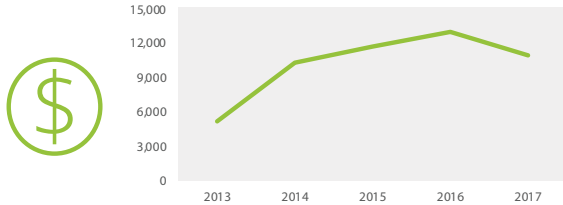# MYANMAR
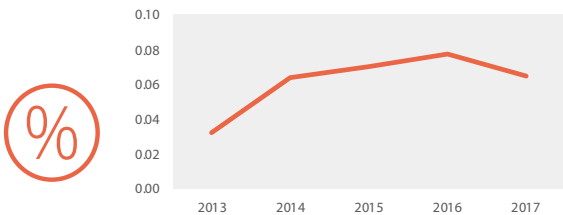
Gert-Jan Stads, Cho Cho San, Aeintjue Kay Khing, Norah Omot, Nguyen Thi Pham, Alejandro Nin-Pratt, Duncan Boughton, Su Su Win, and Thanda Kyi

ASTI facilitated by APAARI and IFPRI
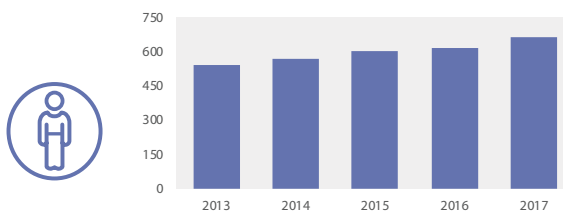INDO-PACIFIC

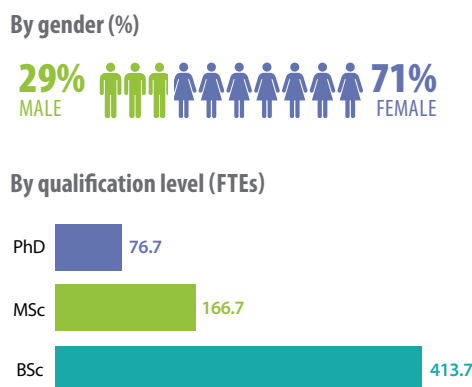|	MYANMAR	LAOS	THAILAND	VIETNAM
AGRICULTURAL RESEARCH SPENDING				
Million kyat (2011 constant prices)	10,943.7			
Million PPP dollars (2011 constant prices)	46.6	19.3	847.2	177.6
SPENDING INTENSITY				
Agricultural research spending as a share of AgGDP	0.06%	0.26%	0.94%	0.20%
AGRICULTURAL RESEARCHERS				
Full-time equivalents	657.1	203.2	2,911.4	4,250.1
Share of researchers with MSc and PhD degrees	37%	47%	50%	67%

Notes: Data in the table above are for 2017 and exclude the private for-profit sector. Information on access to further resources, data procedures and methodologies, and acronyms is provided on page 8. See **www.asti.cgiar.org/myanmar/directory** for an overview of Myanmar's agricultural R&D agencies.

▶ Despite a considerable increase in agricultural research spending in recent years, Myanmar is still seriously underinvesting. At just 0.06 percent in 2017, the country's agricultural research intensity ratio (that is, spending as a share of AgGDP) is one of the lowest in the world.

▶ The number of agricultural researchers has grown steadily over time, as has the average qualification level of researchers. The majority of researchers are crop scientists, however, leaving other important areas (notably livestock and fisheries) severely underresearched.

▶ ADS was launched in 2018 to address many of the challenges that Myanmar's national agricultural research system is facing, including severe underinvestment, organizational fragmentation, limited geographic dispersion of research, neglected research domains, and an ineffective extension system.

INSTITUTIONAL PROFILE, 2017

- DOA — 21%
- DAR — 53%
- Other government — 11%
- Higher education — 15%
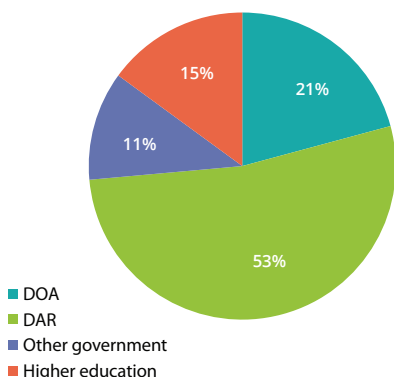
RESEARCHER PROFILE, 2017

By gender (%)

29% MALE   71% FEMALE

By qualification level (FTEs)

- PhD: 76.7
- MSc: 166.7
- BSc: 413.7

RESEARCH FOCUS, 2017

0.4% 1% 3% 1% 10% 4% 81%

- Crops
- Livestock
- Forestry
- Fisheries
- Natural resources
- Socioeconomics
- Other

