ASTI Country Brief | July 2019

BANGLADESH

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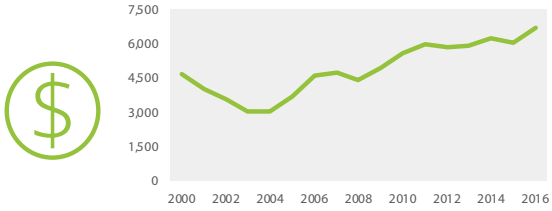
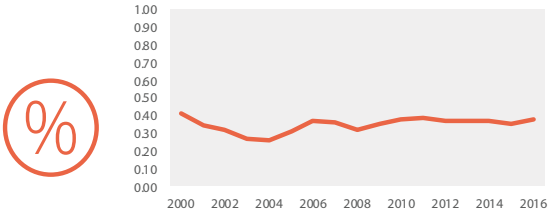
AGRICULTURAL RESEARCH SPENDING



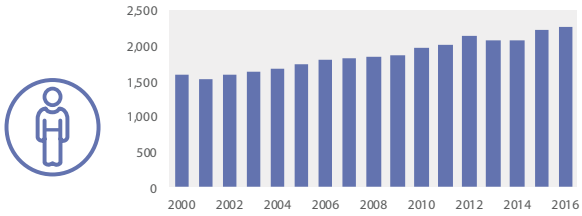
	BANGLADESH	INDIA (2014)	NEPAL	SRI LANKA
Million taka (2011 constant prices)	6,664.0			
Million PPP dollars (2011 constant prices)	287.9	3,298.4	81.9	112.4

SPENDING INTENSITY



	BANGLADESH	INDIA (2014)	NEPAL	SRI LANKA
Agricultural research spending as a share of AgGDP	0.38%	0.30%	0.42%	0.62%

AGRICULTURAL RESEARCHERS

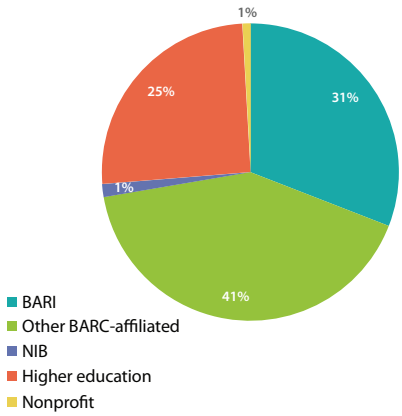


	BANGLADESH	INDIA (2014)	NEPAL	SRI LANKA
Full-time equivalents	2,268.6	12,746.6	519.7	648.0
Share of researchers with MSc and PhD degrees	91%	99%	71%	78%

Notes: Data in the table above are for 2016. Information on access to further resources, data procedures and methodologies, and acronyms and definitions are provided on Page 8. See **www.asti.cgiar.org/bangladesh/directory** for an overview of Bangladesh's agricultural R&D agencies.

- Agricultural research investment and human resource capacity in Bangladesh have grown considerably in recent years, largely as a result of increased government and World Bank funding.
- Despite this growth, Bangladesh still only invested 0.38 percent of its AgGDP in agricultural research in 2016—well below the level needed to address multiple challenges, including rapid population growth and severe climate change impacts.
- Although research staff numbers and qualification levels have gradually improved over time, an aging pool of PhD-qualified researchers remains as an important challenge.

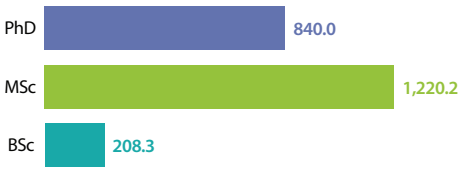
INSTITUTIONAL PROFILE, 2016



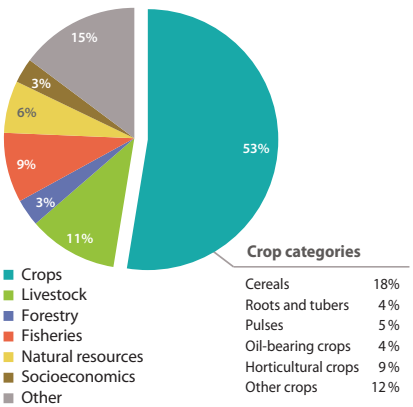
RESEARCHER PROFILE, 2016

By gender (%)

By qualification level (FTEs)



