2. A Snapshot of Agricultural Research Investment and Capacity in Asia

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ABSTRACT

Since the turn of the millennium, Asia has recorded rapid growth in its levels of agricultural research spending. Most of the growth in regional spending was driven by China. Spending in India and Indonesia has also increased substantially since 2000. However, many countries in Asia continue to underinvest in agricultural research. Cambodia, Lao PDR, and Pakistan still invest less than 0.20 per cent of their agricultural GDP in agricultural research, which is clearly insufficient considering the numerous emerging challenges these countries face, including widespread poverty, rapid population growth, climate change, and environmental degradation. On a positive note, the number of Ph.D. qualified agricultural researchers has risen in nearly all Asian countries since 2000, although in some countries–particularly Nepal, Pakistan, and Vietnam–many senior researchers are approaching retirement age. Women remain severely underrepresented in agricultural research in Asia. Many countries have a long way to go to ensure that female perspectives are integrated within research agendas.

Keywords: Agricultural research; Asia; Capacity; Expenditure; Investment; Researchers

1. Introduction

Agricultural research was one of the main drivers behind the enormous increases in food production in South, East, and Southeast Asia (referred to as "Asia" in the remainder of this report) during the twentieth century. The implementation of research-based agricultural methods and new technologies enhanced the quantity and quality of agricultural outputs, and led to rapid economic growth and poverty reduction. Despite these tremendous advances, Asia is still home to more than half of the world's poor. Most of them live in rural areas where agriculture remains the main source of employment and income.

The generation of new agricultural technologies is crucial to sustain economic growth, to increase labour productivity, and to meet the changing food needs of a wealthier (and in some countries rapidly growing) population in the coming decades. Policymakers know that more investment in agricultural research is the key to increasing agricultural production. But, because of scarce resources and competing demands on national budgets, shorter-term goals often take priority over longer-term agricultural research investments. This is why quantitative data are essential to an informed decision-making process. Agricultural research stakeholders need such data to analyse research investment and capacity trends, identify key gaps, set future priorities, promote efficient resource use, and ensure effective coordination and coherence of agricultural research initiatives. The International Food Policy Research Institute's (IFPRI's) Agricultural Science and Technology Indicators (ASTI) is the leading programme globally that provides agricultural research capacity, investment, and output data in developing countries.

ASTI datasets are fairly up-to-date and of high quality for most developing regions around the world, including Africa south of the Sahara, West Asia and North Africa, South Asia, and Latin America and the Caribbean. Funding constraints, however, have prevented ASTI from maintaining datasets with the same level of quality and detail for Southeast Asia (and the Pacific). Until recently, the most recent year for which complete ASTI data were available for the Asia region as a whole was 2009. Based on new (primary and secondary) data from a large number of Asian countries, the current

report provides an updated overview of agricultural research investment and capacity levels in low-and middle-income countries in Asia since 2000.

2. Data and Method

The data in this report only cover public national agricultural research. Staff and expenditure data for private-sector companies and international agricultural research agencies operating in the region, such as the centres of the Consultative Group on International Agricultural Research (CGIAR), have been excluded. ASTI follows the definition of agriculture provided by the Food and Agriculture Organization of the United Nations (FAO), which comprises crops, livestock, forestry, fisheries, natural resources, on-farm postharvest activities, as well as the socioeconomic aspects of primary agricultural production. The figures in this report, therefore, exclude off-farm postharvest, agrochemical, and food processing research. All ASTI datasets as well as those from external sources used in this report are collected and processed using internationally accepted definitions and procedures for compiling research statistics developed by the Organization for Economic Cooperation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

The analysis in this report is based on comprehensive datasets derived from a variety of sources. Data for Bangladesh, India, Nepal, and Pakistan are most detailed and complete as ASTI recently finalized first-hand data collection rounds from a comprehensive set of agricultural research agencies operating in these countries. Funding and time constraints prevented ASTI from collecting recent data with a similar level of detail from other Asian countries. However, in Laos, Malaysia, Sri Lanka, and Vietnam, ASTI was able to obtain detailed recent human resource and expenditure data from the principal agricultural research agencies operating in these countries. By linking these post-2010 data with existing complete pre-2010 ASTI datasets, and extrapolating the data for some of those countries' smaller research agencies to a more recent year based on the trend of the larger agencies, fairly comprehensive long-term country-level time series could be developed. Data series for China, Indonesia, and Thailand were derived from external sources (see Table 1). Recent data for Afghanistan, Bhutan, Maldives, Myanmar, the Philippines, and Timor Leste were unavailable, and these countries have been excluded from analysis in this report. It was not possible to update the information to the same year for all countries. The latest year for which data is available, therefore, differs from country to country.

Table 1. Data sources and availability

Country	Latest year of data availability		
	Human resources	Financial resources	Data source
Bangladesh	2012	2012	ASTI survey conducted in 2013/2014
Cambodia	2010	2010	ASTI survey conducted in 2011/2012
China	NA	2013	National Bureau of Statistics of China (2014)
India	2014	2014	ASTI survey conducted in 2015
Indonesia	2014	2014	ASTI survey conducted in 2011/2012, updated with recent financial and human resource data from IAARD (various years), FORDA (2014), and Industry (2015)
Lao PDR	2014	2014	ASTI survey conducted in 2011/2012, updated with unpublished recent first-hand financial and human resource data from the National Agriculture and Forestry Research Institute (NAFRI)
Malaysia	2014	2014	ASTI survey conducted in 2011/2012, updated with unpublished recent first-hand financial and human resource data from the Malaysian Agricultural Research and Development Institute (MARDI) and MASTIC (2014)
Nepal	2013	2013	ASTI survey conducted in 2013/2014
Pakistan	2012	2012	ASTI survey conducted in 2013/2014

Contd...

