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Agricultural R&D Capacity and Investments in the Asia–Pacific Region

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Science and technology (S&T) are major contributors to food security, poverty reduction, and economic growth, as has been proven in Asia since the early-1970s through the Green Revolution in agriculture. Continuing to secure such gains, however, is becoming an increasingly complex undertaking. More than ever, quantitative data are vital for measuring, monitoring, and benchmarking the performance of agricultural S&T systems, including their inputs and outcomes. This brief reviews major institutional developments and investment and human resource trends in agricultural research and development (R&D) in 11 countries of the Asia–Pacific region. The brief draws on a set of country briefs, reports, and underlying datasets developed by the Agricultural Science and Technology Indicators (ASTI) initiative. ASTI worked with regional partners to collect detailed quantitative and qualitative information on research capacity and investment trends within agricultural R&D agencies. These data were then linked with investment and human resource data from the Chinese government and other secondary sources to provide a broader regional and global context.

Institutional Developments in Public Agricultural Research

The region's early agricultural research efforts were established by European colonizing powers and mostly focused on commodity-based research, often funded through commodity levies. These structures remained in place until the mid-20th century, well after the majority of countries attained independence. As a result, national research efforts were initially highly fragmented. From the 1960s, however, many Asian countries began to centralize and consolidate their agricultural research systems. Bangladesh, India, Pakistan, the Philippines, and more recently Nepal, Sri Lanka, and Taiwan established an agricultural research council to oversee the management and funding of agricultural research and, in some cases, the day-to-day operations of agricultural research activities. Other countries such as Indonesia, Malaysia, Papua New Guinea, and South Korea merged their existing agricultural research operations to form a national agricultural research institute, often with considerable autonomy from their overarching ministry.

The institutional structure of most of the region's agricultural research systems has remained relatively unchanged over the past two decades. Unsurprisingly, however, given the region's diversity, considerable differences exist across countries. In most of the smaller countries, agricultural research is undertaken by a few government agencies and faculties of universities; in the large countries like China, India, and the Philippines the systems are extremely complex. Agricultural research is, however, still dominated by the government sector in most of the

11 countries included in the ASTI survey.[1] On average, the government sector employed close to two-thirds of the region's public agricultural R&D staff in 2002/03, while the higher education sector accounted for 38 percent, and the nonprofit sector for just 0.2 percent. At the country level, these relative shares shifted only slightly during the period 1991 to 2002/03.[2]

The higher education sector has gained prominence in a few countries; India, for example, reported that more of its agricultural researchers worked in the higher education sector than in the government sector as a result of a land-grant system that closely links education and research. Nevertheless, the individual capacity of many higher education agencies often remains very small. In the Philippines, for example, close to three-quarters of the 148 higher education units involved in agricultural research in 2002 employed 10 full-time equivalent (fte) researchers or fewer.

Overall, nonprofit institutions play only a limited role in agricultural research in the Asia–Pacific region. While nonprofit institutions, by definition, are not controlled by national governments, they are often linked to producer organizations and hence receive most of their funding through taxes levied on production or exports. Nonprofit organizations in Papua New Guinea operate this way, as do many nonprofit agencies that conduct research on export crops in Latin America and Africa. Agencies funded through taxes in Asia, however, do not always have nonprofit status. The R&D institutes conducting research on the principal export crops of Malaysia and Sri Lanka, for example, are financed through export levies, but they still fall under the direct supervision of government ministries. Nevertheless, these types of agencies often have a level of bureaucratic freedom than their parent organizations, giving them more flexibility when it comes to generating funding, employing, and incentivizing staff. Nepal was one of the few countries in the survey sample with a number of small nongovernmental organizations (NGOs) active in agricultural research.[3] These NGOs are entirely funded by foreign donors and mainly focus on issues related to rural development.