Crop categories
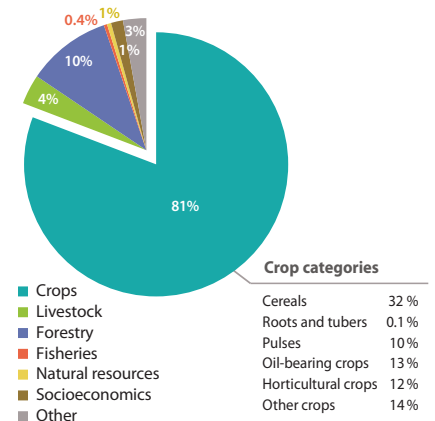
Cereals	32 %
Roots and tubers	0.1 %
Pulses	10 %
Oil-bearing crops	13 %
Horticultural crops	12 %
Other crops	14 %

KEY CHALLENGE

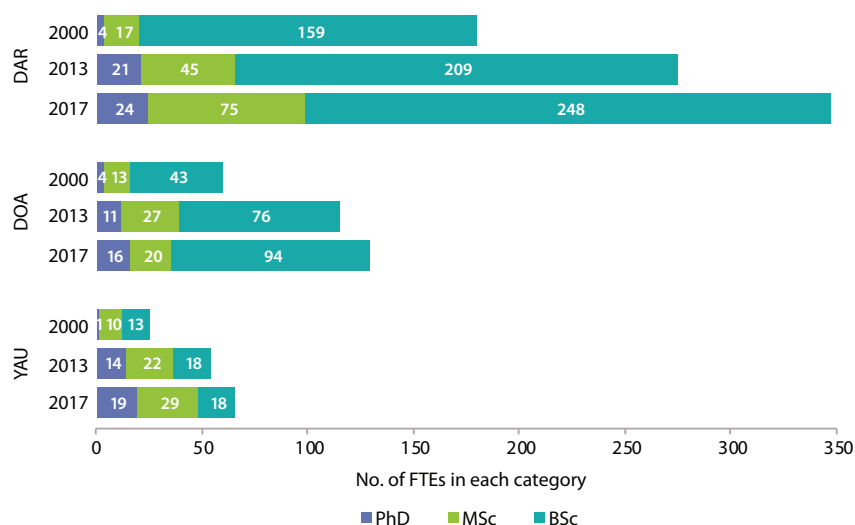▶ After decades of neglect, Myanmar's agricultural research system is being rebuilt. Despite a considerable increase in recruitment in recent years, the country's human research capacity remains inadequate in terms of the number of researchers, their qualifications and experience, and their ability to address the diversity of Myanmar's agroecological zones. Moreover, researcher salary levels are too low to attract and retain highly qualified scientists.

POLICY IMPLICATIONS

▶ Myanmar has made progress in strengthening its research capacity in recent years, but ongoing training and recruitment remain a priority. An ambitious training plan has been developed for DAR staff based on a thorough skills gap analysis, with the intention of doubling the Department's number of MSc- and PhD-qualified researchers in the coming years. Nonetheless, success in attracting and retaining research staff will require higher salary levels and other incentives, such as clear, performance-based career paths.

Agricultural researchers by degree level, 2000, 2013, and 2017

DAR
- 2000: 4, 17, 159
- 2013: 21, 45, 209
- 2017: 24, 75, 248

DOA
- 2000: 4, 13, 43
- 2013: 11, 27, 76
- 2017: 16, 20, 94

YAU
- 2000: 1, 10, 13
- 2013: 14, 22, 18
- 2017: 19, 29, 18

No. of FTEs in each category

■ PhD ■ MSc ■ BSc

◀ Until 2011, Myanmar was one of the world's most isolated economies. This situation severely affected overseas postgraduate training opportunities for agricultural scientists. Since sanctions against the country were eased, greater donor-funded training opportunities became available, and the average qualification levels of agricultural scientists steadily improved. In 2017, DAR, DOA, and YAU employed 24, 16, and 19 FTE researchers with PhD degrees, respectively. The number of MSc-qualified staff employed at these three agencies has also increased considerably since 2000. Many recent MSc- and PhD-qualified graduates were trained in Australia, China, Germany, Japan, Malaysia, the Netherlands, Singapore, and South Korea. In addition, three scientists completed PhD training locally at YAU in 2017, and many more are set to follow in the coming years. Many of DOA's PhD-qualified staff are only conducting limited research, however, and they are often assigned to management tasks or to international projects because of the advanced English language skills they obtained during overseas training.

▶ Nowhere in the world is the share of female agricultural researchers higher than in Myanmar. While in many countries in South Asia, women represent around one-fifth of the pool of agricultural researchers, in Myanmar, more than 70 percent of agricultural researchers are female. In addition, female researchers in Myanmar do not hold considerably lower average degree levels than their male colleagues, as is the case in most low- and middle-income countries around the world. Nonetheless, women are severely underrepresented in research management positions in Myanmar. And while the high rate of participation of women in agricultural research may appear positive, the underlying reason is a cause for concern. Civil servant salaries are so low in Myanmar that they act as a disincentive to predominantly male household heads because they are insufficient to support a family. As a result, research positions mainly attract female applicants.