Table 1 (Contd.)

Country	Latest year of data availability		
	Human resources	Financial resources	Data source
Sri Lanka	2013	2012	ASTI survey conducted in 2010/2011, updated with unpublished recent first-hand financial and human resource data from a complete set of research agencies under the Sri Lanka Council for Agricultural Research Policy and the Department of Agriculture
Thailand	NA	2013	NRCT (various years) and Suphannachart (2015)
Vietnam	2015	2010	ASTI survey conducted in 2011/2012, updated with unpublished recent first-hand human resource data from agencies under the Vietnam Academy of Agricultural Sciences

Source: Constructed by author; NA denotes that data are not available

3. Institutional Context

The structure of national agricultural research systems (NARS) in Asia is highly complex, comprising a large number of government, higher education, private sector, and international research agencies. China's agricultural research system consists of an array of national-, provincial-, and prefectural-level agencies. The focus of the national research agencies, including the Chinese Academy of Agricultural Sciences, the Chinese Academy of Fishery Sciences, and the Chinese Academy of Tropical Agricultural Sciences is on basic research and technologies that address key national priorities and challenges. Research conducted by the provincial and prefectural agencies is mostly applied.

In India, a considerable share of agricultural research falls under the Indian Council for Agricultural Research (ICAR), which oversees a large number of agencies focusing on crop, livestock, fisheries, natural resources, agricultural engineering, and policy research. In addition, the country has a comprehensive network of State Agricultural Universities, which conduct state-specific research and education. The organization and coordination of the NARS in Bangladesh, Nepal, Pakistan, and Sri Lanka bear some similarities to India's system in that they all have national agricultural research councils that coordinate agricultural research, set priorities, and administer competitive grant schemes. However, their roles and scope of authority vary and in some cases are undergoing change.

The setup of NARS in Southeast Asia differs from one country to the other. In Indonesia, the Indonesian Agency for Agricultural Research and Development (IAARD) oversees nine major research centres that focus on crop and livestock research. The Indonesian Research Institute for Estate Crops–the largest agricultural research agency in the country in terms of expenditures–is linked to IAARD, but not formally part of it. The Forest Research and Development Agency oversees most of the country's forestry research, and the higher education sector (dominated by Bogor Agricultural University) plays a fairly important role in the country's agricultural research as well. Cambodia, Lao PDR, and Malaysia all bear some similarity in that their NARS are anchored by large national agricultural research institutes, complemented by a number of smaller government and higher education agencies. In the case of Malaysia, the palm oil, rubber, and cocoa commodity boards play a particularly important role in agricultural research as well. In Thailand, the bulk of research falls under the Ministry of Agriculture and Cooperatives, which oversees four main research departments that focus on rice, other crops, livestock, and fisheries. The country's universities play a critical role in agricultural research too, Kasetsart University in particular. The institutional setup of agricultural research in Vietnam has undergone significant changes over the past decade. Two consecutive rounds of mergers reduced the number of government research agencies from 28 to 6. The Vietnam Academy of Agricultural Sciences currently oversees the bulk of the country's agricultural research.

In most countries in Asia, the government sector employs the majority of agricultural researchers. One important exception is India, where the higher education sector dominates in terms of number of researchers. Throughout Asia, the role of the

higher education sector has gradually risen in recent decades based on an increase in the number of higher education agencies, both through the creation of new universities and of new departments and faculties within existing universities. Still, many of these universities and faculties employ only a handful of agricultural researchers. A number of non-profit agencies, mostly non-governmental organizations, operate in the region. In Cambodia and Nepal, in particular, they play a fairly important role in national agricultural research.

4.1. Agricultural research spending

4.1.1. Investment levels across countries

In accordance with international standards developed by the Organization for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific, and Cultural Organization (UNESCO), all spending data in this report are expressed in purchasing power parity (PPP) dollars, which measure the relative purchasing power of currencies across countries by eliminating national differences in price levels (see Box 1). Agricultural research spending levels differ broadly across the Asian sample countries. China ranks the highest. In 2014, the country spent 9.4 billion PPP dollars (in 2011 prices) on agricultural research (Table 2). India and Indonesia ranked second and third, spending 3.4 billion and 1.4 billion PPP dollars (in 2011 prices) that year, respectively. Unsurprisingly, spending levels in some of the region's smaller countries are considerably lower.

Asia has recorded rapid growth in agricultural research expenditure levels since the turn of the millennium. However, most of the growth in regional spending was driven by just one country: China. Following a period of stagnation in spending the 1990s, the Chinese government passed some reforms in the early 2000s, which promoted innovation in agricultural science and technology and opened new funding opportunities. As a result, Chinese agricultural research expenditures nearly quadrupled in inflation-adjusted terms during 2000–2013. Agricultural research expenditure levels in India also quadrupled during 2000–2014, when expressed in current prices (chiefly due to increased government support). However, corrected for relatively high levels of inflation, growth in Indian agricultural research spending was considerably lower (75% during 2000–2014). Indonesia also recorded remarkable growth. The country's agricultural research expenditures have more than doubled since the turn of the millennium. In contrast, Sri Lanka's security situation forced the government to divert resources to national security, leading to an overall decline in agricultural research investment levels. In Lao PDR, recent increases in government funding to agricultural research were offset by high inflation levels and reduced donor support, prompting an overall drop in agricultural research spending (in real terms).

