ASTI Country Brief | April 2020

MALAYSIA

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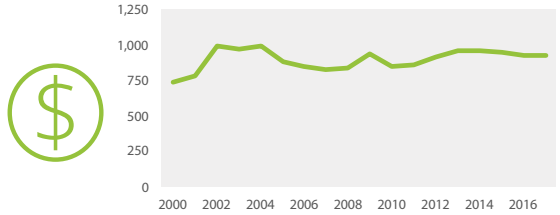
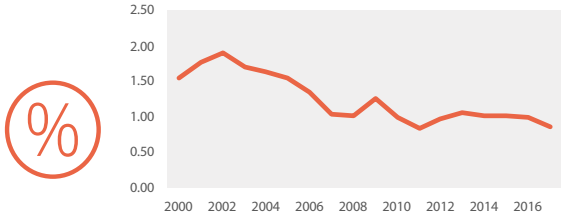
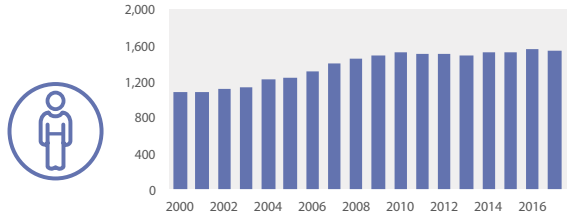
AGRICULTURAL RESEARCH SPENDING



SPENDING INTENSITY



AGRICULTURAL RESEARCHERS

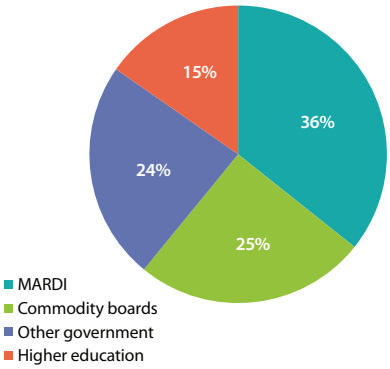


	MALAYSIA	INDONESIA	THAILAND	VIETNAM
Million ringgit (2011 constant prices)	917.9			
Million PPP dollars (2011 constant prices)	629.0	629.7	847.2	177.6
Agricultural research spending as a share of AgGDP	0.85%	0.17%	0.94%	0.20%
Full-time equivalents	1,543.4	4,289.5	2,911.4	4,250.1
Share of researchers with MSc and PhD degrees	72%	71%	50%	67%

Notes: Data in the table above are for 2017. Research conducted by the private for-profit sector is excluded from this country brief due to incomplete data coverage. Information on access to further resources, data procedures and methodologies, and acronyms and definitions is provided on Page 8. See **www.asti.cgiar.org/malaysia/directory** for an overview of Malaysia's agricultural R&D agencies.

- Malaysia's total agricultural research spending remained stagnant in the decade leading to 2017, averaging around 0.9 to 1.0 billion ringgit per year (in constant 2011 prices).
- Relative to AgGDP, agricultural research spending rapidly declined, from nearly 1.9 percent in 2002 to just 0.85 percent in 2017. Nonetheless, Malaysia's agricultural R&D spending as a share of AgGDP remains one of the highest in Southeast Asia.
- The country's total number of agricultural researchers remained relatively constant during the decade leading to 2017—averaging around 1,500 FTEs—but qualification levels improved markedly.

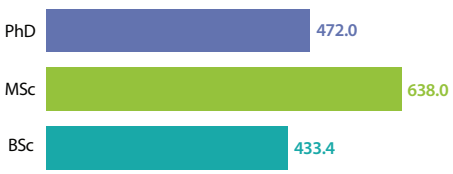
INSTITUTIONAL PROFILE, 2017



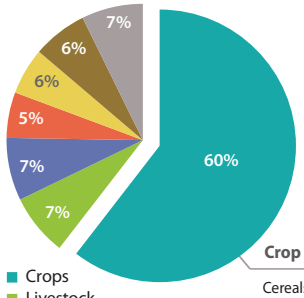
RESEARCHER PROFILE, 2017

By gender (%)

By qualification level (FTEs)



RESEARCH FOCUS, 2017



Crop categories

Cereals	11 %
Oil-bearing crops	21 %
Horticultural crops	16 %
Other crops	13 %

KEY CHALLENGE

- A large number of researchers at Malaysia's principal crop R&D agency, MARDI, retired in recent years, resulting in the loss of considerable knowledge and experience. Many retirees have not been replaced due to budget constraints, and severe capacity gaps are emerging (particularly among breeders and pathologists). Overall, MARDI's total number of researchers fell by 10 percent during 2014–2017. Attracting, motivating, and retaining young scientists is challenging given disparities in the salary levels and benefit packages offered by the public and private sectors.