Human and Financial Resources in Public Agricultural Research

China has by far the highest capacity in agricultural R&D in the world, employing over 50,000 agricultural fte researchers in 2002 (Table 1). India also has a large agricultural research capacity, employing close to 17,000 fte researchers that year. Only three other sample countries—Indonesia, Pakistan, and the Philippines—had an agricultural research staff of 3,000 or more fte researchers in 2002, while in contrast Laos and Papua New Guinea each employed just over 100 agricultural fte researchers.

The total number of agricultural researchers in China actually declined by more than 10 percent during the period 1991–2002, from about 60,000 to 50,198 fte's. More recent data, however, indicate that the total number of researchers has rebounded, bringing the 2005 total close to the 1991 level. The number of agricultural researchers in India has remained fairly constant since 1991, although it declined by about 500 fte's in 2000/03 because of unfilled vacancies due to staff retirements and a national recruitment freeze. More recently, the Government of India has addressed this negative trend by approving the creation of 1,000 new research positions at the institutes of the Indian Council for Agricultural Research (ICAR). In contrast, Indonesia's staff of agricultural researchers grew considerably during the early 1990s to more than 5,100 fte's in 1995, but totals have since fallen due to major reorganizations of government-led agricultural R&D initiatives and the East Asian financial crisis.

The remaining nine sample countries display different growth patterns for the 1991–2002 period. In Laos, Nepal, and Vietnam, total agricultural research staff numbers grew considerably; in Malaysia, Papua New Guinea, and the Philippines growth was moderate; and in Bangladesh, Indonesia, Pakistan, and Sri Lanka growth slowed and in some instances declined due to national recruitment freezes. A number of countries are experiencing difficulties in attracting and retaining qualified research staff, especially in the government sector. In Bangladesh, Laos, Nepal, Pakistan, and Sri Lanka researchers within the government agencies are limited by low salary levels and a lack of promotional and other incentives, which has led many—often the more senior and well-qualified—to pursue opportunities within universities, nonresearch agencies, and even abroad. An alarming trend in a few other countries (Malaysia, Pakistan, Vietnam and, more recently, India) is that many of the most experienced and highly qualified researchers are approaching retirement age. Recruitment efforts have been

[1] The 11 countries included in the sample are Bangladesh, India, Indonesia, Laos, Malaysia, Nepal, Pakistan, Papua New Guinea, the Philippines, Sri Lanka, and Vietnam. In 2002, agricultural R&D spending in these countries constituted 63 percent of the region's agricultural R&D spending, excluding China and the region's four high-income countries (Australia, Japan, New Zealand, and South Korea).

[2] The data reported in this brief were compiled using internationally accepted statistical procedures and definitions developed for compiling R&D statistics by the Organisation for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO). Estimates were grouped into three major institutional categories: government agencies, higher education agencies, and business enterprises. Business enterprises comprised two further subcategories: private enterprises and nonprofit institutions. Public agricultural research is defined to include government agencies, higher education agencies, and nonprofit institutions (thereby excluding private enterprises).

[3] Some NGOs in other countries were also involved in agricultural research, but their activities were small and often ad hoc.

initiated in India, Malaysia, and other countries to build staff numbers, and especially qualification levels. A history of political isolation has imposed an additional barrier to capacity development in Laos and Vietnam; lack of knowledge of English, in particular, has seriously hindered postgraduate training opportunities abroad and limited access to international publications.

In 2002, spending on public agricultural R&D for the 11 sample countries and China combined totaled close to $5.1 billion (in 2005 international dollars). China accounted for half this amount, and India for a further 25 percent. Malaysia reported the third-largest spending on public agricultural research, followed by Indonesia, Pakistan, the Philippines and Bangladesh. The five remaining sample countries each spent less than $100 million.[4] China's agricultural research spending more than doubled between 1991 and 2002 (from $1.2 to $2.6 billion) as a result of significant increases in government support. The Indian government also increased its commitment to research over this timeframe, leading to substantial growth in the country's agricultural R&D expenditures, especially from 1996 to 2002. Total public agricultural research spending in Pakistan fell by about one-third during 1991–99 because of the

[4] Financial data in this brief are reported in real values using GDP deflators and purchasing power parity (PPP) indexes taken from the World Bank (2007, 2008). Data differ from those published in the underlying country briefs and reports due to a major revision of PPP indexes for China, India, and many other developing countries released by the World Bank early in 2008.