Share of female researchers

Myanmar 71%
Thailand 47%
Vietnam 47%
Cambodia 30%
Laos 25%
Bangladesh 22%
India 18%
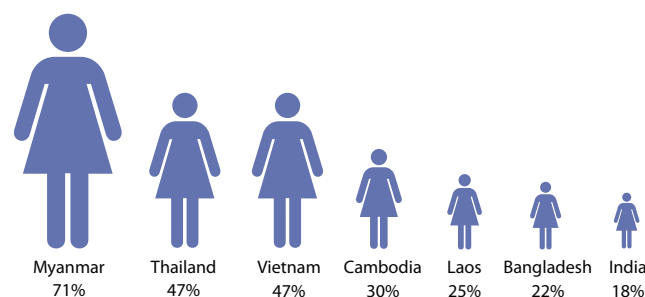
Note: Data for Myanmar, Thailand, Vietnam, Cambodia, and Laos are for 2017; data for Bangladesh are for 2016; and data for India are for 2014.

CHALLENGES TO ATTRACT AND RETAIN SCIENTISTS

▶ In Myanmar, a young scientist with a BSc degree in agriculture can earn a higher salary in an entry-level position with an NGO or donor-funded initiative than a PhD-qualified senior scientist can at a government institution. The fact that the country's public-sector salaries are so low makes attracting and retaining highly qualified research staff extremely challenging. Moreover, promotional opportunities at government agencies tend to be based on seniority rather than merit, making government agencies unattractive employers for young, ambitious scientists. Those who succeed in getting promoted often move into administrative positions, leaving research altogether. Despite the influx of a large number of young, qualified scientists in recent years, motivating and retaining them will be challenging given the low salary levels, lack of promotional opportunities, and reality that the skills they gained overseas cannot always be applied back home because of outdated research infrastructure or financial constraints.

CAPACITY STRENGHTENING AT DAR

▶ In 2018, DAR developed an ambitious plan to recruit and/ or train 55 PhD- and 106 MSc-qualified scientists by 2023, ultimately doubling DAR's number of postgraduate researchers and addressing its most pressing capacity challenges. Roughly half the researchers selected will receive postgraduate training focused on genetic improvement, mostly of rice, maize, oil crops, legumes, and industrial crops. In addition, a considerable number of scientists will be trained in areas like agronomy, soil science, water management, plant pathology, plant entomology, statistics, and agricultural economics. The majority of the scientists have already commenced their training both in-country and abroad (mostly in Australia, China, Japan, and South Korea). DAR funds most of the local training, whereas overseas training is funded by the governments of Australia, Japan, and South Korea, as well as by the Food and Agriculture Organization of the United Nations, the International Atomic Energy Agency, and a number of CGIAR centers.

MOVING TOWARD A MORE DEMAND-DRIVEN AGRICULTURAL RESEARCH SYSTEM

▶ Almost all of DAR's PhD-qualified researchers and the vast majority of researchers with MSc degrees are stationed at headquarters in Yezin, just outside the capital of Naypyidaw. YAU, the University of Veterinary Science, and FRI also operate from Yezin, whereas UY and the largest research unit under DOA—the Horticulture and Plant Biotechnology Division—are Yangon-based. With 90 percent of the country's PhD-qualified agricultural researchers located in either Yezin or Yangon, Myanmar's agricultural research system is extremely centralized geographically.

The development and adoption of improved varieties occurs more rapidly and effectively if undertaken through a more decentralized approach, where farmers and agribusinesses interact closely with research and extension. DAR's current network of satellite farms already provides the basic infrastructure for such an approach, but several factors impede the satellite farms from participating in research prioritization and design, including the very low number of researchers with PhD and MSc degrees at these farms, limited exposure of Yezin-based researchers to farmers due to transport and budget constraints, and a general tradition of hierarchical decisionmaking. In addition, the satellite farms tend to focus more on seed production than on research because they are expected to generate revenues from the production and sale of seed. Nonetheless, with appropriate mandates for (multidisciplinary) staffing and cropping systems, the satellite farms could play a vital role in identifying research priorities for the major cropping systems in their respective areas, and engaging more closely with extension workers to design and implement onfarm trials and demonstrations in response to the needs and priorities of local farmers. This kind of decentralized research model is currently being piloted in the Sagaing region, involving DAR and DOA researchers, extension staff, and local farmers (Boughton and Win 2019).

Myanmar's agricultural researchers by discipline, 2017

	FTEs	
DISCIPLINE	PhD	MSc
Plant breeding/genetics	24.0	43.3
Plant pathology	4.0	9.5
Plant physiology	3.1	10.6
Other crop sciences	8.6	10.5
Livestock breeding	0.4	0.3
Veterinary medicine	4.6	5.4
Other livestock sciences	7.1	10.1
Forestry and agroforestry	2.4	26.8
Fisheries and aquaculture	0.4	1.3
Soil science	3.2	8.4
Natural resource management	1.2	1.4
Food sciences and nutrition	0.6	0.9
Socioeconomics (incl. agricultural economics)	2.9	8.2
Other	14.0	29.9
Total	**76.7**	**166.7**

▲ Myanmar lacks a critical mass of PhD-qualified researchers in a number of key areas. Although the majority of DAR's researchers are involved in plant breeding, its biotechnology laboratories have very few staff (DAR's Biotechnology Research station in Yezin has only two staff members with PhD degrees) and limited equipment to support efficient plant breeding programs. The growth potential of Myanmar's aquaculture and livestock sectors is enormous, but the country lacks a critical mass of breeders covering these sectors. In addition, Myanmar has insufficient researchers with PhD degrees in critical areas such as agronomy, soil and water management, pest and disease control, and socioeconomic analysis.