RESEARCH FOCUS, 2016



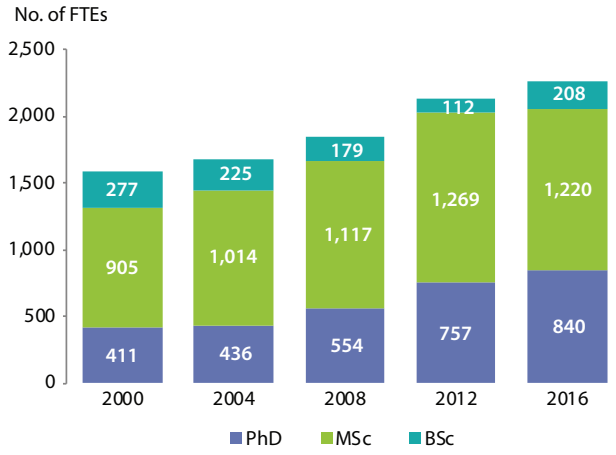
CHALLENGE

- BARC's mandate of coordinating the country's agricultural research is constrained by a number of factors: (1) research institutes are administered by different ministries and under different legislation and regulations; (2) the civil service system of promotions restricts researchers' opportunities for career advancement; and (3) BARC has no authority in allocating research funding despite being responsible for reviewing the institutes' research programs and budgets each year.

POLICY IMPLICATIONS

- While the 2012 BARC Act conferred the Council with greater authority to approve research programs and recommend budget allocations to its affiliated research institutes, BARC still lacks the autonomy to allocate funding based on designated research priorities and the quality and quantity of results and outputs. Such autonomy is needed to enhance the efficiency and effectiveness of Bangladesh's agricultural research.

Agricultural researchers by qualification level, 2000–2016



▲ During 2000–2016, Bangladesh's agricultural research capacity grew by more than 40 percent. Average qualification levels also improved considerably during this time. In 2016, 37 percent of the country's agricultural researchers held PhD degrees compared with 26 percent in 2000. The total number of PhD-qualified agricultural researchers more than doubled during this period in absolute terms.

Agricultural researchers by qualification level, 2016

SECTOR/AGENCY	PhD	MSc	BSc	TOTAL
		(FTEs)		
Government				
BARI	221.0	313.0	167.0	701.0
Other BARC-affiliated (12)	310.2	591.8	37.5	939.5
NIB	7.0	25.0	—	32.0
Higher education				
BAU (6)	114.3	59.1	—	173.4
Other higher education (42)	182.9	216.6	3.0	402.5
Nonprofit (2)	4.6	14.8	0.8	20.2
Total (64)	**840.0**	**1,220.2**	**208.3**	**2,268.6**

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

▲ Of the 2,269 FTEs involved in agricultural research in Bangladesh in 2016, 37 percent were PhD-qualified. Researchers with MSc degrees accounted for 54 percent, and researchers with BSc degrees for 9 percent. Average qualification levels were higher at BAU and the other higher education agencies than at government institutions.

LARGE-SCALE CAPACITY STRENGTHENING THROUGH NATP

- The main factor underlying the rapid improvement in the qualifications of Bangladeshi researchers is the National Agricultural Technology Program (NATP), funded through loans from the World Bank and the International Fund for Agricultural Development. The program, spanning 2009–2024, focuses on revitalizing agricultural research and extension, and linking small producers of high-value commodities with the market. NATP funds a large number of research activities while also focusing on enhancing the efficiency of BARC and the agricultural research institutes through institutional reform, human resource development, and the establishment of well-functioning systems of management and information and communications technologies.

  NATP comprises three phases. During its first phase (NATP–I: 2009–2014), 108 researchers successfully completed PhD degrees both in Bangladesh and in other Asian countries. An additional 10 scientists completed postdoctoral research (in Japan, the United Kingdom, and the United States) in areas of biosafety, climate change, research priority setting, and geographic information systems. NATP's second phase (NATP–II: 2016–2021) earmarked PhD-degree funding for an additional 120 scientists (60 at local universities and 60 at universities elsewhere) in areas such as biotechnology, crop modeling and simulation, nanotechnology, precision agriculture, and geographical information systems. In addition to degree-level training, NATP-II is also funding short-term training activities in Bangladesh and abroad based on thorough analyses of skills gaps.

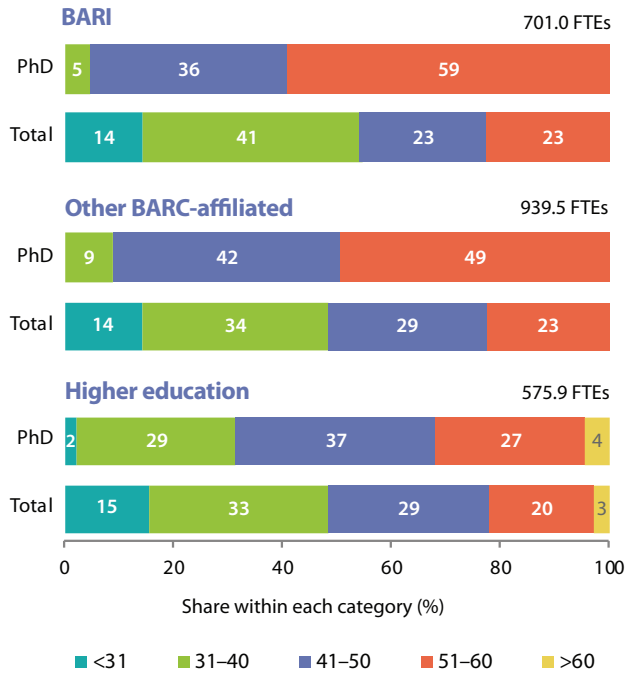
  Aside from NATP, additional degree-level training opportunities for Bangladeshi researchers are being funded by donor agencies, BARC, the Prime Minister Fellowship program, and other government sources.