POLICY IMPLICATIONS

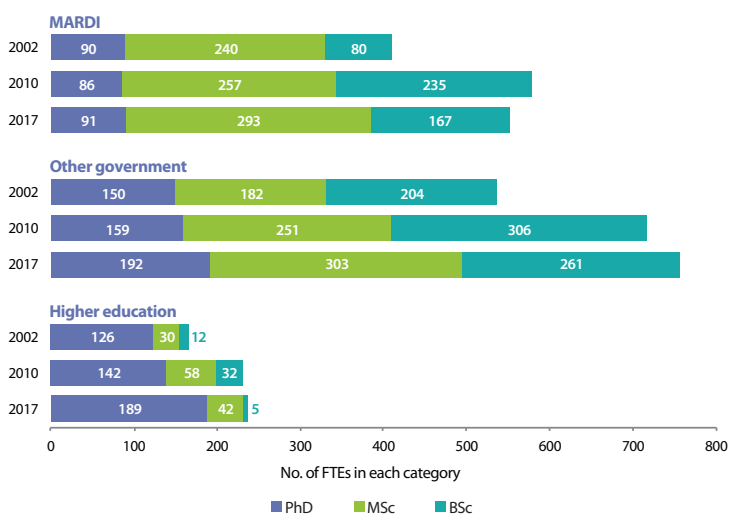
- In recent years, the Malaysian government introduced ambitious policies targeting food security and agricultural development, but these have not yet led to stronger agricultural R&D capacity. It is crucial that funding be made available for staff recruitment, that inexperienced scientists receive the necessary training and mentoring to be able to conduct effective research, and that appropriate conditions and incentives are established to encourage their long-term commitment to MARDI.

Agricultural researchers by degree level, 2017

	PhD	MSc	BSc	TOTAL
SECTOR/AGENCY		**(FTEs)**		
Government				
Department of Agriculture, Sarawak	4.2	13.3	15.4	32.9
Department of Agriculture, Sabah	—	6.3	25.2	31.5
Department of Fisheries, Sabah	—	0.8	2.4	3.2
Fisheries Research Institute	10.5	37.5	13.5	61.5
Forestry Research Institute Malaysia	80.0	75.0	28.0	183.0
Fisheries Research Institute, Sarawak	—	7.0	3.0	10.0
Malaysian Agricultural Research and Development Institute	91.0	293.0	167.0	551.0
Malaysian Cocoa Board	11.0	18.0	16.0	45.0
Malaysian Nuclear Agency	4.3	4.3	3.1	11.7
Malaysian Palm Oil Board	70.0	*115.0*	*115.0*	300.0
Malaysian Rubber Board	10.8	17.4	15.9	44.1
Veterinary Research Institute	1.4	8.2	23.6	33.2
Subtotal	283.2	595.8	428.2	1,307.1
Higher education				
Universiti Putra Malaysia (6)	132.4	4.9	—	137.3
Universiti Kebangsaan Malaysia	*21.0*	*6.3*	*5.2*	*33.1*
Universiti Malaysia Kelantan	9.3	5.3	—	14.5
Universiti Malaysia Sarawak	7.0	1.7	—	8.7
Universiti Malaysia Terengganu	11.1	3.6	—	14.7
Universiti Teknologi MARA	7.5	20.5	—	28.0
Subtotal	188.9	42.2	5.2	236.3
TOTAL	**472.0**	**638.0**	**433.4**	**1,543.4**

Notes: Data in italics were estimated based on available degree data for 2010. Figures in parentheses denote the number of agencies included in the respective category.

Agricultural researchers by degree level, 2002, 2010, and 2017



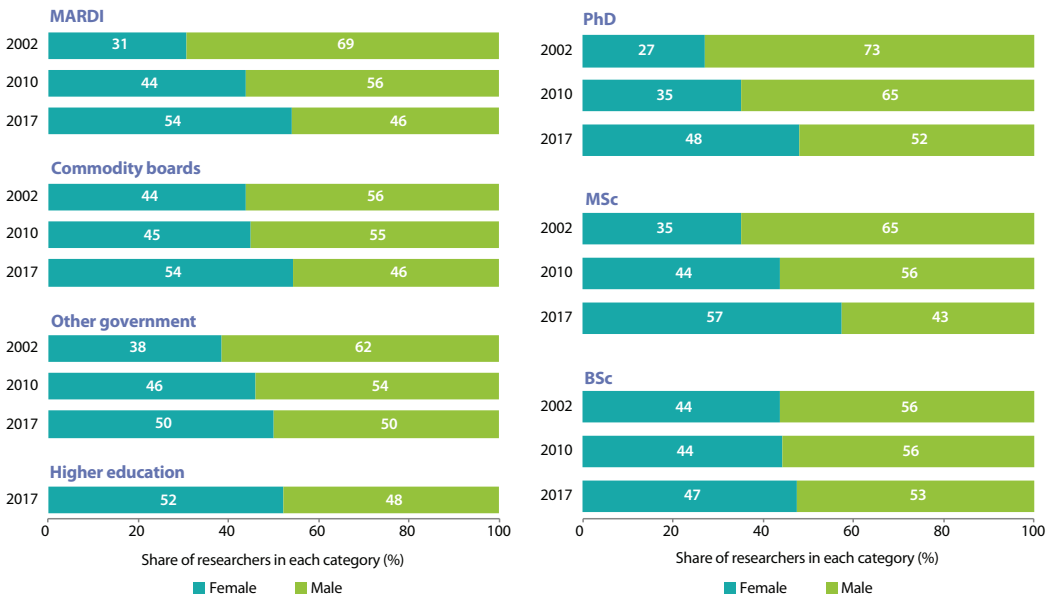
- In 2017, 31 percent of Malaysian agricultural researchers were PhD-qualified; 41 percent held MSc degrees; and 33 percent BSc degrees. University-based researchers hold much higher average qualification levels than their colleagues at government institutions. Average qualification levels of Malaysian agricultural researchers have steadily improved over time due to both training and recruitment. As of 2014, newly recruited researchers at MARDI are required to hold at least an MSc degree, which explains the gradual decline in the number of researchers holding only BSc degrees.