Distribution of DAR researchers by location, 2017

	PhD	MSc	BSc
LOCATION		(headcounts)	
Yezin headquarters	26	80	249
Aungban Satellite Farm	1	1	5
Magway Satellite Farm	–	1	8
Tatkone Satellite Farm	–	1	13
Zalote Satellite Farm	–	1	8

▲ DAR's main satellite farms are Aungban, Magway, Tatkone, and Zalote. As of 2019, DAR operated 25 satellite farms, but many do not conduct research or employ graduates/postgraduates. Four new satellite farms will be established in the coming years in order to provide coverage to all of Myanmar's regions and states.
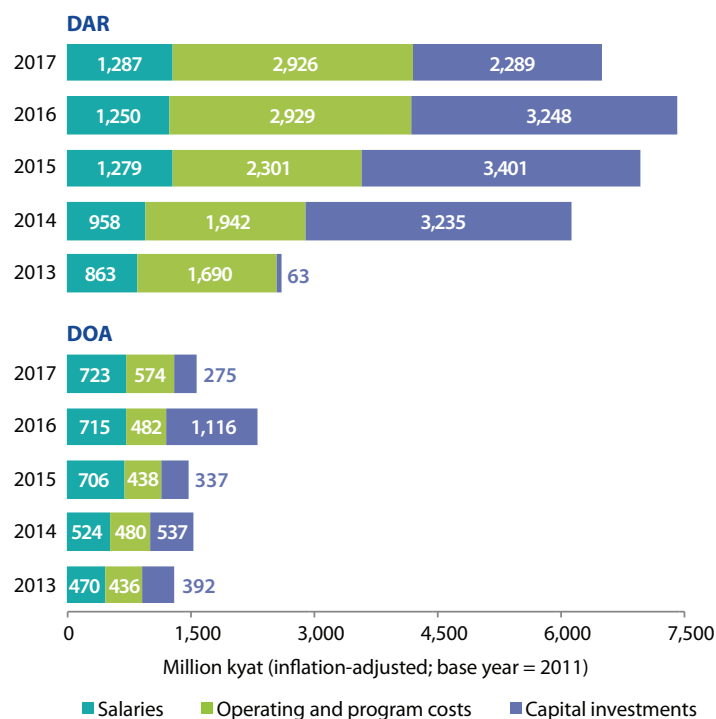
KEY CHALLENGE

▶ Accounting for just 0.06 percent of AgGDP and less than 1 percent of MOALI's total budget, agricultural research is grossly underfunded in Myanmar. Moreover, the research system is highly fragmented and coordination among the various research entities is minimal, often leading to costly duplication of research activities.

POLICY IMPLICATIONS

▶ The recent launch of ADS and the development of an agricultural research masterplan are clear signs of the government's prioritization of agricultural research. However, much higher investment levels are needed for research to effectively respond the agricultural sector's many challenges. Diversification of funding should be promoted through a more enabling policy environment that stimulates private funding. Research governance would need to be reorganized under a national structure to eliminate duplication of effort and enhance linkages among research agencies and between researchers and farmers.

DAR's and DOA's research expenditures by cost category, 2013–2017

DAR

Year	Salaries	Operating and program costs	Capital investments
2017	1,287	2,926	2,289
2016	1,250	2,929	3,248
2015	1,279	2,301	3,401
2014	958	1,942	3,235
2013	863	1,690	63

DOA

Year	Salaries	Operating and program costs	Capital investments
2017	723	574	275
2016	715	482	1,116
2015	706	438	337
2014	524	480	537
2013	470	436	392

Million kyat (inflation-adjusted; base year = 2011)

■ Salaries   ■ Operating and program costs   ■ Capital investments

◀ Myanmar stands out from most low- and middle-income countries when it comes to the composition of its agricultural research spending. Whereas in most countries salaries typically represent 50–70 percent of a national agricultural research institute's investments, DAR spent just 19 percent of its total budget on salaries during 2013–2017, and DOA spent only 38 percent. The main reason for these low shares is the country's extremely low civil service salary levels. Although a nationwide pay rise in 2015 remedied the situation somewhat, salaries remain too low to enable DAR and DOA to attract and retain highly qualified research staff.