MEASURES TO ATTRACT AND RETAIN TALENTED YOUNG SCIENTISTS

Despite an overall increase in researcher numbers among BARC-affiliated institutes since the turn of the millennium, more than 300 highly qualified researchers left these institutes during 2000–2012 to accept opportunities with better remuneration elsewhere. To curb this brain drain, the Bangladesh government introduced a series of measures to retain and motivate agricultural researchers. These included a one-off additional month's salary for researchers in 2013, and permanent salary increases of as much as 100 percent from 2015. More government and donor-funded opportunities now exist to help young researchers pursue degree-level education both at home and abroad. Combined, these measures have been fairly successful in recent years in halting the loss of capacity.

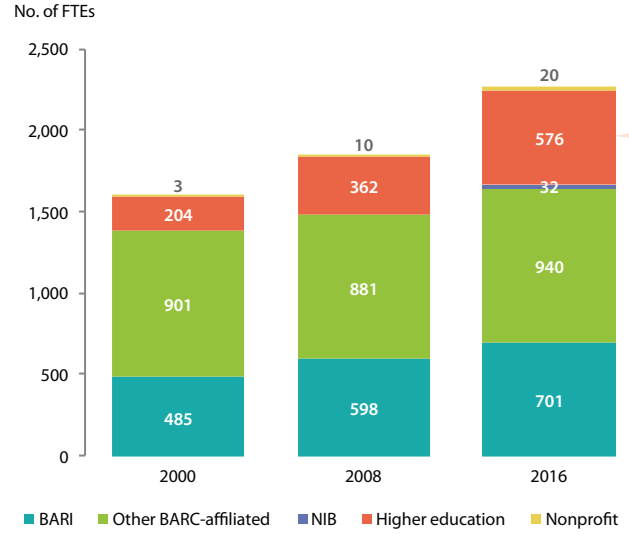
From another perspective, steps have been taken to raise the retirement age for "outstanding" researchers from 59 to 65 years (in line with the higher education sector). To this end, BARC has prepared a set of guidelines and performance criteria on which approvals for late retirement will be based, and these have been submitted for ministerial approval. This strategy could at least ameliorate the acute age-related capacity challenge the country faces.

Agricultural researchers by age bracket, 2016



As of 2016, nearly 60 percent of PhD-qualified researchers at BARI and about half of those at the other BARC-affiliated institutes were in their fifties and approaching the mandatory civil servant retirement age of 59 years. Researchers with MSc and BSc degrees were considerably younger, as were university-based scientists. It is important that young MSc-qualified researchers are given the opportunity to upgrade their qualifications so that BARI and the other BARC-affiliated institutes can maintain an appropriately trained pool of agricultural scientists into the future.

Institutional composition of national agricultural research, 2000–2016



Breakdown	FTEs
BAU	173
SAU	99
BSMRAU	59
Other universities	245
Total	**576**

Note: NIB was established in 2010. CDB and BSRTI are categorized under "Other BARC-affiliated" even though their association with BARC only began in 2012.

The composition of Bangladeshi agricultural research has undergone important shifts over time, with the higher education sector playing an increasingly prominent role. The number of university-based FTE researchers nearly tripled during 2000–2016. BARI's research capacity also expanded considerably (from 485 to 701 FTEs). In contrast, research capacity at the other BARC-affiliated institutes remained comparatively stable during this timeframe.

CHALLENGE

- Despite its recent increase in agricultural research spending, Bangladesh is still underinvesting. In 2016, the country's spending on agricultural R&D represented only 0.38 percent of its AgGDP, which is low based on the country's rapid population growth, high levels of poverty, and low agricultural productivity—all in the context of adverse climate change impacts.

