# Malaysia

Keith O. Fuglie
International Potato Center
Bogor, Indonesia

This chapter presents the results of a survey of agricultural research spending by the private sector in Malaysia in 1995. The purposes of this survey were to (1) determine how much and what kind of agricultural research is being conducted by the private sector, (2) identify policy constraints and incentives to private research and technology transfer, and (3) assess major impacts of these private investments on agricultural productivity. These results update findings on private agricultural research reported in Pray (1987).

The Malaysian survey consisted of interviewing representatives of nine companies in Kuala Lumpur, Shah Alam, Sengalor, and Penang in May 1996. The companies were selected to include those with research and technology transfer activities in plantation, livestock, and agricultural chemical, and food industries. These interviews were supplemented with discussions with officials from the Malaysian Government, USDA's Foreign Agricultural Service, and agribusiness associations in Malaysia.

This chapter provides an overview of agricultural development in Malaysia and discusses agriculture's role in science and technology policy, reviews the major agricultural input industries in Malaysia through which private companies deliver improved agricultural technology to farmers, provides estimates of private research expenditures in each of these input industries, describes some of the major impacts of private agricultural research and the influence of policies on private incentives to invest in agricultural research.

## Agricultural Development in Malaysia

By Asian standards, Malaysia is a relatively small country, with a population approaching only 20 million people. It has achieved remarkable economic progress over the past two decades and is well on the way to becoming a fully industrialized nation. In 1995, the economy as a whole grew at 9.3 percent, and agricultural value added increased by 4 percent. From the turn of the century until the 1970s, exports of primary products (especially rubber and tin) were a major component of national income and provided investment for economic development. Since then, manufacturing production and exports have risen rapidly, and the share of agriculture in the economy has steadily fallen. Agriculture accounted for 14 percent of GDP in 1995, down from 38 percent in 1960 (Asian Development Bank, 1996). Malaysia has taken an outward orientation to its development strategy. It maintains an open trading and investment regime and has sought and encouraged private-sector participation in all sectors of the economy. The government has moved to privatize many state-owned firms.

The sustained high rate of economic growth has led to steadily rising wages and incomes. Labor has increasingly shifted out of agriculture and into manufacturing, construction, and services. Until the recent economic downturn in 1997, the Malaysian economy was operating at full employment with a tight labor market. Labor shortages had emerged, particularly in agriculture and other low-wage sectors. As a consequence, large numbers of foreign workers had come to Malaysia from poorer neighboring countries. The Asian Development Bank (1996) estimates that there were 1 million foreign workers in Malaysia in 1995 out of a total labor force of 7.8 million. The plantation sector is particularly dependent on low-cost foreign workers.

The agricultural economy is dominated by the plantation sector. Oil palm and rubber currently account for 70 percent of all agricultural land use. Area expansion was the major source of agricultural production growth until recently. While agricultural land continues to expand at a modest pace, crop and plantation land is also being lost to urbanization. Pressure on land and labor resources is causing structural change in the agricultural sector. Within agriculture, production of oil palm and fruit crops are increasing, while production of rubber and cacao are declining due to their lower profitability. These trends have affected the direction

of agricultural research investments by the private sector in Malaysia, as described below.

Malaysia has emphasized the production of plantation crops where it maintains a comparative advantage. As a consequence, it relies on imports for a large part of its food and feed needs. It currently imports about 35 percent of its rice needs, most of its corn and soybeans, and all of its wheat. It also is a net importer of horticultural crops. For many of the imported agricultural commodities, Malaysia adds value locally through livestock production and food processing. However, retail prices for the most important foods (rice, wheat flour, poultry) are administratively determined, and shortages may emerge if world prices rise above domestic prices. Nevertheless, trends toward greater reliance on imports for basic food and feed commodities are likely to continue (Rahman, 1996). In its 7th Development Plan (1996-2000), the Malaysian Government continued to pursue agricultural growth through more efficient resource allocation, emphasizing commodities in which it maintains a comparative advantage, such as plantation crops, and de-emphasizing self-sufficiency goals in food and feed crops.