Another factor that makes DAR stand out from its international counterparts is its relatively high share of capital investment. In fact, most of the growth in research expenditure in recent years was driven by increased capital investment. A large influx of donor funding, following the country's first ever donor conference in 2013, coupled with an increase in the government's prioritization of agricultural research, has initiated the much-needed upgrade of research infrastructure and equipment. However, much more funding for the upgrade of laboratories, office space, research equipment, vehicles, and information technology is needed in the coming years, particularly in the regions, to overcome decades of neglect.
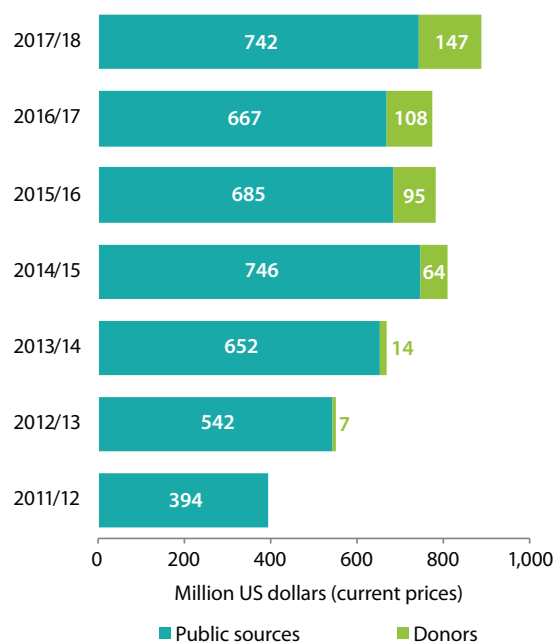
MOALI temporarily reduced its funding to DAR and DOA in 2017. Spending levels were forecast to rise thereafter based on the launch of ADS and a number of large donor-funded projects.

AGRICULTURAL DEVELOPMENT STRATEGY AND INVESTMENT PLAN

▶ The new Agricultural Development Strategy (ADS) and investment plan for MOALI were launched in 2018 to address many of the challenges the country's national agricultural research system is facing, including severe underinvestment, organizational fragmentation, limited geographic dispersion of research, severely underresearched areas (including livestock, fisheries, and socioeconomics), and an ineffective extension system. ADS proposes a unified national agricultural research and extension system and the establishment of a National Agricultural Research Council mandated to coordinate and guide all research on crops, livestock, fisheries, postharvest issues, and socioeconomics. This new entity would conduct a thorough review of the country's current system of agricultural research stations and extension units under different departments, with a view to rationalizing and integrating their activities to ensure that priority research areas in all of Myanmar's major agroecological zones receive sufficient coverage.

In addition, ADS seeks the establishment of an Institute for Policy Studies in Agricultural Development and a reinstatement of the Academy of Agricultural Sciences to strengthen and integrate academic, research, and policymaking capacity in the agricultural sector. Human resource development plays a critical role in ADS as well. Traditionally, agricultural mechanization, irrigation, and rural development have consumed the bulk of MOALI's budget (86 percent during 2012–2018). The Investment Plan accompanying ADS (2018–2023) is set to realign the allocation of scarce MOALI resources in favor of agricultural research, the livestock and fisheries sectors, and agricultural planning and statistics systems (MOALI 2018).

Funding composition of MOALI budget, 2011–2018

Year	Public sources	Donors
2017/18	742	147
2016/17	667	108
2015/16	685	95
2014/15	746	64
2013/14	652	14
2012/13	542	7
2011/12	394	

Million US dollars (current prices)

■ Public sources ■ Donors

Sources: World Bank (2017) and MOALI (2018).

Note: Data include funding to all departments and universities under MOALI; disaggregated data on research versus nonresearch streams were not available.

WELL-COORDINATED DONOR SUPPORT ALIGNED WITH NATIONAL PRIORITIES

▶ In 2011, Myanmar embarked on its transition to democratic governance and market-oriented reforms. The country's agricultural sector had been mismanaged for decades, resulting in high levels of poverty. The reforms initiated as part of Myanmar's transition opened important opportunities for poverty reduction and sustainable, inclusive growth. This was reflected in increased engagement by development partners in policy dialogue and investment decisions. To improve the coordination of funding from individual donor agencies and to enhance the efficiency and impact of the various projects supported, it was commonly agreed that donor-funded projects should be closely aligned with national priorities. Consequently, rather than establishing separate funding streams between donors and recipients, the bulk of donor funding to agriculture-related projects is channeled to MOALI, which in turn allocates funding to the various departments under its supervision, including DAR, DOA, and YAU. MOALI determines its departments' yearly funding requirements based on projected GDP growth and fiscal revenues from the central and state governments, as well as the donor funding pipeline. As a result, it is difficult to track the amount of donor funding that individual research agencies receive each year. In 2018, donor funding accounted for 17 percent of MOALI's total budget and close to 40 percent of MOALI's capital budget. Total donor funding to Myanmar's agricultural sector is projected to rise by 22 percent during 2018–2023 (MOALI 2018).

LARGE DONOR-FUNDED PROJECTS IN SUPPORT OF AGRICULTURAL R&D

▶ LIFT is a multi-donor fund (currently consisting of the United Kingdom, the European Union, Australia, Switzerland, the United States, Canada, and Ireland) established in 2009 to address food insecurity and poverty. LIFT funds a variety of research projects focused on rural livelihoods, as well as aquaculture, pulses, maize, oilseeds, and rubber value chains. Capacity strengthening plays an important role in all LIFT-funded projects.