POLICY IMPLICATIONS

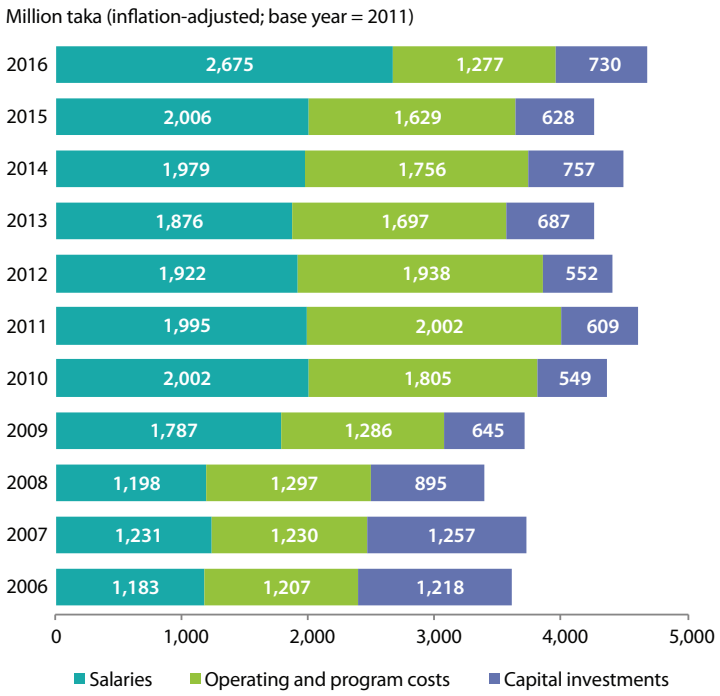
- Clear signs of the government's prioritization of agriculture and agricultural research include the prominence of agricultural research in the seventh Five-Year Plan and the government's commitment to NATP. It will be important, however, for this support to be sustained and enhanced into the future. Research is a long-term endeavor requiring sustained funding. Diversification of funding should also be promoted through a more enabling policy environment that stimulates private funding.

Total expenditure by BARC-affiliated agencies, 2006–2016

AGENCY	2006	2011	2016
	Million taka (inflation-adjusted; constant 2011 prices)		
BARI	1,722.2	1,865.2	2,264.9
BRRI	372.0	537.8	565.7
BLRI	122.0	183.8	323.8
BINA	94.5	302.3	259.2
SRDI	160.8	436.2	212.4
BFRI	143.7	162.6	207.5
BJRI	219.2	208.7	197.2
FRI	120.5	113.8	193.5
BARC	412.0	521.2	160.4
BSRI	143.5	138.1	140.2
CDB	43.1	47.2	73.1
BSRTI	9.6	41.0	43.4
BTRI	45.4	48.8	41.4
Total	**3,608.3**	**4,606.6**	**4,682.7**

▲ Combined, the BARC-affiliated agencies spent 4.7 billion taka in 2016 (in 2011 constant prices). Nearly half of this amount was spent by BARI alone. Total expenditures increased by nearly 30 percent during 2006–2016. This growth was largely driven by BARI, BLRI, BRRI, BINA, and FRI.

Total expenditures by cost category of BARC-affiliated institutes, 2006–2016



▲ A closer look at the breakdown of expenditures of BARC-affiliated agencies by cost category reveals some important shifts over time:

- Two general salary raises, which took place in 2009 and 2015/16, were an important driver of the upward trend in overall spending levels.
- In addition, NATP-I (2009–2014) boosted the BARC institutes' funding for research activities, which is reflected in the increased operating and program costs.
- The interim period between NATP-I and NATP-II sparked a decline in operating and program costs in 2015–2016, but indications suggest that this was only temporary.
- Between 2016 and 2018, 190 competitive research grants and 40 program-based research grants were awarded through the project.

BANGLADESH'S SEVENTH FIVE-YEAR PLAN

- In October 2015, the government of Bangladesh approved its seventh Five-Year Plan (2016–2021), which focuses on empowering the country's population, for example, by creating employment and skills-development opportunities and supplying credit for small and medium-sized enterprises. Along with growth, the seventh plan emphasizes social protection, urban transition, and a sustainable development pathway resilient to natural disasters and climate change. The plan stresses the critical role that agricultural research can play in achieving these objectives. Specifically, the plan promotes research into improving the quality and yields of rice, wheat, maize, pulses, oilseeds, tuber crops, vegetables, fruit, cotton, jute, seaweed, and aquatic plants. Moreover, development of climate-resilient varieties and improved management practices is emphasized, along with processing and value addition of agricultural commodities, crop pest and disease management, natural resource management, biotechnology, and farm mechanization.