Table 1 Public agricultural researchers and R&D spending in 12 countries of the Asia–Pacific region, 1991–2002

	Total researchers			Total spending		
Region/country	**1991**	**1996**	**2002**	**1991**	**1996**	**2002**
	(full-time equivalents)			*(in million 2005 international dollars)*[a]		
China	60,114	53,083	50,198	1,174	1,531	2,574
South Asia						
Bangladesh	1,635	1,772	1,807	81	82	109
India[b]	14,968	16,675	16,737	746	861	1,355
Nepal	na	346	428	na	15	26
Pakistan	3,223	3,428	3,508	223	188	171
Sri Lanka	539	572	583	39	42	51
Southeast Asia						
Indonesia	4,548	4,760	4,751	220	255	177
Laos	na	na	109	na	na	13
Malaysia	937	1,041	1,118	227	267	424
Philippines	2,424	3,053	3,213	80	121	141
Vietnam	1,862	1,991	2,732	8	22	56
The Pacific						
Papua New Guinea	86	108	107	28	35	28
Sample total (11)[c]	30,596	33,842	35,093	1,680	1,907	2,551
Sample total plus China (12)[c]	90,710	86,925	85,291	2,854	3,438	5,125

Source: N. M. Beintema and G. J. Stads, *Diversity in agricultural research resources in the Asia–Pacific region* (Bangkok and Washington, DC: Asia–Pacific Association of Agricultural Research Institutions and International Food Policy Research Institute, forthcoming 2008).

Notes: Data in parentheses indicate the number of countries in each category; na indicates data were not available.

[a] Financial data are provided in real values using gross domestic product (GDP) deflators and purchasing power parity (PPP) indexes taken from the World Bank's *World development indicators 2007* and the World Bank's *2005 international comparisons program: Tables of final results*. PPPs 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.

[b] Fte researcher numbers include technicians holding university degrees at the Indian Council for Agricultural Research (ICAR) institutes and state agricultural universities.

[c] Regional totals include researcher and expenditure estimates for Nepal (1991) and Laos (1991 and 1996).

