely from year to year, while operating costs remained more or less stable, averaging around \$3.4 million per year. NARI has the freedom to determine how its annual budget from the national government is allocated. As previously mentioned, the institute received very little national government funding in 1999 because of plans by the incumbent government to close it down. In an attempt to remain operational, NARI prepaid significant amounts of its 1999 staff costs (both salaries and contract payments) in 1998, which explains the high level of salary expenditures that year. Research staff worked on a casual basis in 1999 until the new national government reinstated NARI's funding; thereafter, expenditure levels gradually rebounded.

Capital expenditures remained very low in the late 1990s and early 2000s; no funding was allocated for upgrading equipment, vehicles, or buildings. Unlike the nonprofit commodity agencies, DAL did not receive capital upgrades through the early 1990s ADB-financed Agricultural Research and Extension Project, so the infrastructure inherited by NARI was in disrepair. NARI quickly sought donor support after the initiation of research activities in 1998, and toward the end of 1999, the project Australian Contribution to a National Agricultural Research System in PNG (ACNARS) provided financial support for the renovation of buildings and equipment.

Figure 7—Cost-category shares in NARI's expenditures, 1998–2002



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

Note: Data include estimated salaries for expatriate staff (see *Methodology* on page 8).

In 2002, salaries constituted similar shares of expenditures at PNGFRI (40 percent), CCRI (44 percent), and NARI (49 percent), while salaries made up a larger share—about two-thirds—of expenditures at CRI, once again primarily because of the comparatively labor-intensive nature of coffee production.

FINANCING PUBLIC AGRICULTURAL R&D

Over the past decade, funding for agricultural research in PNG came from a number of sources including the national government, loans from the ADB, export levies, and various other (foreign) donors. Certain PNGFRI projects were funded

by ITTO and the MacArthur Foundation (PNGFRI 1999). CCRI's funding in recent years was primarily generated through an export levy and product sales, supplemented by funding from the national government, producer organizations, and donors including the European Union; the governments of Australia, New Zealand, and France; the Coconut Genetic Resources Network (COGENT); and the Common Fund for Commodities (CFC). OPRA depended largely on a plantation crop levy supplemented by government funding; in addition, many of its research projects were funded by external research grants (Koczberski et al. 2001). CRI received minimal government funding during 1996–2002. Research was financed via a levy on coffee proceeds, supplemented by donor funding, mainly from Australia, the European Union, and France. Research activities at the PNG University of Technology were largely funded by the private sector; ACIAR also provided funding for its joint research projects with the university. In recent years, however, operating budgets at PNG's higher-education agencies have been cut by 40 percent (Ponzetta 2004).

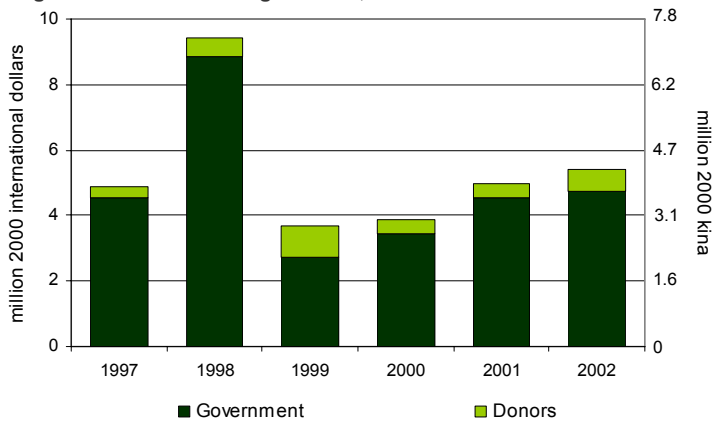
The ADB-funded Agricultural Research and Extension Project—the only large donor project to target PNG's agricultural R&D sector—ran from 1992 until 1996. The project sought to strengthen research and extension programs for various cocoa, coffee, oil palm, and tree crop farming systems through funding for the provision of buildings, equipment, vehicles, staff training, and operating costs. The project also assisted in the establishment of the Cocoa Coconut Extension Agency (CCEA). Support for agricultural research was provided through the four main research agencies existing at the time: CCRI, CRI, DAL and OPRA. The initial project budget totaled US\$27.5 million, comprising US\$22 million from the ADB loan and US\$5.5 million from the national government; total disbursements by the end of the project were slightly higher, at US\$28.6 million (US\$22.1 million from the ADB loan and 6.5 million from national government).⁷ The project was rated as a partial success. Staff training, buildings, equipment, and vehicles generally strengthened the agricultural R&D agencies involved; however, it was deemed that farmer needs and priorities were insufficiently addressed, as was the goal of formulating and managing long-term research and extension programs (ADB 1998).