SOURCES OF AGRICULTURAL RESEARCH FUNDING

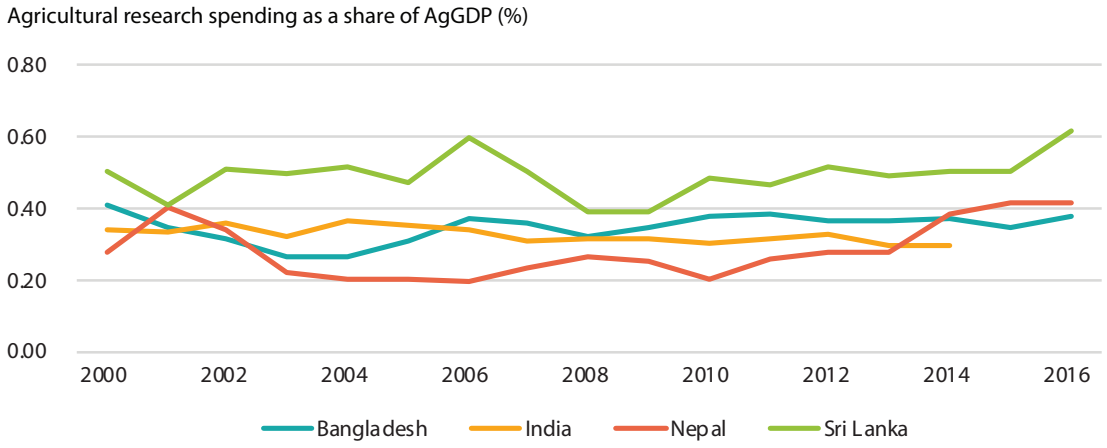
- Government funding to BARC-affiliated institutes falls into two categories: (1) recurring funding, which is derived from the national government and is primarily allocated to salaries and operating costs, and (2) Annual Development Program funds, which are derived from donors and the government, and are mainly allocated to capital investments.
- Universities do not receive direct research funding from the government. Scientists seek external support for their own research, mostly from foreign donors, BARC, the Krishi Gobeshona Foundation, or international scientific partners. The University Grants Commission is responsible for assessing the needs of universities and allocating funding accordingly (including for training, infrastructure and equipment, and limited research activities).
- Since 2008, the Krishi Gobeshona Foundation has been providing research agencies—from the government, higher education, or private sectors—with competitive grants for research projects with a duration of roughly two years.
- The principal donors to agricultural R&D in Bangladesh include the World Bank; the International Fund for Agricultural Development; the European Union; the Bill & Melinda Gates Foundation; the Asian Food and Agricultural Cooperation Initiative (South Korea); and the governments of Canada, Japan, and the United States.

PRIVATE-SECTOR AGRICULTURAL RESEARCH

- In Bangladesh, agricultural research is mainly performed by the public sector. Nevertheless, private seed companies like Supreme Seed, Lal Teer, and ACI Limited play a key role in developing and improving hybrid rice. In addition, Lal Teer, Giant Agro Processing, Metal Agro, A.R. Malik Seeds, United Seed Store, and Mollika Seed Company are important contributors to developing and improving the country's horticultural varieties (mostly potato and vegetable seed). Most of the research activities of these private companies are self-funded, although some are financed through research partnerships with multinational seed companies like DuPont Pioneer, Monsanto, and East-West Seed, or international research institutes like the International Rice Research Institute. In addition to private Bangladeshi companies, multinationals like Bayer Crop Science and Syngenta also conduct extensive in-country research aimed at improving seed quality for a number of crops.

  The private sector is currently the least developed source of sustainable financing for public-sector agricultural R&D in Bangladesh. Cultivating private funding requires that the national government provides a more enabling policy environment through tax incentives, protection of intellectual property rights, and regulatory reforms to encourage the spill-in of international technology.

Agricultural research intensity, 2000–2016



▲ Bangladesh's agricultural research intensity ratio—that is, agricultural research spending as a share of AgGDP—has remained relatively constant over time, hovering at around 0.35–0.40 percent. Bangladesh's 2016 ratio (0.38) was similar to Nepal's (0.42), but lower than Sri Lanka's (0.62). In comparison, in 2014 India invested 0.30 percent of its AgGDP in agricultural research. It should be noted, however, that when comparing intensity ratios across countries, broader agricultural and economic contexts also need to be taken into account.

CHALLENGE

- Over the past four decades, Bangladesh's growth in rice production outpaced its population growth. Yet, future growth in rice productivity will be challenged by decreasing land and water availability, and the potential negative impacts of climate change. Meanwhile, agriculture is undergoing profound transformation from subsistence farming to (semi)commercial farming. In the wave of rapid globalization, smallholders are struggling to produce high-value crops that grant them access to global markets.

POLICY IMPLICATIONS

- Bangladesh will need to prioritize breeding programs that focus on developing rice varieties with resistance to drought, flooding, heat stress, and salinity (as prioritized in the seventh Five-Year Plan). At the same time, increased attention needs to be given to appropriate technologies for nonrice crops and to addressing inadequacies of market infrastructure and services for such crops. An enabling policy environment is critical to maximizing the impact of innovations on the agriculture sector, on rural and economic development, and ultimately on poverty and malnutrition.

New varieties released or registered by BARC-affiliated institutes, 2013–2016

CROP	BARI	BINA	BJRI	BRRI	BSRI	BTRI
Barley	1					
Beans	2	1				
Fiber crops			2			
Flowers	6					
Fruit	9					
Garlic	2	1				
Groundnuts		1				
Herbs and spices	12	1				
Maize	3					
Olives	1					
Onions	1					
Potatoes	26					
Pulses	6	4				
Rice		6		21		
Sesame seed		1				
Soybeans		1				
Sugarcane					4	
Sweet potatoes	4					
Tea						2
Vegetables	14	4	1			
Wheat	2	1				
TOTAL	**89**	**21**	**3**	**21**	**4**	**2**

Note: Data for BSRI were not available.