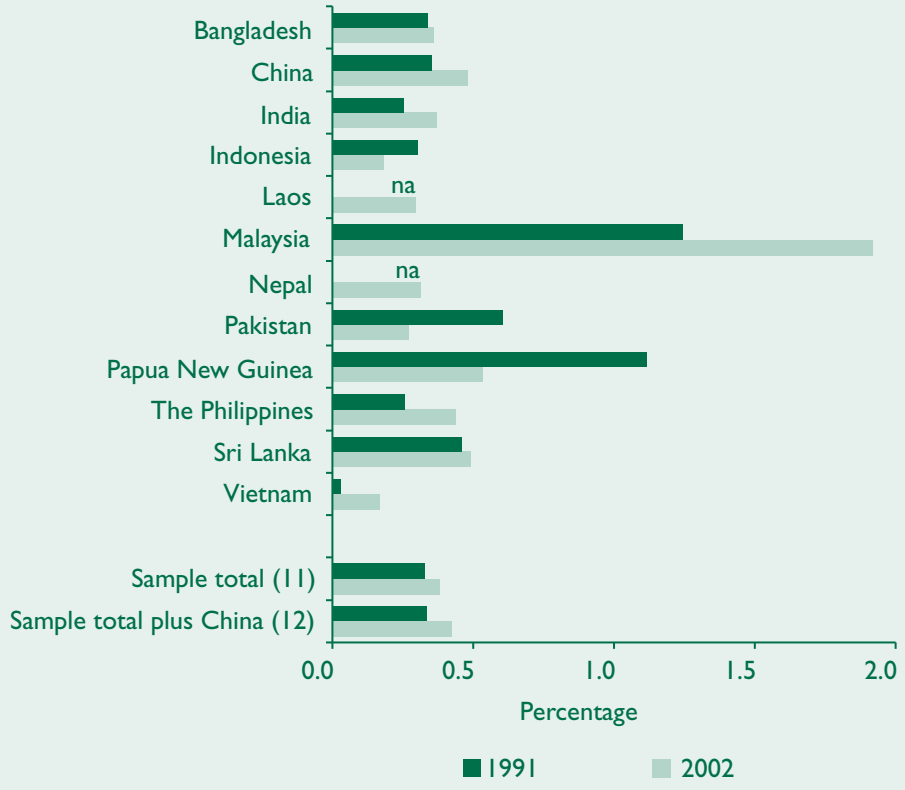
completion of various donor-funded projects at the Pakistan Agricultural Research Council (PARC), combined with declining government allocations to agricultural research. The Asian financial crisis of the late 1990s also had a severe negative impact on agricultural R&D spending in countries like Indonesia and the Philippines. In Indonesia, for example, real agricultural R&D spending fell by one-third during 1997/98 alone and had not rebounded to precrisis levels by 2003. Laos has been afflicted with mass inflation in recent years, such that its agricultural R&D expenditures (in real terms) were cut by more than half during 1999–2003. Growth in agricultural R&D spending was notably high for Vietnam, due to the prioritization of agricultural and rural development by the national government, and for Nepal, given the influx of funding between 1998 and 2002 due to a large World Bank loan.

Intensity Ratios

A useful, and internationally comparable, indicator of the level of national agricultural R&D is research intensity, which most commonly measures total public agricultural R&D spending as a percentage of agricultural gross domestic product (AgGDP). As a group, in 2002 the 11 sample countries and China invested $0.43 for every $100 of agricultural output, which represented a considerable increase over the $0.34 in 1991 (Figure 1). This indicates that growth in agricultural research spending, on average, outpaced growth in agricultural production. It is important to note, however, that the region's investment intensity is still very low compared with other world regions. Malaysia, an upper middle-income country, roughly doubled its agricultural research intensity during 1991–2002, reaching to 1.92 percent of AgGDP, largely as a result of strong growth in public agricultural research expenditures by the country's three government-owned commodity boards. In contrast, other countries such as Pakistan and Laos experienced severe reductions in their research intensity ratios as a result of the aforementioned declines in agricultural R&D spending.

While no official recommendation on agricultural research intensity ratios has been set, recent literature suggests a level of about 1 percent of AgGDP. This would not be appropriate in all contexts, however, given that prevailing policy and institutional environments must be taken into account, along with the broader structure of a country's agriculture sector and its overall economy. With the exception of Malaysia and Papua New Guinea, the intensity ratios of the 12 individual countries discussed here were all below 0.50 percent, indicating that further increases in agricultural research spending would continue to have a positive impact on agriculture. Undoubtedly, countries such as Pakistan and Laos are grossly underinvesting in agricultural R&D, but the need is less acute in some other countries like India, which—notwithstanding its low agricultural research intensity ratio of 0.37 percent—has a well-equipped agricultural research system in terms of infrastructure and human resources.

Figure 1—Intensity ratios, 1991and 2002



Source: N. M. Beintema and G. J. Stads, *Diversity in agricultural research resources in the Asia–Pacific region* (Bangkok and Washington, DC: Asia–Pacific Association of Agricultural Research Institutions and International Food Policy Research Institute, forthcoming 2008).

Notes: Data in parentheses indicate the number of countries in each category. Intensity ratios indicate the ratio of total public agricultural R&D spending to total agricultural gross domestic product.