National Agricultural Research Institute

Between 1997 and 2002, NARI's financing averaged \$5.4 million per year, but the year-to-year trend was erratic. Funding in the first year of the agency's operation was high, at \$9.4 million, but as previously discussed it contracted to \$3.7 million in 1999 (Figure 8). Overall, government funding averaged close to 90 percent of the institute's financial resources over this period, while the remainder was contributed by donors, including ACIAR, the Australian Quarantine and Inspection Service (AQIS), the European Union, the Secretariat of the Pacific Community (SPC), the World Bank, and AusAID.

As mentioned, the current PNG government is strongly committed to securing appropriate levels of funding for NARI in the years to come. Supplementary funding will be generated internally through the sales of products and services or contributed by foreign donors, including the ACIAR and the European Union, for specific projects.

Figure 8—NARI's funding sources, 1997–2002



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

Note: Total funding received was much lower than total spending because funding data excluded opening cash balances and contributions in-kind.

Funding through Commodity Levies

The three commodity-specific research agencies—CCRI, CRI, and OPRA—are largely financed through commodity levies as already discussed. Collection mechanisms used, and revenue shares allocated to research differ according to commodity:

- Cocoa and copra levies are 30 kina and 4 kina per metric ton of production value, respectively. Two-thirds of the cocoa levy is allocated for cocoa research activities, while 2 percent of the copra levy goes to coconut research (Omuru and Kingwell 2004). For oil palm, New Britain Palm Oil Limited (NBPOL) and all other oil palm growing companies pay 0.77 kina per metric ton of production value to OPRA in the form of a levy.
- PNG's coffee exporters pay approximately 80 kina per metric ton, which averages about 4 million current kina per year. In the past, a quarter of this coffee levy was allocated to research and another quarter to extension. Currently, however, no specific percentage of this levy is earmarked for coffee research.
- CRI's research funding is currently project based; funding is released only according to what is planned in specific projects.

PRIVATE AGRICULTURAL R&D

As discussed, the two private agencies that conduct agricultural R&D in PNG account for 9 percent of the country's total researchers and expenditures. Ramu Sugar Limited is publicly listed on the Port Moresby Stock Exchange and has achieved tremendous growth in recent years. This growth has yet to affect the company's research spending, however. Research conducted focuses on tropical sugar varieties, but the company also leads an important cattle-farming project and is expected to diversify into other crops with export potential, such as palm oil and peanuts, in the years to come. No levies are currently charged on sugar; sugar research is funded through internally generated sources. At present, this represents roughly 3 percent of the company's gross yearly revenues.

Trukai Industries Limited is committed to assisting PNG in increasing domestic food production. The company invests heavily in research, as indicated by average expenditures per

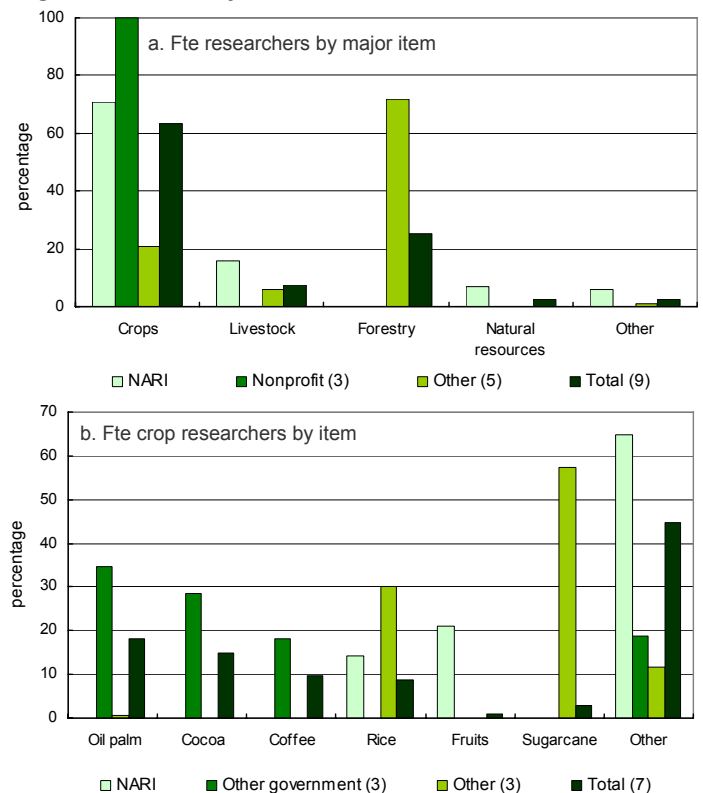
researcher of \$500,000 in 2002. The company focuses its research efforts on beef, peanuts, and rice (Trukai 2003).