Box 1: Purchasing power parity exchange rates as the preferred measure of research investments

Comparing research data is a highly complex process due to important differences in price levels across countries. The largest components of a country's agricultural research expenditures are staff salaries and local operating costs, rather than internationally traded capital investments. For example, the wages of a field laborer or a laboratory assistant at a research facility are much lower in Cambodia than they are in any European country; similarly locally made office furniture in Pakistan will cost a fraction of a similar set of furniture bought in the United States.

Standard market exchange rates are the logical choice for conversions when measuring financial flows across countries; however, they are far from perfect for comparing economic data. When calculating economic data, such as agricultural research spending across countries, the preferred method is the purchasing power parity (PPP) index. PPPs measure the relative purchasing power of currencies across countries by eliminating national differences in pricing levels for a wide range of goods and services. PPPs are also used to convert local prices in individual countries to a common currency. In addition, PPPs are relatively stable over time, whereas exchange rates fluctuate considerably.

Table 2. Agricultural research spending (excluding private for-profit sector), 2000–2014

Country	Total spending (in million 2011 PPP dollars)						
	2000	2005	2010	2011	2012	2013	2014
Bangladesh	200.4	158.0	239.0	256.4	250.6	NA	NA
Cambodia	17.7	19.8	22.4	NA	NA	NA	NA
China	2,614.9	3,769.8	7,887.5	7,768.2	8,918.9	9,366.2	NA
India	1,927.9	2,269.6	2,880.5	3,194.6	3,473.2	3,279.4	3,360.3
Indonesia	579.6	914.7	1,067.7	1,182.0	1,282	1,585.2	1,352.7
Lao PDR	37.2	21.4	16.2	14.5	12.8	8.8	8.8
Malaysia	91.0	117.0	101.6	78.6	83.7	87.9	86.5
Nepal	39.2	29.8	36.5	49.9	53.4	47.9	NA
Pakistan	235.6	305.0	291.5	291.0	332.5	NA	NA
Sri Lanka	90.4	59.4	49.2	51.2	46.4	NA	NA
Thailand	327.0	278.0	439.5	354.4	390.0	423.6	NA
Vietnam	61.6	108.9	136.0	NA	NA	NA	NA

Source: See Table 1

Notes: NA denotes that data are not available. Numbers in italics have been extrapolated based on available recent data from agencies listed in Table 1. In 2010, IAARD, FORDA, AMFR, and Bogor Agricultural University accounted for 50 per cent of Indonesia's agricultural research spending; NAFRI accounted for 80 per cent of total agricultural research spending in Lao PDR in 2010; MARDI accounted for 26 per cent of agricultural research spending in Malaysia in 2011; NARC accounted for 85 per cent of agricultural research spending in Nepal in 2012; government agencies accounted for 89 per cent of agricultural research spending in Sri Lanka in 2009.

4.2. Intensity of agricultural research spending

Analysing absolute levels of research expenditures explains only so much. Another way of comparing the commitment to agricultural research investments across countries and over time is to measure total agricultural research spending as a share of agricultural output (AgGDP). This relative measure goes beyond absolute agricultural research spending levels to indicate the "intensity" of research investments. The United Nations have called for minimum agricultural research investment targets of at least 1 per cent of AgGDP, but none of the twelve Asian sample countries have reached that target in recent years (Figure 1).

China's intensity ratio (0.62 in 2013) was more than twice as high as India's (0.30 in 2014). As previously mentioned, both China and India have recorded considerable growth in agricultural research investment since 2000, but so have their respective AgGDP levels. As a result, the intensity ratio in China has increased only very slowly on the long run, while India's intensity ratio has remained relatively stagnant. At 0.84 per cent in 2014, Malaysia recorded the highest intensity ratio among the twelve sample countries. Nonetheless, this ratio has shown an enormous decline in recent years as a result of a drop in agricultural research expenditures (in real terms) coupled with a rapid increase in agricultural output.

Although intensity ratios provide useful insights into relative investment levels across countries and over time, they fail to take into account the policy and institutional environment within which agricultural research occurs, the broader size and structure of a country's agricultural sector and economy, or qualitative differences in research performance across countries. For these reasons they need to be interpreted carefully within the context of national circumstances. A one-size-fits-all investment target for the region is certainly not desirable given that structural economic differences call for different investment strategies. In fact, countries like China and India have very developed and successful research systems, and can be said to invest sufficiently in agricultural research given the size of their economies and their income levels.