Agricultural R&D Spending within a Broader Regional and Global Perspective

Using ASTI data and additional secondary sources for the period 1981–2002, agricultural R&D investment trends were calculated for all 31 countries of the Asia–Pacific region (Table 2).[5] In 2002, the region spent $9.6 billion on public agricultural R&D (in 2005 international prices), though spending levels varied considerably across countries. China and

Japan each represented more than a one-quarter share of this total, while India's public spending on agricultural R&D constituted 14 percent. The 11 low-income countries (excluding India) accounted for only 5 percent of the Asia–Pacific total. Other countries with significant public agricultural research spending were Malaysia, South Korea, Thailand, and Australia, whose expenditures ranged from $400 to $640 million each.

Agricultural R&D spending for the region in 2000, including the region's four high-income countries, totaled $8.7 billion or 38 percent of that year's global total of $22.9 billion. This represented a considerable increase over the 1981 share of 32 percent. Excluding the region's high-income countries, the 2000 share of the global total was 21 percent.[6]

Table 2 Regional and global trends in public agricultural R&D spending, 1981–2002

Region/country	Total spending			Regional shares		
	1981	1991	2002	1981	1991	2002
	(in million 2005 international dollars)			*(percentage)*		
The Asia-Pacific region by income class						
India	396	746	1,355	8.0	11.1	14.1
Other low-income countries (11)	244	390	440	4.9	5.8	4.6
China	711	1,174	2,574	14.4	17.5	26.8
Other middle-income countries (13)	610	966	1,308	12.4	14.4	13.6
Japan	2,128	2,534	2,683	43.2	37.7	27.9
Other high-income countries (4)	841	909	1,264	17.1	13.5	13.1
The Asia-Pacific region by subregion						
China	711	1,174	2,574	14.4	17.5	26.8
India	396	746	1,355	8.0	11.1	14.1
South Asia excluding India (5)	234	357	359	4.8	5.3	3.7
Southeast Asia (9)	598	967	1,355	12.1	14.4	14.1
The Pacific (11)	22	32	34	0.4	0.5	0.4
OECD countries (4)	2,969	3,443	3,945	60.2	51.2	41.0
Asia–Pacific region (31)	4,930	6,719	9,623	100	100	100
Global total (141)	15,513	20,266	22,924[a]	—	—	—

Source: N. M. Beintema and G. J. Stads, *Diversity in agricultural research resources in the Asia–Pacific region* (Bangkok and Washington, DC: Asia–Pacific Association of Agricultural Research Institutions and International Food Policy Research Institute, forthcoming 2008); Global totals from N. M. Beintema and G. J. Stads, *Measuring public agricultural research investments: A revised global picture*. (Washington, D.C: International Food Policy Research Institute, forthcoming 2008).

Notes: Data in parentheses indicate the number of countries in each category. "Other low-income countries" includes Bangladesh, Bhutan, Cambodia, Laos, Myanmar, Mongolia, Nepal, Pakistan, Papua New Guinea, the Solomon Islands, and Vietnam; "other middle-income countries" includes Fiji, Indonesia, Kiribati, Malaysia, the Marshall Islands, Micronesia, Palau, the Philippines, Sri Lanka, Samoa, Thailand, Tonga, and Vanuatu; "other high-income countries" includes Australia, French Polynesia, New Zealand, and South Korea. The income-class totals were scaled up from national spending estimates for 17 countries representing 95 percent of the reported regional total (89 percent if China and India were excluded). OECD indicates Organisation for Economic Co-operation and Development. The data in this section exclude city states such as Singapore and a few small Pacific islands for which data were unavailable.

[a] Data are for 2000.

[5] The data in this section exclude city states, such as Singapore, and a few small Pacific islands for which data were unavailable.