- BARI, BINA, BJRI, BRRI, BSRI, and BTRI released a combined total of 140 new crop varieties during 2013–2016, although the majority were released by BARI. BRRI released a large number of rice varieties in recent years, but so far none have been sufficiently promising to replace *BRRI Dhan 28* and *29*, which were released in 1994 and have been the primary drivers of increased rice productivity since that time. Nevertheless, these two varieties are becoming increasingly vulnerable to pests and diseases. Consequently, future rice productivity is very much dependent on new breakthroughs in rice research and the wide dissemination of improved varieties to farmers.

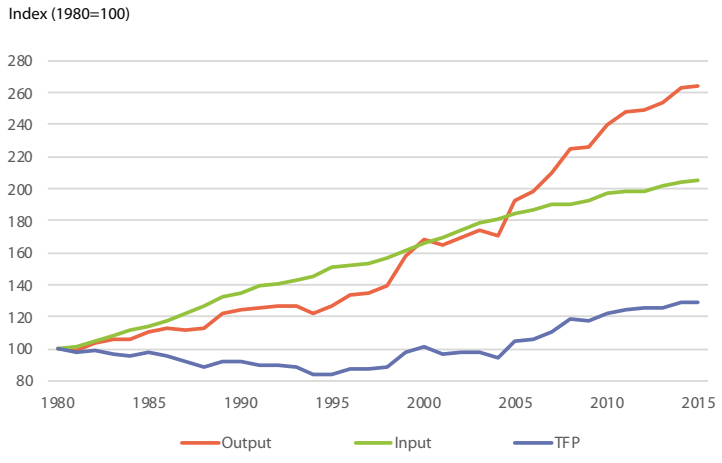
In addition to crop variety releases by BARC-affiliated institutes, BAU's Faculty of Agriculture released seven new mango, guava, litchi, and other fruit varieties during 2013–2016, as well as a large number of new farming technologies.

LIMITED AGRICULTURAL PRODUCTIVITY GROWTH

- Increasing the efficiency of agricultural production—that is, getting more output from the same amount of resources—is critical for improving food security. Total factor productivity (TFP) is an indicator of how efficiently agricultural land, labor, capital, and other inputs (seed, fertilizer, and so on) are used to produce a country's agricultural outputs (crops and livestock). It is calculated as the ratio of total agricultural output to total production inputs. When more output is produced from a constant amount of resources—indicating that resources are being used more efficiently—TFP increases.

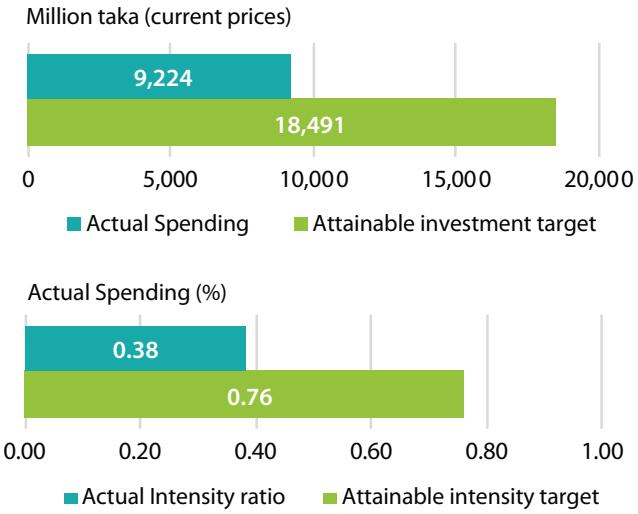
For most of the 1980s and 1990s in Bangladesh, agricultural input growth was higher than agricultural output growth, so TFP growth was negative. In the 1980s, Bangladesh enforced highly restrictive trade and exchange rate policies, which commanded high import tariffs and export taxes on agricultural commodities. In the early 1990s, large-scale reforms were passed focusing on liberalizing agricultural input markets. These reforms increased imports of fertilizer, tractors, and other technologies from abroad. They also facilitated the introduction of various irrigation techniques previously unavailable, which suddenly enabled double cropping of rice. This combination of technology inflows and an enabling policy environment prompted a rapid acceleration of agricultural outputs and a gradual increase in TFP starting in 1995. Over the next two decades, continuous investment in agricultural research and extension, improvements in postharvest management and agroprocessing, and investments in market infrastructure complemented agricultural price and trade policies, and acted as an important driving force for improved agricultural productivity and efficiency (Hasan 2012).

Long-term growth in agricultural input, output, and productivity, 1980–2015



Source: Calculated by authors based on USDA–ERS (2018).