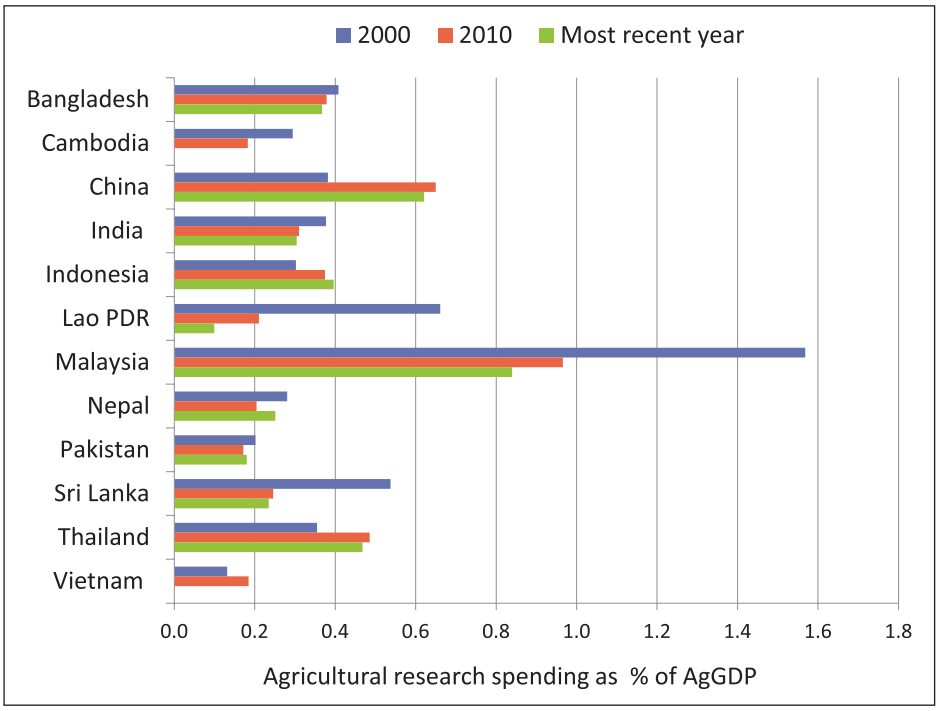


Figure 1. Intensity of agricultural research spending (excluding private for-profit sector) (*Source: See Table 1*)

Note: The most recent year of available data is 2010 for Cambodia and Vietnam; 2012 for Bangladesh, Pakistan, and Sri Lanka; 2013 for China, Nepal, and Thailand; and 2014 for India, Indonesia, Lao PDR, and Malaysia. The 2012 intensity ratio for Bangladesh differs slightly from the one published in the ASTI country factsheet because of recent World Bank revisions to its GDP deflators and AgGDP figures for Bangladesh.

Despite the limitations of intensity ratios, they do reveal that many countries in Asia are underinvesting in agricultural research. Cambodia, Lao PDR, and Pakistan all invest less than 0.20 per cent of their AgGDP in agricultural research, which is clearly insufficient considering the numerous emerging challenges these countries face, including widespread poverty, rapid population growth, climate change, and environmental degradation. Being aware of these challenges, some national governments have set ambitious agricultural research investment targets (India and Nepal, for example, aim to invest 1 per cent of their AgGDP on agricultural research, and Sri Lanka has set itself a target of 1.5 per cent). Although such investment targets can be useful to mobilize resources for agricultural research, simply doubling, tripling, or quadrupling investments should not be misconstrued as the end goal. The real goals are to ensure that research agencies have the necessary human, financial, operating, and infrastructural resources to effectively and efficiently develop, adapt, and disseminate S&T innovations within an appropriate enabling public policy environment in order to maximize their impact on the agriculture sector, on rural and economic development more generally, and ultimately on poverty and hunger.

4.3. Allocation of expenditures across cost categories

A closer look at the composition of agricultural research spending reveals some important cross-country differences in terms of how expenditures are allocated across salaries, operating and programme costs, and capital investments. India, Malaysia, and Pakistan, for instance, spent between 60 and 80 per cent on salary-related costs, while the bulk of agricultural research funding in Cambodia and Vietnam goes towards operating and programme costs (Figure 2). No formula can determine the optimal allocation of agricultural research spending across cost categories: it depends on numerous factors, including country size, agroecological diversity, research mandates, and the composition of staffing. That said, when salary-related expenditures consume more than three-quarters of a research agency's total budget, a clear imbalance exists, such that too few resources remain to support the costs of operating

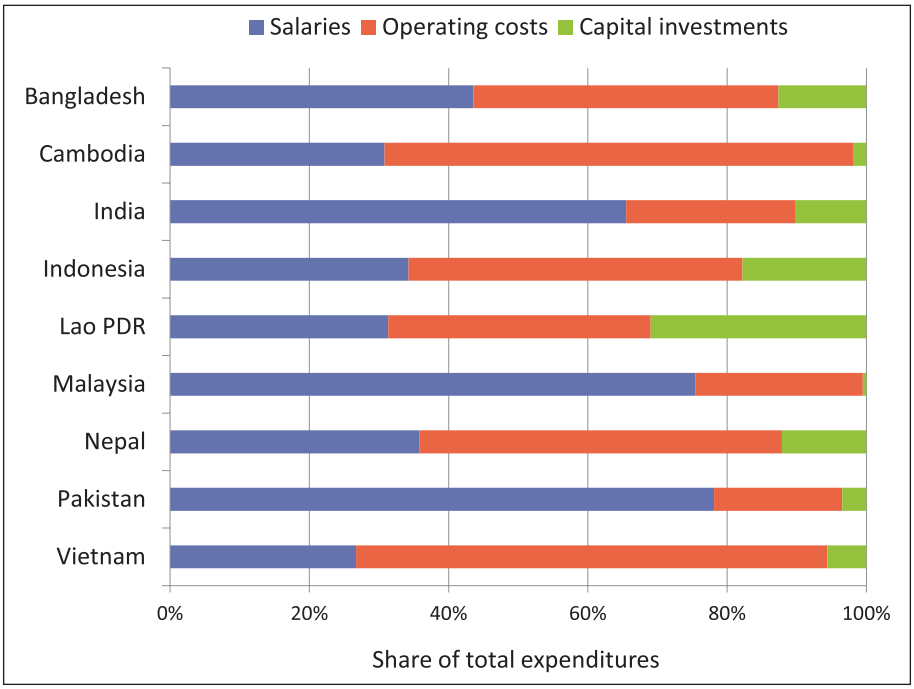


Figure 2. Spending by cost category for the main government agencies (*Source: See Table 1*)