TRAINING OPPORTUNITIES FOR MALAYSIAN AGRICULTURAL SCIENTISTS

MARDI has a training budget of five million ringgit per year. Many of MARDI's scientists have benefited from training abroad (mostly in the United States, the United Kingdom, Australia, New Zealand, and the Netherlands), but this trend has recently been reversed because the institute is focusing on locally based training at UPM and the country's other universities. MARDI provides scholarship plans for both MSc and PhD degrees. Potential candidates are nominated by research managers based on merit, skills gaps, and priority research areas. Those who secure a grant commit to remaining at MARDI for at least five years after completing their degrees, and those who fail to obtain a degree are penalized through salary cuts.

The Malaysian government is prioritizing innovation and has set the ambitious goal of doubling the country's number of PhD-qualified scientists (across all disciplines) from 23,000 in 2016 to 60,000 by 2023. Under the Eleventh Malaysia Plan, the government has earmarked 500 million ringgit for this purpose. A large number of scholarship schemes have been launched in support of postgraduate training, including the MyBrain15 initiative, the Bumiputera Academic Training Scheme, the Academic Training Scheme of Public Higher Education Institutions, the Fundamental Research Grant Scheme, and the Long-term Research Grant Scheme. Researchers at MARDI, the commodity boards, and the other government and higher education agencies involved in agricultural research are also eligible to apply for scholarships under these schemes.

Share of female researchers by institutional category and degree level, 2002, 2010, and 2017



Notes: Commodity boards include the Malaysian Cocoa, Palm Oil, and Rubber Boards. The other government and higher education categories include the remaining agencies listed in the table on page 2.

Participation in agricultural research by women has rapidly increased over time. In 2002, about 35 percent of Malaysia's agricultural researchers were female. By 2017, this share had risen to more than half. Female researchers are now just as likely as their male counterparts to be PhD-qualified. The rapid rise in participation by women is not surprising considering that two-thirds of Malaysian university students (across all sciences) are female. At UPM, UniMAS, UiTM, UMT, and UMK, the ratio of women to men was more than 2 to 1, and rising. The gender gap is less pronounced in agriculture and veterinary sciences than in the social sciences, arts and humanities, medicine, and computer science, but women still outnumber men in agricultural and veterinary faculties by a ratio of 1.3 to 1.0 (Yong 2017).

PRIVATE-SECTOR AGRICULTURAL R&D

In recent decades, private-sector agricultural R&D has gained prominence in the larger Southeast Asian economies, including Malaysia. Most of these private investments occur in high-value commodities, such as plantation and industrial crops, horticulture, and agricultural inputs. Malaysia is no exception in this regard. Complete datasets for Malaysian private firms were not available, so it is difficult to provide specifics of public versus private investments or of developments over time. Nevertheless, ASTI collected detailed R&D-related data from 12 Malaysian companies. The vast majority of these firms were involved in the oil palm sector or other industrial crops (notably rubber and cocoa), but notable exceptions were BERNAS (as of 2017, 2 FTE researchers focused on rice), Craun Research (34 FTEs focused on sago), and Howard (3 FTEs focused on agricultural machinery).

Sime Darby Plantation, the world's largest oil palm company, is also Malaysia's largest private performer of agricultural research. The plantation has been at the forefront of oil palm research since 1900 and has made considerable contributions to the development and commercialization of improved varieties and best practices for cultivating both oil palm and rubber. In 2017, Sime Darby Plantation employed 122 FTE researchers and spent 69 million ringgit on agricultural research (in 2011 constant prices). As the world's second-largest oil palm company, FELDA (employing 44 FTE researchers in 2017) is also a significant performer of agricultural research in Malaysia. FELDA runs one of Southeast Asia's largest biotechnology centers and specializes in the production of oil palm clones with specific traits. The company's R&D spending totaled 31 million ringgit in 2017 (in 2011 constant prices).

The Malaysian government has various incentives in place to stimulate private investment in (agricultural) R&D. Companies that provide R&D services are eligible for "Pioneer Status" (an income-tax exemption) or an investment tax allowance for capital expenditures on R&D. For companies conducting in-house R&D, a double tax deduction is available for R&D-related expenses. Various financial assistance schemes have also been established to facilitate private R&D. In addition to conducting in-house research, a number of companies conduct joint research with the public sector or outsource their research to agencies like MARDI, which in turn receives royalties on the products developed.

KEY CHALLENGE

- While large oil palm plantations account for three-quarters of Malaysia's cultivated land, smallholder farmers are still among the poorest Malaysians. The fact that two ministries are responsible for agriculture—the Ministry of Agriculture and Food Industry and the Ministry of Plantation Industries and Commodities—has reinforced imbalances in the development of food and cash crops. This dichotomy is also apparent in R&D investment. MARDI, which predominantly focuses on food crops, has experienced severe budget cuts in recent years, whereas investments in oil palm R&D are still on the rise.