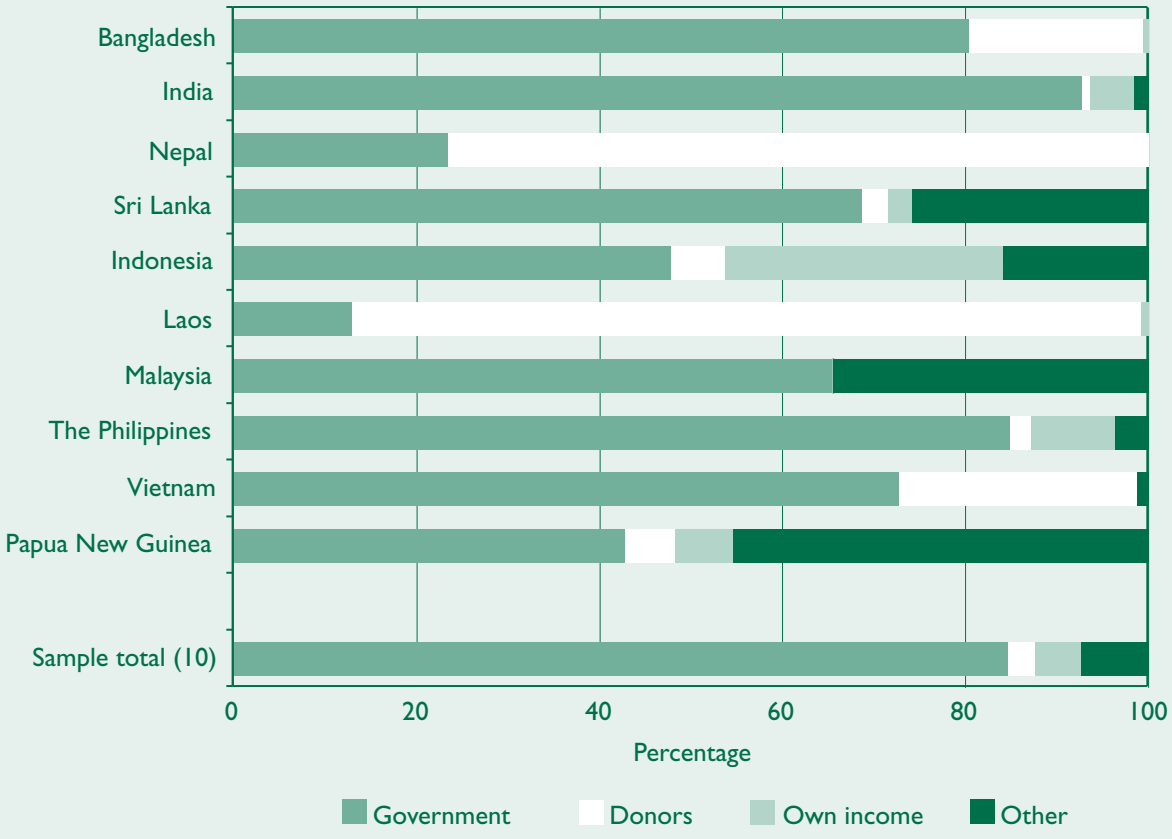
[6] These totals differ from the regional totals presented in Pardey et al. (*Agricultural research: A growing global divide?* Food Policy Report, International Food Policy Research Institute, 2006) because they include Australia, Japan, and New Zealand, which Pardey et al. treat as a separate developed-country category. In addition, the global totals reported in Beintema and Stads (*Measuring public agricultural research investments: A revised global picture*. International Food Policy Research Institute, forthcoming 2008) are lower due to the World Bank's aforementioned PPP index revisions in 2008.