Notes: Data for Cambodia and Vietnam are for 2010; data for Bangladesh and Pakistan are for 2012; data for Nepal are for 2013; and data for India, Indonesia, Lao PDR, and Malaysia are for 2014. Bangladesh, Cambodia, India, Nepal, and Pakistan shares are based on a full set of government agencies operating in these countries. Indonesia data only cover FORDA and agencies under IAARD; Lao PDR data only cover NAFRI; Malaysia data only cover MARDI; Vietnam data only cover agencies under VAAS.

viable research programmes. This is clearly the case in Pakistan, where salaries accounted for close to 80 per cent of expenditures in 2012. This proportion is immense, particularly coupled with Pakistan's low agricultural research intensity ratio (see Figure 1). Few resources are available to fund the day-to-day operation of research programmes or to maintain/upgrade research infrastructure and equipment in Pakistan. The situation in Nepal is similar. Many stations and laboratories of the Nepal Agricultural Research Council (NARC) are constrained in their research efforts due to outdated research infrastructure; equipment that has fallen into disrepair, insufficient access to vehicles to conduct field research, frequent power cuts that disrupt laboratory research, unreliable Internet access, lack of office space, and lack of up-to-date computer equipment and software. Rehabilitation of the country's research infrastructure is crucial as the quality of research suffers because of substandard infrastructure.

4.4. Funding sources of agricultural research

Funding for agricultural research in Asia is derived from a variety of sources, including national and state/provincial governments, donors, development banks, producer organizations, and the private sector, along with internally generated revenues through the sale of goods and services. Governments are by far the most important source of funding for agricultural research in the region. Government funding can reach an agricultural research agency through a variety of channels. In some countries, staff salaries are directly disbursed by the Ministry of Finance, while operating and capital costs are disbursed by the Ministry of Agriculture or equivalent. Many countries in the region have a Ministry of Science and Technology that allocates research funding through one or more science funds, either competitively or through direct budget allocations.

Bilateral and multilateral donor funding as well as funding from the World Bank or Asian Development Bank (ADB) play a relatively important role in funding agricultural research in Bangladesh, Cambodia, Lao PDR, Nepal, Pakistan, and Vietnam. Agricultural research in Lao PDR is particularly dependent on donor funding. During 2010–2014, 55 per cent of NAFRI's funding came from the governments of Australia, Japan, and South Korea, ADB, and

a number of United Nations agencies. Annual levels of donor funding to NAFRI have fluctuated considerably, however. In fact, the short-term, project-oriented nature of donor-funded projects has led to the situation where Lao PDR is the most volatile country in Asia in terms of agricultural research funding.

In Malaysia, commodity levies play an important role in funding research conducted by the Malaysian Palm Oil Board and the Malaysian Rubber Board. One reason for the success of these commodity taxes (or cesses) is that the private sector is directly involved in the research programmes of the commodity boards. Until recently, research on plantation crops in Sri Lanka was funded through cess proceeds as well, but this funding mechanism has been gradually phased out by the government.

Given insufficient funding for the operation of research programmes, some Asian research agencies have no choice but to seek alternative sources of funding such as through the sale of goods (for example seed, vaccinations, or publications) and services (such as laboratory tests and technical assistance). Funding diversification through the sale of goods and services is not encouraged in all Asian countries, however. All internally generated resources through the sale of goods and services by agricultural research agencies in Pakistan, for instance, are channelled back to the national treasury, which creates a disincentive for agricultural research agencies to pursue this revenue stream.

5. Human Resource Capacity in Agricultural Research

Human resource capacity refers to the quantity and quality of scientific and technical personnel employed in national research systems. It is difficult to arrive at an estimate of total human resource capacity in agricultural research in Asia because the necessary data are not available for all countries, and different countries have different definitions of what constitutes an agricultural researcher. Predictably, China has the largest agricultural research system in the region (excluding the private for-profit sector), followed by India and Indonesia (Table 3). Medium-sized countries, employing between 1,000 and 4,000 full-time equivalent (FTE; See Box 2) researchers, include Bangladesh, Malaysia, Pakistan, Thailand, and Vietnam. Agricultural research systems in Cambodia, Lao PDR, and Nepal are much smaller, employing between 100 and 500 FTEs each.

Table 3. Total number of agricultural researchers (in full-time equivalents), 2000–2014

Country	Total researchers (in full-time equivalents)						
	2000	2005	2010	2011	2012	2013	2014
Bangladesh	1,590.4	1,729.0	1,960.8	1,999.6	2,121.0	NA	NA
Cambodia	153.0	266.2	284.4	NA	NA	NA	NA
China	48,355.5	58,064.8	NA	NA	NA	NA	NA
India	13,283.4	12,417.1	12,041.3	12,324.8	12,613.0	12,795.1	12,752.2
Indonesia	4,546.8	4,720.9	4,988.0	5,077.9	5,256.2	5,480.8	5,990.2
Lao PDR	114.0	150.8	176.9	179.7	165.9	157.1	152.1
Malaysia	1,112.6	1,244.6	1,609.4	1,726.4	1,709.7	1,679.1	1,770.9
Nepal	391.2	376.4	419.5	427.4	403.4	423.6	NA
Pakistan	3,453.7	3.338.4	3,438.3	3,515.5	3,678.3	NA	NA
Sri Lanka	517.7	525.0	616.4	624.7	625.0	588.9	NA
Vietnam	2,461.4	3,206.3	3,744.2	3,803.3	3,862.3	3,921.4	3,980.4

Source: See Table 1

Notes: NA denotes that data are not available. Numbers in italics have been extrapolated based on available recent data from agencies listed in Table 1. In 2010, IAARD, FORDA, and Bogor Agricultural University employed 58 per cent of Indonesia's agricultural researchers; NAFRI accounted for 80 per cent of agricultural researchers in Lao PDR in 2010; MARDI accounted for 36 per cent of agricultural researchers in Malaysia in 2010; NARC accounted for 84 per cent of agricultural researchers in Nepal in 2012; government agencies accounted for 89 per cent of agricultural researchers in Sri Lanka in 2009; agencies under VAAS accounted for 34 per cent of agricultural researchers in Vietnam in 2010.