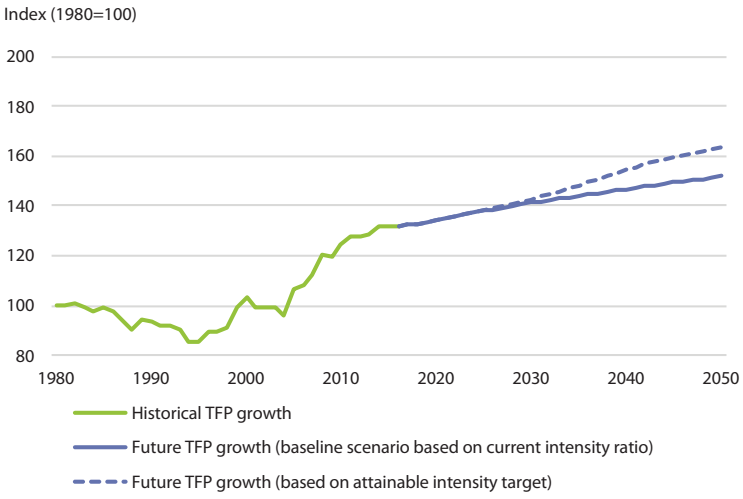
Actual agricultural research spending and attainable investment targets, 2016



Sources: Calculated by authors based on ASTI (2019) and Nin Pratt (2016).

Notes: Traditionally, agricultural research intensity ratios compare investment and AgGDP levels to determine whether countries may be underinvesting. ASTI's Intensity Index incorporates additional factors that account for the size and nature of a nation's economy and hence facilitate more accurate cross-country comparisons. For more information, see https://astinews.ifpri.info/2017/07/01/a-new-look-at-research-investment-goals-for-ssa/.

Agricultural productivity projections based on actual and attainable investment rates, 1980–2050



Sources: Calculated by authors based on ASTI (2019), on USDA-ERS (2018), Nin Pratt (2016), FAO (2018), and World Bank (2018).

HOW MUCH IS BANGLADESH UNDERINVESTING IN AGRICULTURAL RESEARCH?

Conventional recommendations of agricultural research intensity levels, such as the 1 percent target set by the United Nations, assume that national investments should be proportional to the size of the agricultural sector. In reality, a country's capacity to invest in agricultural research depends on a range of variables, including the size of the economy, a country's income level, the level of diversification of agricultural production, and the availability of relevant technology spillovers from other countries. In efforts to address these nuances, ASTI developed a multi-factored indicator of research intensity that comprises a range of weighted criteria (for further details, see Nin Pratt 2016). Under this approach, countries with the same mix of inputs are expected to require similar minimum levels of research investment, and investment below that level can be interpreted as an indicator that the country is potentially underinvesting based on its particular input mix.

ASTI's weighted indicator of research intensity demonstrates that Bangladesh is indeed underinvesting in agricultural research. Even though the 1 percent investment target is out of reach, based on the structural characteristics of Bangladesh's economy and agricultural sector, an investment target of 0.76 percent of AgGDP is thought to be realistic and attainable. To have met this lower target in 2016, Bangladesh would need to have invested 17,081 million taka, instead of the 9,224 million taka it actually invested (both in current prices). In other words, the gap between actual investment in agricultural research and estimated attainable agricultural research investment was 7,857 million taka in 2016 alone. Between 1981 and 2016, the yearly investment gap was very high, raising questions as to what Bangladesh's agricultural productivity could have been today had all these accumulated investments been made in the past.

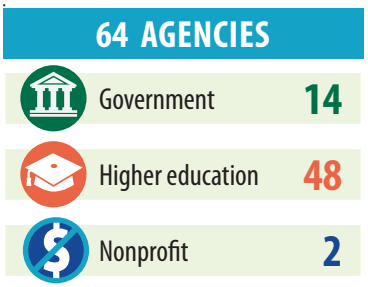
In an effort to answer this question, ASTI ran long-term projections on the impact of historical agricultural research investment on the country's agricultural output and productivity, and of the higher rates of investment needed to close the gap. The projections indicate that closing the agricultural R&D investment gap by 2030 would result in higher yearly agricultural productivity growth, of around 0.4–0.6 percent to 2050—which is considerable, but still much lower than in most other South Asian countries. It is difficult to explain the exact reasons behind relatively lower productivity growth projections at this level of aggregation, but other studies have pointed to Bangladesh's resource constraints for agricultural production and the exceptional land pressures it faces.

REVITALIZING THE AGRICULTURAL EXTENSION SYSTEM

Another important factor limiting the impact of agricultural research investment in Bangladesh is the relative ineffectiveness of the country's agricultural extension system, not just for crops, but also for livestock and fisheries. The Department of Agricultural Extension has inadequate capacity, and its linkages with other actors in Bangladesh's agricultural innovation system are weak. Another issue is the number of different ministries directly involved in assisting farmers, and the limited cooperation and coordination among them. The absence of active participation in setting extension priorities by the local government is also problematic. Agricultural research does not operate in isolation. The drivers of agricultural transformation are multidimensional and interrelated. A more holistic approach to agricultural innovation, comprising research, extension, education, and policy is vital, as are an effective institutional framework, governing mechanisms, and political environment that stimulate interaction between the multitude of actors.