▶ For more than 30 years, JICA has supported DAR's seed bank for germplasm. It also plays an important role in strengthening YAU's capacity and research infrastructure through the Technical Cooperation Project. Currently, JICA is supporting a five-year project (2018–2023) to strengthen rainfed lowland and upland rice breeding based on genomic technology. This project will introduce paddy-based genetic breeding to Myanmar in order to develop high-yielding and pest- and disease-tolerant rice varieties.

▶ KOICA (South Korea) funds a number of projects related to agricultural mechanization and seed multiplication.

▶ The government of Myanmar is currently in negotiation with the World Bank for a US$80 million loan for the Myanmar National Food and Agriculture Systems Project (2020–2024). The proposed project will focus on increasing the productivity of selected high-value commodities, enhancing agricultural diversification and competitiveness, and diversifying diets in selected agroecological zones. Other important components of the project will be upgrading the infrastructure of research stations and laboratories, as well as building capacity and providing policy support within the national agricultural research and extension system.

▶ Negotiations are currently ongoing with the Asian Development Bank for a Climate-Friendly Agribusiness Value Chains Sector Project. The project will consist of a US$40.5 million loan from the Asian Development Bank and a US$22 million grant from the multilateral Global Agriculture and Food Security Program. A portion of the funding will be allocated to DOA and DAR to assist with the development of climate-resilient varieties of rice, beans, pulses, and oilseeds, along with their subsequent commercialization. The program also includes financing to upgrade laboratories focusing on food products, insecticides, and fruit quality.

KEY CHALLENGE

▶ Most of MOALI's services focus on the production of rice paddy and represent a disconnect from Myanmar's highly diversified farming system. The heavy focus on paddy is also reflected in the very high number of new rice varieties released by DAR, compared with other crops. Moreover, DAR's research tends to be disproportionately focused on maximizing yields, and as such neglects other critical research areas, such as pest and disease control, water management, and soil science. Given these constraints, the uptake of many of DAR's improved varieties and technologies has been limited to date.

POLICY IMPLICATIONS

▶ The unified national agricultural research and extension system proposed under ADS is certainly a step in the right direction to enhance the adoption of improved varieties. The involvement of extension agencies, farmers, and agribusiness companies in the design of the research agenda and the development of improved varieties will make Myanmar's research system more demand-driven. As previously mentioned, strengthening DAR's network of satellite farms (and better coordination with DOA farms) is essential to making this decentralized approach a success.

New varieties released by DAR, 2013–2018

CROP	2013	2014	2015	2016	2017	2018	TOTAL
Rice	6	1	8	5	1	5	26
Wheat	3	3	–	–	–	1	7
Maize	3	–	–	–	–	1	4
Groundnuts	1	–	1	1	–	1	4
Chickpeas	–	1	–	1	–	1	3
Soybeans	–	–	–	1	–	2	3
Cotton	–	–	1	–	–	–	1

CROP	2013	2014	2015	2016	2017	2018	TOTAL
Black gram (legumes)	–	–	–	–	1	–	1
Green gram (legumes)	1	–	–	–	–	–	1
Sugarcane	–	–	1	–	–	–	1
Tomatoes	1	–	–	–	–	–	1
Kenaf (fiber)	–	–	–	1	–	–	1
TOTAL	**15**	**5**	**11**	**9**	**2**	**11**	**53**

◀ During 2013–2018, DAR released a total of 53 new varieties, 26 of which were rice varieties. Other important crops include wheat, maize, groundnuts, chickpeas, and soybeans. Despite the importance of horticulture and industrial crops (mostly rubber and cotton) in the country's total value of agricultural production, very few new varieties of these crops have been released in recent years.

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. 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). TFP is calculated as the ratio of total agricultural outputs to total production inputs, so when more output is produced from a constant amount of resources, TFP increases. R&D activities produce new technologies and innovations are a crucial factor driving TFP, but technological spillovers from abroad, higher numbers of skilled workers, investments that favor the development of input and output markets (such as roads and communications), and government policies and institutions that promote market development and competition are major drivers as well.