Box 2: The concept of full-time equivalent researchers

ASTI bases its calculations of human resource and financial data on full-time equivalent staffing, or FTEs, which take into account the proportion of time researchers spend on research activities. University staff members, for example, spend the bulk of their time on non-research related activities, such as teaching, administration, and student supervision, which need to be excluded from research-related resource calculations. As a result, four faculty members estimated to spend 25 per cent of their time on research would individually represent 0.25 FTEs and collectively be counted as one FTE.

Since 2000, Bangladesh, Cambodia, Indonesia, Malaysia, and Vietnam have all made considerable progress in building their agricultural research capacity, both in terms of scientist numbers and in terms of average qualification levels. In contrast, agricultural researcher totals in India, Lao PDR, Nepal, Pakistan, and Sri Lanka have been either stagnant or declining.

5.1. Researcher qualification levels

A minimum number of Ph.D. qualified scientists is generally considered fundamental to the conception, execution, and management of high-quality research; to effective communication with policymakers, donors, and other stakeholders, both locally and through regional and international forums; and for increasing an institute's chances of securing competitive funding. With the exception of Malaysia, all countries for which detailed long-term time series data were available have expanded their pool of Ph.D. qualified agricultural researchers since 2000. India employs by far the highest share of Ph.D. qualified researchers among Asian countries (Figure 3). In 2014, three quarters of Indian FTE agricultural researchers were trained to the Ph.D. level. Generally, technical support staff at Indian agricultural research agencies are highly qualified

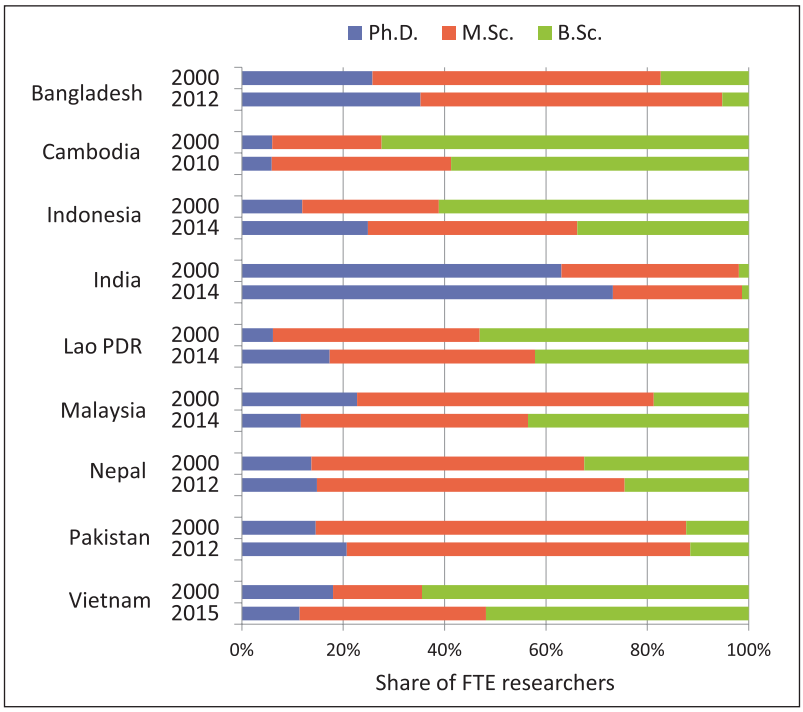


Figure 3. Distribution of researchers by qualification level (*Source: See Table 1*)

Notes: Bangladesh, India, Nepal, and Pakistan shares are based on a full set of government, higher education, and non-profit agencies operating in these countries. Indonesia data only cover FORDA and agencies under IAARD; Lao PDR data only cover NAFRI; Malaysia data only cover MARDI; Vietnam data only cover agencies under VAAS.

as well, often holding M.Sc. degrees and sometimes even Ph.D. degrees. Most other countries in the region employ significantly lower shares of Ph.D. qualified researchers. In China, detailed recent data on researcher qualifications were not available, but of the total number of government researchers and support staff employed in 2009, 12 per cent held Ph.D. degrees, 29 per cent held M.Sc. degrees, and 59 per cent held B.Sc. degrees.

The number of staff with postgraduate degrees have been traditionally low in Cambodia, Lao PDR, and Vietnam, but all three countries recorded progress in recent years. The history of political and economic isolation of these countries has limited training opportunities of scientists abroad. Moreover, lack of foreign language skills with many researchers in these countries–a prerequisite for pursuing Ph.D. training abroad–still presents an impediment, though things have gradually improved over time.

In some Asian countries, differences between research agencies in terms of salary levels or the official status of researchers are major factors determining the ability of a research agency to attract and maintain highly qualified research staff. NARC in Nepal, for example, is considered an unattractive employer by young scientists. Salaries are 2 to 10 times lower than at NGOs or the private sector, and even though university salaries are on a par with NARC's, universities offer researchers more flexibility in terms of consultancies besides their day-time job. Another major factor preventing young researchers from pursuing a career in agricultural research in Nepal is the fact that obtaining a Ph.D. degree currently has no impact on salary. Similarly, in Pakistan, low salaries and a lack of performance-based incentives make provincial research agencies less attractive employers compared with federal government and higher education agencies. Average researcher qualifications at Pakistan's provincial research agencies are, therefore, considerably lower.