Diversity in Financing Public Agricultural Research

Although government allocations represent the principal source of funding for public agricultural research in most countries in the Asia–Pacific region, funding sources differ significantly across countries. In 6 of the 10 sample countries (excluding China and Pakistan) for which detailed funding data were available, government contributions accounted for two-thirds (Malaysia and Sri Lanka) to over 90 percent (India) of total agricultural research funding in 2002/03 (Figure 2). Most of these government contributions came in the form of block-grants, but several countries—such as India, Indonesia, Malaysia, and Sri Lanka—have created competitive funding mechanisms as a means of diversifying and enhancing the efficiency of agricultural research funding. Public agricultural research in Laos and Nepal has traditionally been very donor-dependent. The principal agricultural research agencies in these two countries received more than three-quarters of their funding through donor contributions in 2002/03. In contrast, donor funding was an insignificant contributor to the financing public agricultural research in Malaysia and Sri Lanka (less than 3 percent).

In line with global trends, new mechanisms for financing public agricultural R&D are gradually gaining ground in a number of Asian countries. Internally generated income has become increasingly important in both China and Indonesia. Since the mid-1980s, the Chinese government has encouraged research institutes to generate income through commercial activities such as the provision of research services, and the Indonesian Research Institute for Estate Crops (IRIEC)—Indonesia's largest government agency in terms of R&D expenditures—now generates considerable revenues through the sale of seed and plantation crops, and by contract research for public/private enterprises. Malaysia, Papua New Guinea, and Sri Lanka have introduced a commodity levy system for export crops, whereby producers pay a tax on the production or export value of their respective commodity, and a share of the resulting

Figure 2—Funding sources, 2002/03



Source: N. M. Beintema and G. J. Stads, *Diversity in agricultural research resources in the Asia–Pacific region* (Bangkok and Washington, DC: Asia–Pacific Association of Agricultural Research Institutions and International Food Policy Research Institute, forthcoming 2008).

Notes: Figure excludes Pakistan. Data for Bangladesh, Nepal, Laos, and Vietnam are for the main agricultural research agency only; data for Sri Lanka, Indonesia, Malaysia, and the Philippines include a broader coverage of government agencies; data for Papua New Guinea include the main agricultural research agency and two of the three nonprofit organizations; data for India include all the institutes of the Indian Council for Agricultural Research (ICAR) and the state agricultural universities.

revenues is earmarked for research. The mechanisms for collecting revenues and shares allocated to research vary across countries and commodities.

Private-Sector Agricultural Research Investments

Agricultural research conducted by the private sector has grown in recent years, especially in the developed world, but the role of the private sector in agricultural research in the developing world is still small and likely to remain so given weak private funding incentives. Nonetheless, private-sector involvement in agricultural research is higher in many Asian countries than it is in the rest of the developing world. In addition to carrying out research, private companies also fund public agricultural research, either by outsourcing their research needs to government R&D agencies or though commodity levies paid by farmers. In Bangladesh, Laos, Nepal, and Sri Lanka, the private sector accounted for less than 1 percent of total public and private spending on agricultural R&D (Table 3). In Laos, the private sector is still underdeveloped as a result of the country's socialist past. Permits are difficult to obtain for private-sector start-up companies in agriculture, and standardized tax laws are largely absent. In Vietnam, where the private sector accounted for just 3 percent of total public and private spending in 2002, virtually all companies were government-owned until recently.

In Malaysia and Pakistan, private-sector involvement in agricultural R&D—though still comparatively small—was

Table 3 Estimated public and private agricultural R&D investments, 2002/03

Region/country	Expenditures			Shares	
	Public	Private	Total	Public	Private
	(in million 2005 international dollars)			*(percentage)*	
South Asia					
Bangladesh	109.4	0.6	110.0	99.4	0.6
India	1,355.0	na	na	na	na
Nepal	25.5	0.0	25.5	100.0	0
Pakistan	170.9	10.4	181.3	94.2	5.8
Sri Lanka	51.3	0.3	51.5	99.5	0.5
Southeast Asia					
Indonesia[a]	177.0	41.3	218.3	81.1	18.9
Laos	12.6	0.1	12.6	99.2	0.8
Malaysia	424.3	22.4	446.7	95.0	5.0
Philippines[b]	141.1	30.7	171.8	82.1	17.9
Vietnam	55.9	1.6	57.5	97.2	2.8
The Pacific					
Papua New Guinea	28.2	2.7	30.9	91.4	8.6
Sample total, excluding India (10)	1,167.7	107.5	1,275.2	90.7	9.3

Source: N. M. Beintema and G. J. Stads, *Diversity in agricultural research resources in the Asia–Pacific region* (Bangkok and Washington, DC: Asia–Pacific Association of Agricultural Research Institutions and International Food Policy Research Institute, forthcoming 2008).