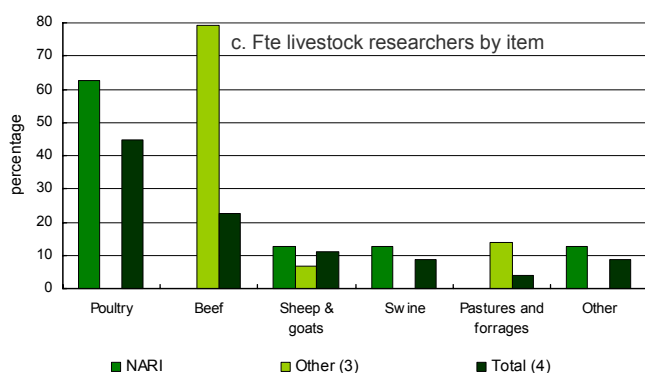
RESEARCH ORIENTATION

Commodity Focus

The allocation of resources across various lines of research is a significant policy decision; hence detailed survey information was collected on the number of fte researchers working in specific commodity and thematic areas. In 2002, of PNG's 115 fte researchers, close to two-thirds conducted crop research, a quarter conducted forestry research, and 7 percent conducted livestock research (Figure 9a). The remaining researchers focused on natural resources and other themes. The country's most researched crops were oil palm (18 percent), cocoa (15 percent), and coffee (10 percent) (Figure 9b). Research on these crops was almost entirely carried out by the nonprofit commodity agencies OPRA, CCRI, and CRI, respectively. NARI's crop researchers predominantly concentrated on rice; yams and other root crops such as taro, sweet potatoes, and cassava; and—to a lesser extent—bananas and other fruits and vegetables. All sugar research was carried out by Ramu Sugar. NARI's livestock researchers principally focused on poultry, followed by sheep and goats, and swine. The fte livestock researchers at the three other agencies involved in livestock research focused on a combination of beef, pastures and forages, and swine (Figure 9c).

Figure 9—Commodity Focus, 2002





Source: Compiled by authors from ASTI survey data (IFPRI-APAARI 2003-04).

Note: Figures in parentheses indicate the number of agencies in each category. The Department of Forestry was excluded because data were unavailable. Figure 9b only includes agencies involved in crop research; Figure 9c only includes agencies involved in livestock research.

Table 2—Thematic focus, 2002

	Numbers of researchers		Shares	
	NARI	Other (5)	NARI	Other (5)
	<i>(in fte's)</i>		<i>(percent)</i>	
Crop genetic improvement	7.4	9.8	20.0	26.9
Crop pest and disease control	10.0	7.7	27.0	21.3
Other crop	5.6	6.3	15.0	17.3
Livestock genetic improvement	—	0.6	—	1.7
Livestock pest and disease control	—	—	—	—
Other livestock	5.9	2.0	16.0	5.5
Soil	2.6	0.7	7.0	1.9
Water	—	—	—	—
Other natural resources	—	—	—	—
Postharvest	—	3.7	—	10.3
Other	5.6	5.5	15.0	15.2
Total	37.0	36.3	100	100

Source: Compiled by authors from ASTI survey data (IFPRI-APAARI 2003-04).