Growth in agricultural output stagnated during the 1980s but has accelerated since (although it remains low compared with most Asian countries). Input growth has been low, reflecting Myanmar's relatively low labor productivity and limited tractor and fertilizer use. In fact, TFP growth has been the main driver of the country's output growth over time. Between 1981 and 1988, TFP growth was close to zero, but far-reaching policy reforms focusing on developing a market-based economy, promoting private-sector investment,
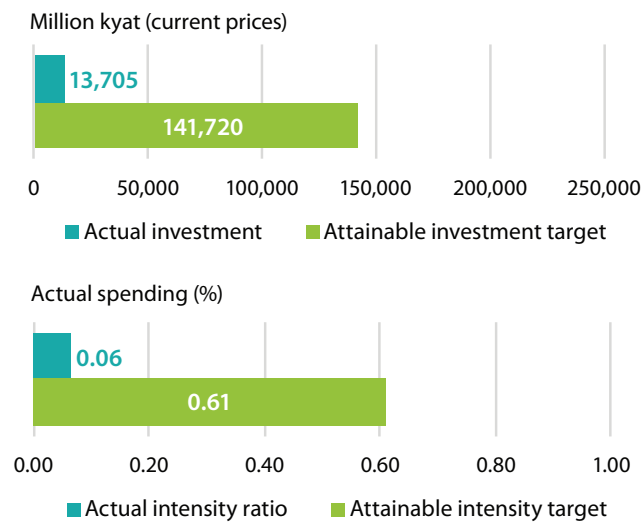
and boosting trade have prompted an acceleration of TFP growth since. Given extremely low domestic R&D investment during 1991–2010, it is fair to say that, to a large extent, TFP growth can be explained by improved efficiency in resource allocation as a result of these policy reforms. In recent years, however, TFP growth has slowed, indicating that the effect of the economic reform process has begun to fade. Future agricultural growth will increasingly depend on technical change, more intensive use of inputs, and further diversification of output.

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

Index (1980=100)
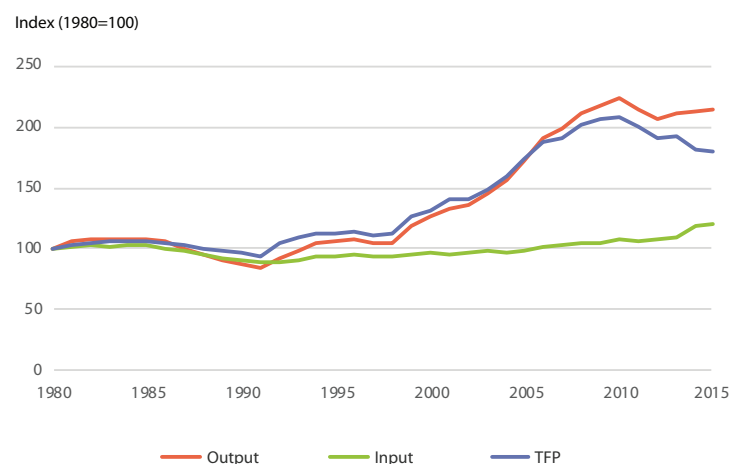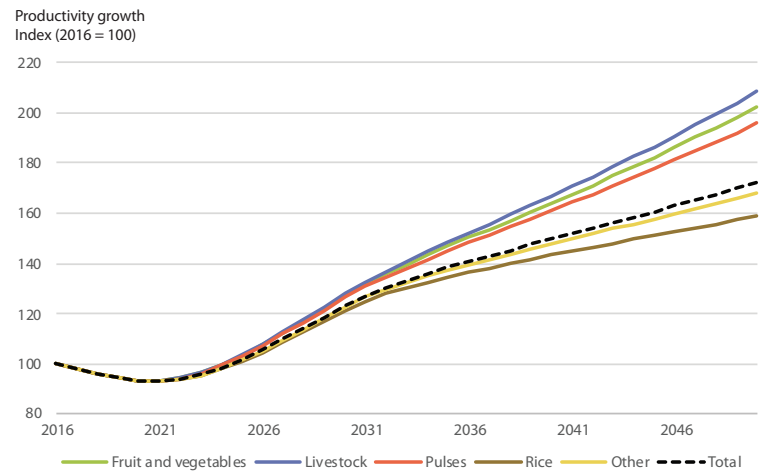

Source: Calculated by authors based on USDA-ERS (2019).

Actual research spending and attainable targets, 2017

Million kyat (current prices)

■ Actual investment	■ Attainable investment target

- 13,705
- 141,720

Actual spending (%)

■ Actual intensity ratio	■ Attainable intensity target

- 0.06
- 0.61

Productivity projections based on research prioritization of high-value commodities, 2016–2050

Productivity growth Index (2016 = 100)

— Fruit and vegetables	— Livestock	— Pulses	— Rice	— Other	---- Total

THE PRODUCTIVITY RESPONSE TO HIGHER AND SMARTER RESEARCH INVESTMENTS

▲ 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, its 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 multifactor indicator of research intensity that comprises a range of weighted criteria (for further details, see Nin-Pratt 2016). Under this approach, countries with similar characteristics (income, size of the economy, and size of the agricultural sector) are deemed to require similar minimum levels of research investment, and investment below that level is interpreted as an indication of potential underinvesting compared with similar countries.