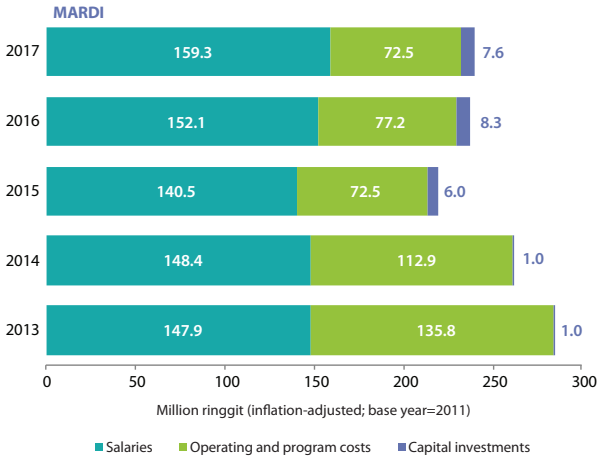
POLICY IMPLICATIONS

- Growing concerns over sustainability, food security, nutrition, and rural development necessitate the implementation and enforcement of a more comprehensive and coherent agricultural policy agenda. The adoption of a more holistic, systemwide view of the country's agricultural sector and development challenges is needed. Increased funding needs to be made available for research on food crops to increase smallholder incomes and reduce Malaysia's food import bill.

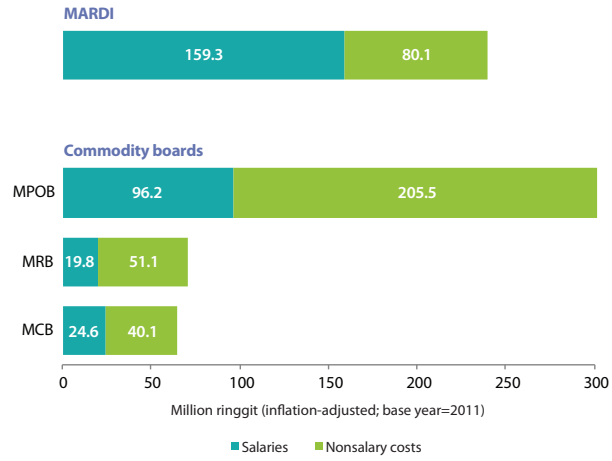
RESEARCH FUNDING FOR PLANTATION CROPS

- Despite MARDI's central role in agricultural R&D, the commodity-based research agencies—which include Malaysia's palm oil, cocoa, and rubber boards (MPOB, MCB, and MRB)—spent nearly twice as much on agricultural research, representing almost half the national total. The high value of export crops and related commodity-based resources means that these agencies are more highly funded than MARDI. MPOB and MRB receive funding through commodity levies on oil palm and rubber, respectively. Oil palm growers pay a tax (known as a cess) of 13 ringgit per metric ton of oil palm produced, of which 11 ringgit is allocated to MPOB's operating and research expenses, and 2 ringgit to the Cooking Oil Stabilization Scheme (to ensure sufficient supply of cooking oil and that its ceiling price is maintained). Overall, revenues of nearly 300 million ringgit were generated in 2019. For rubber, a cess of 40 ringgit per metric ton is imposed on exports from Peninsular Malaysia, which is collected at the point of export by Malaysian Customs. In addition to these revenues, MRB receives considerable research funding through grants from the Industrial and Commercialization Fund. No cess is collected on cocoa production or exports. MCB's research is mainly funded through the Standards and Trade Development Facility, the World Cocoa Foundation, and various domestic and international companies, as well as the Project Development Fund of the Malaysian government's Economic Planning Unit.

MARDI's expenditures by cost category, 2013–2017



Spending allocation of MARDI and the commodity boards, 2017

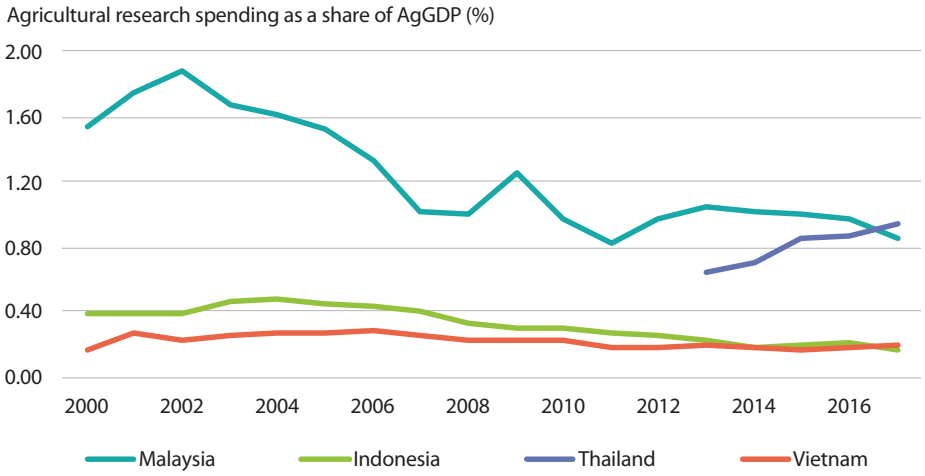


MARDI is entirely funded by the Malaysian government, through both core and competitive funding, with the exception of minimal donor funding for joint research activities with international and regional partners. Malaysia's Ministry of Finance and Economic Planning Unit determine how much funding is allocated to MARDI per year based on government priorities. During 2013–2017, MARDI's funding for research programs was almost halved, severely affecting its capacity to generate innovative, high-quality outputs. The institute is also struggling to maintain its laboratories and research equipment. Although exact data were not available, the current Malaysian government (which came into power in 2018) is said to have cut MARDI's funding even further based on a determination that projected returns to investments are unconvincing.