5.2. Age distribution of agricultural researchers

Data on research staff by age bracket provide an indicator both of current capacity and potential future capacity needs. Agricultural research agencies should attempt to minimize imbalances among research staff as having too many senior researchers approaching retirement age can jeopardize the continuity of future research, whereas a preponderance of young, inexperienced researchers can negatively affect the quality of research over time. On average, South Asian researchers are older than their colleagues in Southeast Asia (Figure 4). In Nepal and Pakistan, for example, long-term recruitment restrictions have left many research agencies with aging pools of researchers. Given the official retirement age of 60 years in these countries, large-scale capacity losses are imminent in the coming years, especially among Ph.D. qualified researchers. Moreover, low salaries, limited opportunities for promotion and training, as well as a lack of performance-based merit systems, constitute key impediments to staff motivation in these countries. Cambodia and Vietnam, on the other hand, employ a disproportionately high number of relatively inexperienced researchers in their 20s and 30s in need of training and mentoring.

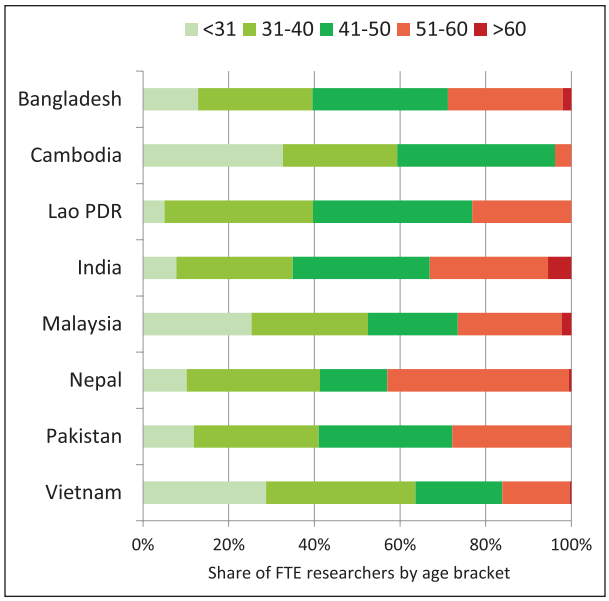
5.3. Female participation in agricultural research

Women account for close to 50 per cent of the agricultural labor force in East and Southeast Asia, and roughly one-third of the agricultural labor force in South Asia. Female researchers, professors, and senior managers offer different insights from their male counterparts, and their input provides an important perspective in addressing the unique and pressing challenges of female farmers in the region. Consequently, it is important that agricultural research agencies employ sufficiently high shares of female agricultural researchers.

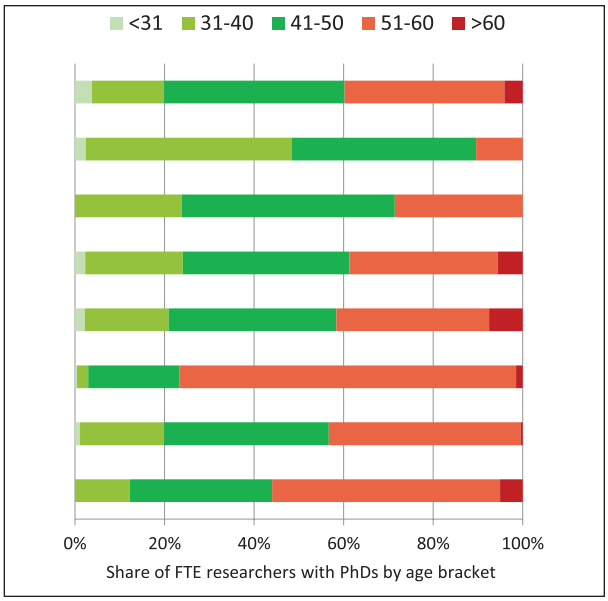
Women have historically constituted significant shares of agricultural researchers in countries like Malaysia, Myanmar, the Philippines, and Sri Lanka; however, in countries like Bangladesh (12%), Nepal (13%), and Pakistan (12%), shares of women scientists remain very low (Figure 5). These countries still have a long way to go in ensuring female participation in agricultural research and integrating gender perspectives into the formulation of related policies.

5.4. Need to continuously monitor Asian agricultural research resources

New quantitative evidence presented in this report demonstrates that total agricultural research spending



a. Total research staff



b. Total Ph.D. qualified research staff

Figure 4. Distribution of agricultural researchers by age bracket (*Source: See Table 1*)

Notes: Data for Cambodia, Malaysia, and Vietnam are for 2010; data for Bangladesh, Nepal, and Pakistan are for 2012; and data for India and Lao PDR are for 2014. Bangladesh, India, Malaysia, Nepal, and Pakistan shares are based on a full set of government, higher education, and non-profit agencies operating in these countries; Lao PDR data only cover NAFRI; Vietnam data only cover agencies under VAAS. The available age distribution data of Indonesian researchers could not be shown in the graphs due to age bracket differences. In 2014, 14 per cent of IAARD researchers were between 25 and 35 years old, 26 per cent between 35 and 45, 39 per cent between 45 and 55, and 21 per cent older than 55. Of the Ph.D. qualified IAARD researchers, 0.3 per cent was between 25 and 35 years old, 14 per cent between 35 and 45, 47 per cent between 45 and 55, and 39 per cent older than 55.