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

Thematic Focus

In 2002, 27 percent of NARI's researchers worked on crop pest and disease control, 20 percent on crop genetic improvement, and 7 percent on soils (Table 2). The remainder of NARI researchers focused primarily on other crop and livestock themes. The major themes at the other five agencies in the sample were crop genetic improvement (27 percent), crop pest and disease control (21 percent), and postharvest activities (10 percent).

CONCLUSION

Total fte agricultural researcher numbers in PNG rose steadily until 2001 and thereafter contracted as a result of restructuring and retrenchment of less productive staff. The country's agricultural R&D expenditures followed a more erratic trend. NARI struggled in its first years of operation, but a change in government brought renewed support and a commitment to ongoing funding. NARI is now expected to be able to draw important foreign donor projects and generate substantial internal revenues from its activities in the years to come.

In contrast to many other developing countries, PNG has a healthy nonprofit sector in agriculture comprising three agencies that focus on commodity-specific research. Although this sector represented the largest in terms of both researcher numbers and expenditures in 2002, its spending has steadily fallen in recent years. CCRI and CRI in particular experienced reductions in their funding from the national government, foreign donors, and commodity levies.

Other factors that set PNG apart from many other developing countries are the limited research role played by its higher-education sector, and the accompanying larger role played by the private sector.

NOTES:

- The authors are grateful to Geoff Fahey, Tom Kukhang, Lastus Kuniata, Peter Manus, Eric Omuru, Martin Powell, Neetha Rao, and Geoffrey Wiles for their assistance in data collection, and thank Raghunath Ghodake, Mark Johnston, and Alan Quartermain for useful comments on previous drafts of this brief.
- The nine-agency sample consisted of:
 - Two government agencies: the National Agricultural Research Institute (NARI) and the Papua New Guinea Forest Research Institute (PNGFRI);
 - Three nonprofit institutions: the PNG Cocoa and Coconut Research Institute (CCRI), the Coffee Research Institute (CRI), and the Oil Palm Research Association (OPRA);
 - Two higher-education agencies: the Department of Agriculture and the Department of Forestry, both under the PNG University of Technology; and
 - Two private enterprises: Ramu Sugar Limited and Trukai Industries Limited.

This sample excludes one higher-education agency involved in agricultural research, the University of Vudal, for which data were unobtainable.

- Unless otherwise stated, all data on research expenditures are reported in 2000 international dollars or in 2000 kina.
- The Dry Lowlands Research Program is coordinated from Laloki; the Mainland Wet Lowlands Program, from Bubia and Labu; the Island Wet Lowlands Program, from Keravat; the Highlands Program, from Aiyura; and the High Altitude Highlands Program, from Tambul (NARI 2004).
- In 2004, CCRI was renamed as the Cocoa and Coconut Institute of PNG (CCI) after its merger with the Cocoa Coconut Extension Agency (CCEA); CRI, the Coffee Development Agency (CDA), and the Coffee Industry Board (CIB) were amalgamated into the Coffee Industry Corporation (CIC) in 2003.
- Overall, expenditure on civil works, research training, and consultants was lower than budgeted, and expenditure on research and extension operations and vehicles and equipment was higher than budgeted (ADB 1998).

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METHODOLOGY

- Most of the data in this brief are taken from unpublished surveys (IFPRI and APAARI 2003-04).
- The data were compiled using internationally accepted statistical procedures and definitions developed by the OECD and UNESCO for compiling R&D statistics (OECD 1994; UNESCO 1984). The authors grouped estimates using three major institutional categories—government agencies, higher-education agencies, and business enterprises, the latter comprising the subcategories private enterprises and nonprofit institutions. The researchers defined public agricultural research to include government agencies, higher-education agencies, and nonprofit institutions, thereby excluding private enterprises. Private research includes research performed by private-for-profit enterprises developing pre, on, and postfarm technologies related to agriculture.
- Agricultural research includes crops, livestock, forestry, and fisheries research plus agriculturally related natural resources research, all measured on a performer basis.
- Financial data were converted to 2000 international dollars by deflating current local currency units with a PNG GDP deflator of base year 2000 and then converting to U.S. dollars with a 2000 purchasing power parity (PPP) index, both taken from World Bank (2004). PPP's are synthetic exchange rates used to reflect the purchasing power of currencies, typically comparing prices among a broader range of goods and services than conventional exchange rates.
- Annual growth rates 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.

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

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