MRB and MCB also experienced reductions in their research funding during 2013–2017. Overall, expenditures fell by 5 percent at MRB and one-third at MCB (in inflation-adjusted terms). The main reason for the contraction at MCB was farmers' decisions to switch to more profitable crops like oil palm in hopes of generating higher incomes. This resulted in a decline in cocoa production of almost 50 percent during 2014–2019. In contrast, despite exhibiting an erratic trend in response to fluctuating yearly cess revenues, MPOB's overall spending rose by 7 percent during 2013–2017. In fact, in 2017 MPOB's total spending exceeded MARDI's (302 million ringgit compared with 239 million ringgit in 2011 constant prices).

What distinguishes the three commodity boards from MARDI is the allocation of expenditures by cost category. As of 2017, two-thirds of MARDI's budget was spent on salaries, leaving relatively little remaining resources for field and laboratory research. In contrast, the commodity boards spent an average of one-third of their total budgets on salaries, which allowed far more scope for conducting research and upgrading research infrastructure and equipment.

Agricultural research intensity, 2000–2017



Source: Compiled by authors from ASTI data.
Note: Data for Thailand for 2000–2012 were not available.

◀ Malaysia has traditionally had the highest agricultural research intensity ratio of all Southeast Asian countries. In 2002, the country invested close to 1.9 percent of its AgGDP in agricultural R&D, while countries like Indonesia and Vietnam only spent a fraction of that amount. Over time, however, Malaysia's agricultural research spending has remained relatively stagnant, whereas the country's agricultural GDP has grown significantly. As a result, during 2000–2017 Malaysia's intensity ratio fell by nearly half. In 2017, the country invested 0.85 percent of its AgGDP in agricultural research, which is still much higher than comparable ratios for Indonesia (0.17 percent) or Vietnam (0.20 percent), but lower than the ratio for Thailand (0.94 percent).

POLICIES TO ADDRESS THE FOOD TRADE DEFICIT HAVE NOT TRANSLATED INTO HIGHER R&D FUNDING

▶ Industrial crops (oil palm, rubber, and cocoa) account for close to 90 percent of arable land use in Malaysia and generate the bulk of the country's agricultural export earnings, but this heavy focus on industrial crops has undermined Malaysia's food sector. The country is heavily dependent on imports of cereals, fruit, and vegetables, as well as agricultural inputs (seed, fertilizer, pesticides), and this trade deficit has only worsened over time. The importance of the agricultural sector, particularly for food security, has been increasingly emphasized in policy documents in recent years, including the National Food Security Policy, the Tenth Malaysia Plan (2011–2015), the Eleventh Malaysia Plan (2016–2020), the National Agro-Food Policy (2010–2020), the National Commodity Policy, and the Economic Transformation Plan.

This increased focus on food security and agricultural development has not been accompanied by increased government support for agricultural R&D, as is illustrated by Malaysia's steadily declining agricultural research intensity ratio. Agriculture (including agricultural R&D) has only gained temporary political prominence in times of crises, such as the Asian financial crisis of 1997, the food and fuel price hikes of 2007/08, and the 2008 global financial crisis. During times that the economy is doing well, the focus on agriculture recedes. Besides, most of the government assistance goes to rice cultivation (which is an important political crop) and oil palm, as opposed to agricultural diversification and the promotion of downstream value addition. This lack of a holistic and coherent vision affects the continuity of research programs and hence the efficiency and long-term impact of agricultural R&D as a whole. By nature, agricultural research is a long-term endeavor requiring sufficient and sustained funding. If the government wants to restore balance in the country's focus on industrial versus food crops and address its food trade deficits, it is important that it increases its support for R&D in other commodity areas and stimulates innovation and the development of new varieties and postharvest technologies.

Number of peer-reviewed publications by government and higher education agricultural research agencies, 2013–2017

	GOVERNMENT AGENCIES					HIGHER EDUCATION AGENCIES				
TYPE OF PUBLICATION	**2013**	**2014**	**2015**	**2016**	**2017**	**2013**	**2014**	**2015**	**2016**	**2017**
Articles in international journals	192	192	223	175	190	769	755	695	726	782
Articles in Asian journals	11	10	22	14	9	7	9	7	8	14
Articles in Malaysian journals	172	258	174	253	219	86	80	71	76	166
Books	69	67	84	62	66	7	11	18	13	10
Book chapters	106	100	52	92	79	13	41	41	35	35
TOTAL	**550**	**627**	**555**	**596**	**563**	**882**	**896**	**832**	**858**	**1,007**
Peer-reviewed publications per FTE researcher per year	0.46	0.51	0.45	0.48	0.46	5.58	5.59	5.12	5.27	6.27

Notes: The government agencies category includes all agencies listed in the table on page 2 except the Veterinary Research Institute and the Fisheries Research Institute. The higher education category includes UPM, UMK, and UniMAS.