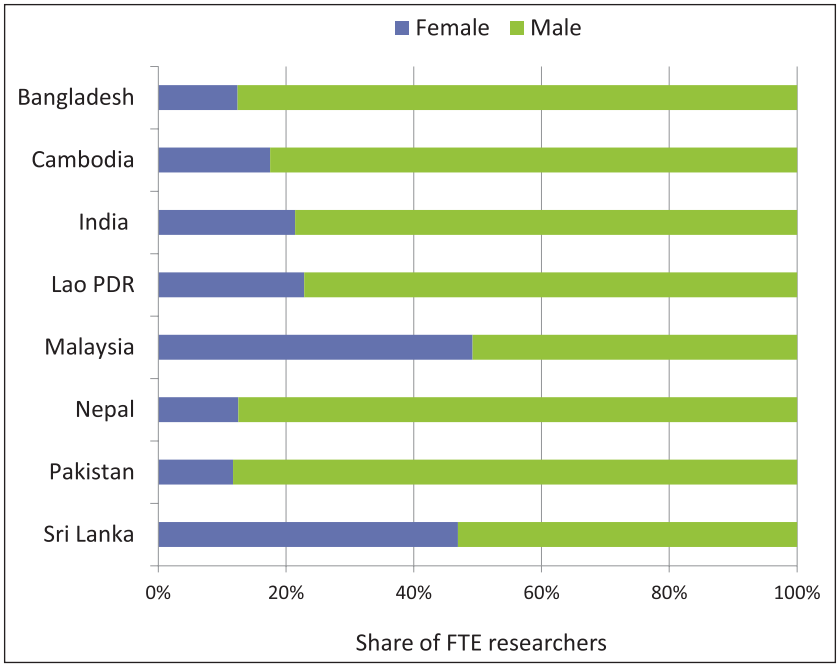


Figure 5. Female participation in agricultural research (*Source: See Table 1*)

Notes: The most recent year of data availability is 2009 for Sri Lanka; 2010 for Cambodia and Malaysia; 2012 for Bangladesh, Nepal, and Pakistan; and 2014 for India and Lao PDR. Lao PDR data only cover NAFRI.

in Asia has increased considerably since the year 2000. Most of this growth was driven by China, India, and Indonesia, all of which have well-staffed and relatively well-funded agricultural research systems. In some of Asia's smaller countries, however, investment levels have stagnated or fallen. A number of countries (Cambodia, Lao PDR, Nepal, and Pakistan in particular) undoubtedly underinvest in agricultural research and are severely challenged by outdated equipment and facilities that impede the conduct of productive research and compromise the number and quality of research outputs. Governments in these countries have to clearly identify their long-term national research priorities and design relevant, focused, and coherent research programmes accordingly. Donor and development bank funding needs to be closely aligned with these national priorities, and consistency and complementarities between donor programmes need to be ensured.

Since the turn of the millennium, a large number of Asian countries have made considerable progress in building human resource capacity in agricultural research, by increasing the number of scientists they employ and/or improving their qualification levels. Some countries will face critical human resource challenges in the near future, however, given that a large share of highly qualified researchers is approaching retirement age. Fundamental to building and maintaining strong capacity across Asia in the coming decades is the development of comprehensive recruitment, training, and succession plans, which take into account existing and anticipated gaps in specific skills and disciplines, the distribution of staffing by age and gender, and degree-level and short-term training needs.

The aim of this report was to give a general overview of where Asia currently stands in terms of agricultural research investment and capacity. Although it gives an accurate insight into developments since 2000, funding constraints prevented ASTI from providing the level of detail and precision the programme is known for in other parts of the world. It was impossible to provide up-to-date detailed trends for every country in the region and data for higher education agencies in Southeast Asian countries have for the most part been extrapolated based on pre-2010 trends. Nonetheless, thanks to the help of numerous in-country partners, ASTI was able to establish fairly decent long-term spending and capacity time series datasets.

It is crucial, however, that agricultural research expenditures, capacity, and outputs continue to be monitored more closely in Asia on the long run. Long-term funding from the Bill and Melinda Gates Foundation has enabled ASTI to establish sustainable, institutionalized systems of data compilation, synthesis, and analysis at frequent intervals in South Asian countries[1]. A solid network of national focal points has been established in these countries to facilitate this process. This has tremendously enhanced ownership of the data, and stimulated further advocacy and analysis at the national level.

Similar institutionalized data collection and analysis systems are needed in other parts of the Asia-Pacific region as well. All countries in the region benefit from clearly established metrics of performance and success, against which progress can be quantified and adjusted to produce the desired outcome. Without accurate data, research stakeholders have no way of knowing whether or not they are on the right track and remain stuck in presumptions. It is, therefore, crucial that sufficient resources are made available in the coming years to build in-country capacity for agricultural research data collection and analysis and to maintain this capacity over time.

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[1]The type of ASTI data collection and analysis in South Asia goes far beyond what has been presented in aggregated form in this short report, and covers a lot more detailed additional information. This includes agency-level data on institutional changes, researcher disciplines, seniority levels of researchers, commodity and thematic research coverage, peer-reviewed research publications, release of new crop varieties and agricultural technologies, number of students enrolled and graduated at higher education agencies, degree programs offered by higher education agencies, as well as extensive qualitative information on the status of national agricultural research systems and the associated institutional and policy environment.

respective countries. Without their commitment, this report would not have been feasible. The author also thanks Hannah Ameye, Nienke Beintema, Kathleen Flaherty, Lang Gao, and Léa Vicky Magne Domgho (IFPRI) for their assistance in data analysis and their comments on a draft version of this report.

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