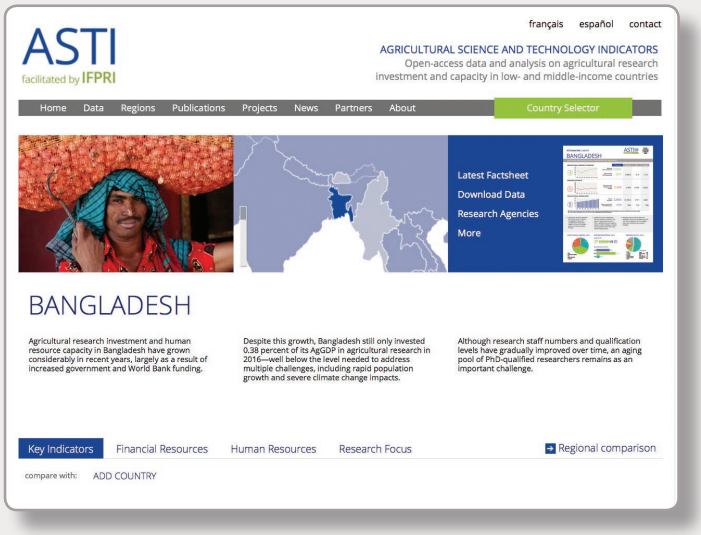
OVERVIEW OF BANGLADESH'S AGRICULTURAL RESEARCH AGENCIES

Sixty-four agencies conduct agricultural research in Bangladesh (excluding the private for-profit sector). The Dhaka-based BARC Secretariat coordinates research undertaken by 12 agricultural R&D institutes. Combined, these institutes accounted for more than 70 percent of the country's agricultural researchers in 2016 (in FTEs). BARI is by far the largest institute (employing 701 FTE researchers in 2016). It conducts research on a variety of cereals, pulses, and horticultural crops, as well as soil and crop management, disease and insect management, and water management and irrigation. The remaining agencies affiliated with BARC each focus solely on a key commodity: rice, sugarcane, jute, tea, cotton, livestock, forestry, fisheries, soil, sericulture, and nuclear agriculture. NIB is the only government agency conducting agricultural research that is not affiliated with BARC. Its 32 FTE researchers focus on livestock, on fisheries, and on plant, microbial, molecular, and environmental biotechnology. The higher education sector plays an increasingly important role in Bangladesh's agricultural research. Forty-eight higher education agencies—including specialized universities, agricultural faculties, and smaller units—conduct agricultural research. Together they accounted for a quarter of the country's total agricultural researchers in 2016. BAU (173 FTEs) is the country's largest agricultural university and comprises six agriculture-related faculties. Other important universities include SAU (99 FTEs) and BSMRAU (59 FTEs). BRAC (15 FTEs) is a well-known nonprofit organization engaged in many different areas of economic development, including (limited) agricultural research. Detailed information on private companies conducting agricultural research in Bangladesh was not available, but a number of Bangladeshi and multinational firms play an important role in conducting hybrid rice and horticultural research.



For a complete list of the agencies included in ASTI's dataset for Bangladesh, visit **www.asti.cgiar.org/bangladesh**.

For more information on ASTI's **data procedures and methodology**, *visit* **www.asti.cgiar.org/methodology**; *for more information on agricultural R&D in Bangladesh, visit* **www.asti.cgiar.org/bangladesh.**



ACRONYMS USED IN THIS COUNTRY BRIEF

AgGDP	agricultural gross domestic product
BARC	Bangladesh Agricultural Research Council
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agricultural University
BFRI	Bangladesh Fisheries Research Institute
BINA	Bangladesh Institute of Nuclear Agriculture
BJRI	Bangladesh Jute Research Institute
BRRI	Bangladesh Rice Research Institute
BLRI	Bangladesh Livestock Research Institute
BSMRAU	Bangabandhu Sheikh Mujibur Rahman Agricultural University
BSRI	Bangladesh Sugarcane Research Institute
BSRTI	Bangladesh Sericulture Research and Training Institute
BTRI	Bangladesh Tea Research Institute
CDB	Cotton Development Board
FRI	Bangladesh Fisheries Research Institute
FTE(s)	Full-time equivalent(s)
NATP	National Agricultural Technology Program
NIB	National Institute of Biotechnology
PPP	purchasing power parity (exchange rates)
R&D	research and experimental development
SAU	Shere-e-Bangla Agricultural University
SRDI	Soil Resources Development Institite
TFP	total factor productivity

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