▲ Malaysian agricultural researchers publish a steady flow of journal articles, books, and book chapters. Their overall publication record is much stronger than those of their counterparts in other Southeast Asian countries. Nonetheless, there is a considerable gap in publication output between agricultural researchers in the government and the higher education sector. The average number of peer-reviewed publications per government researcher totaled 0.46 in 2017, while the publication record of university-based scientists was nearly 14 times higher (6.27 peer-reviewed publications per FTE researcher in 2017).

KEY CHALLENGE

- After decades of expanding land area for crop production, Malaysia has now fully exploited this resource. Future growth in agricultural output will require technical change, not only for oil palm production, but for food crops as well. To date, however, the capacity of the Malaysian R&D system to deliver innovative solutions to increase productivity in the livestock and horticulture sectors—both of which offer important opportunities for smallholder farmers to diversify their production and for the country to reduce its food import bill—has been limited.

POLICY IMPLICATIONS

- ASTI analysis indicates that R&D investment in high-value commodities (such as horticulture and livestock) will trigger faster growth in Malaysia's future agricultural productivity than a research agenda centered around plantation crops (see page 7). In order to drive future technical change, it is important that the government allocates higher R&D investment to commodity areas where projected productivity improvements are highest.

Number of new crop varieties registered in Malaysia, 2013–2017

CROP	2013	2014	2015	2016	2017
Bananas	14		9	–	3
Cocoa	–		–	52	3
Coffee	–		9	–	–
Flowers and ornamental plants	6	6	1	6	2
Lemongrass	–		–	–	4
Fruit (other than bananas)	12		12	20	–
Potatoes	–		3	–	–
Rice	1		1	8	–
Rubber	–		–	19	–
Sweet potatoes	–		–	–	1
Vegetables	4	4	1	–	–
TOTAL	**37**	**10**	**36**	**105**	**13**

- Malaysia's Department of Agriculture is charged with registering new crop varieties developed by the country's public and private sectors. Records exclude developed varieties that were not registered and, hence, may not present an accurate picture of the innovative capacity of the country's agricultural R&D system. Plantation crops, fruit, and ornamental plants are heavily represented among the varieties registered during 2013–2017, most of which were released by the private sector. The number of new varieties registered by MARDI has been limited in recent years and mostly includes rice varieties. Interestingly, no new oil palm varieties were registered during 2013–2017.

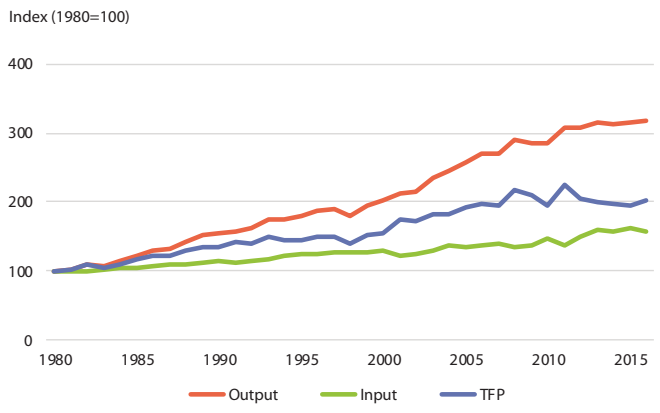
Source: Department of Agriculture (2013–2017).
Notes: Data exclude improved varieties that have yet to be formally registered.

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 producing 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 in roads and communications), and government policies and institutions that promote market development and competition are major drivers as well.

During 1980–2016, agricultural output in Malaysia increased at a rate of 3.4 percent per year on average. Growth in TFP (averaging 2.1 percent per year) was the primary driving factor as opposed to agricultural input growth (averaging 1.3 percent per year). However, in recent years—particularly since the 2008 global financial crisis—both agricultural output and TFP have stagnated, whereas agricultural input use has continued to rise. Several factors underlie this slower output and TFP growth, including the end of a period of high commodity prices (by 2011) and stagnating R&D investment since the turn of the millennium. A major factor driving strong growth of the country's agricultural sector over the past five decades has been the shift in output composition. During the 1960s, rubber represented about half the total value of agricultural output, while cereals (mainly rice) accounted for 15 percent, and livestock and fruit and vegetables accounted for 10 percent each. By 2016, rubber had almost entirely been replaced by oil palm (that year accounting for about 40 percent of the country's total agricultural production value), livestock production (especially poultry and pork) had increased rapidly over time, and the share of rice had fallen to less than 10 percent. These shifts have been the main drivers of rapid increases in the value of Malaysia's agricultural production over the past 50 years. Currently, however, the country's expansion in oil palm production appears to have reached its limit. Future output growth will be highly dependent on technical change, not only for oil palm production, but also for other commodities, especially livestock and fruit and vegetables. Agricultural R&D investment will play a critical role in driving future innovation.