Notes: Data in parentheses indicate the number of countries in each category; na indicates data were not available.

[a] Private-sector investments for Indonesia were scaled up to account for companies that did not provide financial data; the share of these omitted companies was estimated to be 30 percent of plantation crop research, 60 percent of seed research, 20 percent of forestry research, and 70 percent of agricultural research carried out by chemical companies.

[b] Private-sector investments for the Philippines were scaled up to account for companies that did not provide financial data; the share of these omitted companies was estimated to be about 15 percent of private-sector agricultural R&D spending.

more pronounced than in other countries of the region. Although the private sector is responsible for the vast majority of scientific research conducted in Malaysia's manufacturing sector, it undertakes only limited research in agriculture (5 percent of total public and private spending in 2002), mostly related to plantation crops. Pakistan's political and economic climate, coupled with unresolved intellectual property rights issues, is still regarded as unfavorable by many private investors. The Pakistani government has taken steps to encourage private-sector involvement in agricultural R&D, with the result that the private share appears to have risen in recent years.

Accounting for close to one-fifth of public and private agricultural R&D spending, the private sector plays a more important role in Indonesia and the Philippines than it does in the region's other countries. Indonesia in particular reported a notable increase in private-sector involvement in agricultural R&D, which is being carried out by a wide variety of plantation, seed, forestry, food-processing, and fishery companies, among others. The vast majority of private agricultural research in the Philippines focuses on plantation crops, notably fruit, although in recent years most plantation companies have curtailed their research activities because the Philippines is slowly losing ground to Latin American countries, especially Ecuador. Other private crop research in the Philippines involves hybrid varieties of rice, as well as maize and vegetables.[7]

Summary

The Asia–Pacific region is highly diverse in its geography, culture, politics, and history, and this diversity extends to its economic and agricultural development, and consequently to its agricultural R&D systems. In 2002, the Asia–Pacific region as a whole, including its four high-income countries, spent $9.6 billion on agricultural R&D (in 2005 international prices), with China, Japan, and India accounting for about 70 percent of this total. Regional investments in agricultural R&D grew considerably during the 1981–2002, especially in the last decade of the period, during which time both China and India intensified their agricultural research spending. Other smaller countries, such as Malaysia and Vietnam, also realized impressive agricultural R&D spending growth over this timeframe, whereas spending in Pakistan, Indonesia, and Laos, proved sluggish and at times negative, largely due to the Asian financial crisis, the completion of large donor-financed projects, or high rates of inflation.

Although the bulk of Asian agricultural R&D is still financed by national governments, new sources of funding are emerging in some countries. In particular, competitive funding mechanisms, internally generated revenues, and production or export levies have gained prominence. With the exception of Laos and Nepal, donor dependency is low. The private sector has also become more involved both in conducting its own research and in funding public agricultural research. Human and financial resource capacity is also varied: several countries have well-managed and funded systems producing world-class research, while others—some of which are highly dependent on agriculture—have experienced significant reductions in their R&D spending and research intensity levels. More than ever, a knowledge divide between the region's rich and poor countries and the scientific "haves" and "have-nots" is becoming visible. Sustainable financial and political support for agricultural R&D is crucial, as is the creation of attractive investment climates for private investors, if the challenges of sustainable economic and social development facing the region are to be met.

[7] Given the high volume of private companies with agricultural R&D programs in India, obtaining details of private agricultural R&D investments proved difficult; as a result, spending by India's private sector was excluded from the analysis.

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