ASTI's weighted indicator of research intensity shows that Myanmar is, indeed, grossly underinvesting in agricultural research. Based on the structural characteristics of the economy and the agricultural sector, the country should be able to invest 0.61 percent of its AgGDP in agricultural research. To have reached this target, Myanmar would need to have spent 141,720 million kyat in 2017, instead of the 13,705 million kyat it actually spent (both in current prices).
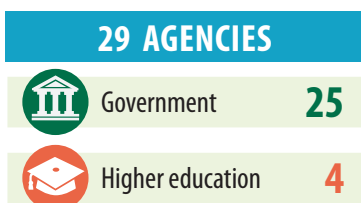
What would it take for Myanmar to close the investment gap by 2030, and how would increased agricultural R&D investment affect future productivity growth? In an effort to answer these questions, ASTI ran long-term projections on the impact of historical agricultural research investment on the country's agricultural output and productivity, and on the investments that would be needed to reach future targets. Results indicate that to reach the 0.61 percent investment target by 2030, Myanmar would need to increase research investment by a yearly rate of 20 percent during 2017–2030, which seems infeasible given its much more modest historical investment growth rates. However, spending growth at half this rate—that is, at 10 percent per year—is thought to be more realistic and would still yield a considerable TFP response. ASTI projections indicate that with 10 percent yearly agricultural R&D investment growth between 2017 and 2050, the productivity of Myanmar's agricultural sector would be 70 percent higher in 2050 than it is today.

It is not only the quantity, but also the quality of agricultural R&D investment that is important. Myanmar has set the goal of diversifying its agricultural production and increasing its exports. It will therefore need to invest proportionally less in research on cereals and more on high-value commodities, such as fruit and vegetables, cash crops, livestock, and fisheries. Neighboring Thailand successfully diversified its agricultural sector decades ago, allowing it to become highly profitable and competitive today. Of its agricultural researchers' time, Thailand currently allocates just 10 percent to cereals but nearly a quarter to livestock and fisheries. In contrast, Myanmar still allocates about one-third of its research effort to cereals (mostly rice and maize) and just 4 percent to livestock, while aquaculture and fisheries remain virtually unresearched.

ASTI carried out detailed analysis of the optimal allocation of research resources across commodities, along with the effects on future TFP growth. Results showed that productivity growth for pulses and high-value commodities could roughly double by 2050, and that rice productivity could increase by 60 percent. For this to occur, research investment in livestock, fruit and vegetables, and pulses would need to increase at rates of 15, 14, and 13 percent per year, respectively, during 2017–2050, whereas investment in all other commodities would need to grow at 6.5 percent per year. Total sectoral TFP growth under this "high-value" scenario would be the same as when investment increases were distributed more evenly across commodities. Nevertheless, if Myanmar is to successfully diversify agricultural production and make its agricultural sector more profitable and competitive on global markets, it will be important to accelerate research investment in high-value commodities.

OVERVIEW OF MYANMAR'S AGRICULTURAL RESEARCH AGENCIES

Twenty-nine agencies conduct agricultural research in Myanmar. DAR is the largest by far, accounting for more than half the country's agricultural researchers. DAR researchers (347 FTEs in 2017) are located at the Department's headquarters in Yezin and a number of satellite farms across the country. DAR's research is structured across six divisions: rice and other cereals; oilseed and food legumes; industrial crops, horticulture, and vegetables; agronomy, agricultural economics, and agricultural statistics; soil science, water utilization, and agricultural engineering; and biotechnology, plant protection, and microbiology. Under DOA, 17 agencies dispersed across the country conduct research on a wide range of commodities and thematic areas. The largest of these in terms of research capacity are the Land Use Division (25 FTEs, mostly involved in soil research), the Vegetable and Fruit Research and Development Center (25 FTEs), and the Horticulture and Plant Biotechnology Division (19 FTEs). FRI (66 FTEs) is Myanmar's principal forestry research institute, LBVD (7 FTEs) is the principal livestock research institute, and the Department of Fisheries (3 FTEs) is the main fisheries research entity. The higher education sector plays a restricted role in agricultural research in Myanmar, accounting for just 15 percent of the country's agricultural research capacity. YAU (66 FTEs) is the largest agricultural university by far, focusing its research mostly on rice, soybeans, and vegetables. The other universities with a limited research focus are the University of Veterinary Science (16 FTEs), UY (12 FTEs), and the University of Forestry and Environmental Science (4 FTEs). Agricultural R&D performed by the private sector in Myanmar is negligible. Most companies in Myanmar outsource their research to government agencies. DAR, for instance, undertakes crop trials for a large number of companies. Similarly, livestock companies engage LBVD to conduct fodder, feed additive, and vaccine trials, as well as their quality control experiments.

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

29 AGENCIES

| 🏛 Government | **25** |
| 🎓 Higher education | **4** |

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

ACRONYMS USED IN THIS COUNTRY BRIEF

ADS	Agricultural Development Strategy
AgGDP	agricultural gross domestic product
DAR	Department of Agricultural Research
DOA	Department of Agriculture
FRI	Forestry Research Institute
FTE(s)	full-time equivalent(s)
JICA	Japan International Cooperation Agency
KOICA	Korea International Cooperation Agency
LBVD	Livestock Breeding and Veterinary Department
LIFT	Livelihoods and Food Security Fund
MOALI	Ministry of Agriculture, Livestock and Irrigation
NGO(s)	nongovernmental organization(s)
PPP(s)	purchasing power parity (exchange rates)
R&D	research and experimental development
TFP	total factor productivity
UY	University of Yangon
YAU	Yezin Agricultural University