Long-term growth in agricultural input, output, and productivity, 1980–2016



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

SMARTER ALLOCATION OF RESEARCH INVESTMENT ACROSS COMMODITIES

Even though Malaysia's agricultural R&D spending as a share of AgGDP has fallen substantially in recent years, the country's level of underinvestment in agricultural R&D is not as severe as in most other Southeast Asian countries. Based on the structural characteristics of Malaysia's economy and agricultural sector, ASTI determined that an investment target of 1.19 percent of Malaysia's AgGDP is realistic and attainable (for further details, see Nin-Pratt 2016). The country has traditionally invested at levels very close to or even above this target. Investments have only fallen below this level in recent years. The country's 2017 intensity ratio was about three-quarters of the attainable investment target (0.85 versus 1.19 percent of AgGDP).

Increasing agricultural R&D investment to attainable levels would certainly have a positive impact on future productivity growth; however, both the total level of agricultural R&D investment and the allocation of this investment are important. Limited potential to expand the area under oil palm production combined with untapped potential in other economically important crop and livestock areas, mean that the R&D investment decisions the country makes today will have serious repercussions for future agricultural productivity growth.

ASTI ran long-term projections of the impact of historical trends in agricultural research investment on the country's agricultural output and productivity, as well as on the impact of shifts in the allocation of investments across commodities. Four investment scenarios were considered:

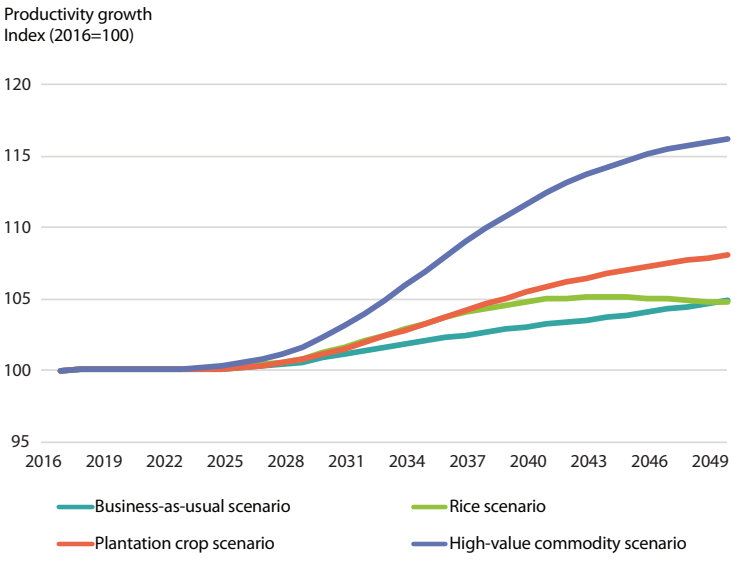
1. A *business-as-usual scenario*, which assumes that Malaysia's research focus remains unchanged in the future (32 percent of investment is allocated to oil palm, 27 percent to fruits and vegetables, 24 percent to rice, 12 percent to rubber, and only 4 percent to livestock).
2. A *rice scenario*, under which 70 percent of the country's agricultural research investment is allocated to rice.
3. A *plantation crop scenario*, under which 70 percent of research investment is allocated to plantation crops (mostly oil palm).
4. A *high-value commodity scenario*, under which 70 percent of investment is allocated to fruit, vegetables, and livestock.

All projections are for the 2017–2050 period, and all scenarios assume that total R&D investment for crops and livestock continues to grow at historical rates. Other commodity areas, such as forestry, fisheries, food science, and so on, were not included in this exercise.

Results show that the business-as-usual scenario has the least impact on TFP to 2050 (an increase of 5 percent over 2016 levels). Prioritizing investment in rice research leads to a strong initial increase in productivity, but this stagnates around 2040 due to lack of investment in livestock and other crops. Results are better when priority is given to oil palm, although the TFP gains in 2050 are relatively small (8 percent higher than 2016 levels, compared with 5 percent higher under the business-as-usual scenario). Projections indicate that the best results in TFP growth are achieved under the high-value commodity scenario, where priority is given to investment in fruit, vegetables, and livestock. Under this scenario, results indicate a 16 percent increase in TFP over 2016 levels. Livestock productivity is particularly responsive to investment, largely because it represents a significant share of the country's current agricultural output but has historically received low levels of R&D investment.

In conclusion, the Malaysian government should consider allocating higher levels of R&D investment to fruit, vegetables, and livestock in order to trigger faster productivity growth.

Agricultural productivity projections under different R&D investment allocation scenarios, 2016–2050

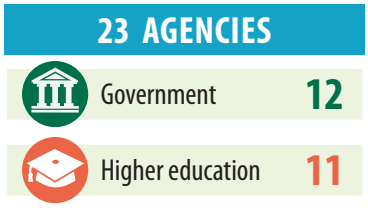


Sources: Calculated by authors based on ASTI (2020), USDA-ERS (2018), Nin-Pratt (2016), FAO (2018), and World Bank (2018).

Notes: Resource allocation across crops and livestock under the business-as-usual scenario is the same as the actual 2017 allocation. The rice scenario allocates 70 percent of the country's investment in agricultural R&D to rice; the plantation crop scenario allocates 70 percent of total investment to plantation crops; and the high-value commodity scenario allocates 70 percent of investment to fruit, vegetables, and livestock. For more information on the methodology behind these projections, see https://www.asti.cgiar.org/knowledge-stocks and https://www.asti.cgiar.org/tfp-projections.

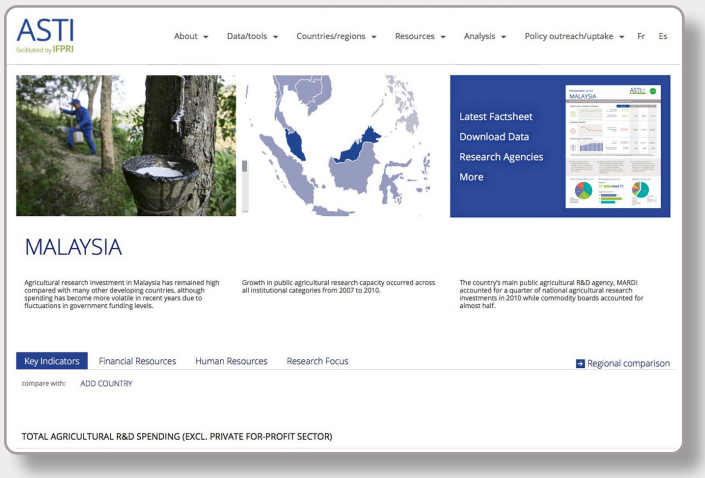
OVERVIEW OF MALAYSIA'S AGRICULTURAL RESEARCH AGENCIES

Twenty-three public agencies conduct agricultural research in Malaysia. MARDI is the country's main agricultural R&D agency, accounting for a quarter of national agricultural research investments and 36 percent of human resource capacity in 2017 (excluding the private for-profit sector). MARDI, administered by the Ministry of Agriculture and Food Industry, encompasses three branches (Research, Technology Transfer and Commercialization, and Operations) and oversees 29 regional research stations. MARDI's main focus is on rice and horticulture, but it also conducts livestock, socioeconomic, and natural resources research. Despite MARDI's central role in agricultural R&D, the country's commodity-based research agencies spent nearly twice as much as MARDI on agricultural research. The centers, all of which fall under the Ministry of Plantation Industries and Commodities, include the Malaysian Palm Oil Board (300 FTE researchers in 2017), the Malaysian Cocoa Board (45 FTEs), and the Malaysian Rubber Board (44 FTEs). A number of other government research agencies conduct R&D in Malaysia, the largest being the Forestry Research Institute Malaysia (183 FTEs), the Fisheries Research Institute (62 FTEs), and the Veterinary Research Institute (33 FTEs). Two of Malaysia's states, Sabah and Sarawak, exercise a greater degree of autonomy and, as such, operate their own crop, forestry, and fisheries research agencies. The higher education sector plays a relatively limited role in Malaysia's agricultural R&D, accounting for 15 percent of the country's research capacity in 2017. Universiti Putra Malaysia (UPM) is the largest of these agencies, by far. It comprises four related faculties focused on agriculture, veterinary medicine, forestry, and food sciences and technology, along with the Institute of Agricultural and Food Policy Studies and the Institute of Tropical Agriculture and Food Security. These six UPM units employed a combined total of 137 FTE researchers in 2017. Other important agricultural research performers in the higher education sector include the Universiti Kebangsaan Malaysia's Faculty of Science and Technology (33 FTEs) and the Universiti Teknologi MARA's Faculty of Plantation and Agrotechnology (28 FTEs). The private sector also plays an important role in Malaysian agricultural R&D. The sector's largest contributors are Sime Darby Plantation and FELDA, both of which conduct considerable oil palm research (see page 3 for more detail on private-sector R&D).



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

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



ACRONYM LIST

AgGDP	agricultural gross domestic product
FELDA	Federal Land Development Authority
FTE(s)	full-time equivalent(s)
MARDI	Malaysian Agricultural Research and Development Institute
MCB	Malaysian Cocoa Board
MPOB	Malaysian Palm Oil Board
MRB	Malaysian Rubber Board
PPP(s)	purchasing power parity (exchange rates)
R&D	research and experimental development
TFP	total factor productivity
UiTM	Universiti Teknologi MARA
UMK	Universiti Malaysia Kelantan
UMT	Universiti Malaysia Terengganu
UniMAS	Universiti Malaysia Sarawak
UPM	Universiti Putra Malaysia

ABOUT ASTI, IFPRI, APAARI, AND MARDI

Working through collaborative alliances with numerous national and regional R&D agencies and international institutions, **ASTI** is a comprehensive and trusted source of information on agricultural R&D systems across the developing world. In the Indo–Pacific region, ASTI is facilitated by the **International Food Policy Research Institute (IFPRI)** and the **Asia-Pacific Association of Agricultural Research Institutions (APAARI)**. The **Malaysian Agricultural Research and Development Institute (MARDI)** under the Ministry of Agriculture and Food Industry, is Malaysia's principal agricultural R&D agency; its research predominantly focuses on rice, horticulture, livestock, natural resources, socioeconomics, and food technology.

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