## Structure of Agricultural Input Industries

A principal way for new technology to reach farmers is to supply them with new and improved agricultural inputs, such as better seed, livestock feed, crop protection chemicals, livestock pharmaceuticals, and farm machinery. The private sector can be expected to invest in research to improve agricultural inputs when (1) the size of the market is sufficiently large, (2) technological improvements can be made relatively quickly and easily, and (3) individual companies have some means of protecting their intellectual property from copiers (Pray and Fuglie, 1996). Before examining private-sector investment in agricultural research, a brief review of agricultural input sectors is provided.

### Plantations (Perennials)

Plantation or perennial crops play an important role in the Malaysian economy and a dominant role in its agricultural sector. They occupy 70 percent of the agricultural land and account for a similar proportion of agricultural value added. The most important perennial is oil palm, followed by rubber and cacao.

The origin of the Malaysian plantation economy dates back to the latter part of the 19th century, when colonial planters introduced rubber trees from South America and oil palm trees from West Africa. The growth of the automobile and electrical industries in western countries sparked an international rubber boom. Malaysia became the primary source of natural rubber for automobile tires, electrical wires, and other uses. To support the industry, the Rubber Research Institute of Malaysia (RRIM) was established in 1910 to develop improved technology for the industry (Pray, 1991). While rubber has lost its number one position in the agricultural sector to oil palm, it continued to occupy more than 30 percent of agricultural land in 1994, or 1.73 million hectares (table F-1).

At the time of Malaysian independence in 1964, most rubber and oil palm plantations were foreign owned. The Malaysian Government encouraged a process of "Malaysianization" to transfer ownership to local interests. Government investment bodies such as the National Investment Board (PNB) were instrumental in buying out foreign-owned plantations and transferring stock holdings to local ownership. By the early 1990s, the process of Malaysianization was largely complete. The PNB maintains large share holdings (30 percent or more) in three of the largest plantation companies in Malaysia (Guthrie, Sime Darby, and Golden Hope, formerly Harrison-Crossfield).

While rubber production was started by large plantations, it spread to small holders. By 1960, 60 percent of rubber area was held by small holders. By 1994, small holders' share of rubber area had further increased to 80 percent. The principal reason for the decline in the share of rubber area held by estates is the rising cost of labor. Rubber tapping remains a labor-intensive activity despite efforts to mechanize production. In a recent study of efficiency in the Malaysian rubber economy, Chew and Mohayidin found no evidence of economies of scale in rubber production. While some economies of scale probably exist in plantation establishment (land clearing and planting), there are no such economies at the labor-intensive tapping (harvesting) stage. Small holders may actually have a cost advantage in operating established plantations because the cost of monitoring hired labor is reduced.

Another major structural change in the Malaysia rubber sector is the development of a local processing industry to transform raw rubber (latex) into value-

**Table F-1—Agricultural cropland in Malaysia (area harvested)**

| | 1990 | Share of total cropland | 1995 | Share of total cropland |
|---|---|---|---|---|
| | *1,000 hectares* | *Percent* | *1,000 hectares* | *Percent* |
| **Industrial crops:** | | | | |
| Oil palm | 1,746 | 35.5 | 2,235 | 43.5 |
| Rubber | 1,614 | 32.8 | 1,475 | 28.7 |
| Coconut | 316 | 6.4 | 265 | 5.2 |
| Cacao | 298 | 6.1 | 210 | 4.1 |
| Sugarcane | 22 | 0.4 | 24 | 0.5 |
| Coffee | 13 | 0.1 | 15 | 0.3 |
| **Food and other crops:** | | | | |
| Rice | 681 | 13.8 | 673 | 13.1 |
| Fruits | 99 | 2.0 | 103 | 2.0 |
| Vegetables | 18 | 0.4 | 23 | 0.5 |
| Cassava | 39 | 0.8 | 42 | 0.8 |
| Corn | 20 | 0.4 | 23 | 0.4 |
| Peppers | 12 | 0.2 | 10 | 0.2 |
| Tobacco | 11 | 0.2 | 10 | 0.2 |
| Total cropland | 4,917 | 100.0 | 5,139 | 100.0 |

Source: FAOSTAT.

added products for domestic consumption and export. The share of rubber production exported as latex is shrinking, while exports of rubber products such as automobile tires and latex gloves is increasing. A similar trend can be seen in the palm oil industry.

Though oil palm was introduced into Malaysia in the late 1800s, it remained a relatively minor crop until the 1960s. Since then, production has expanded rapidly. Oil palm surpassed rubber as the principal agricultural commodity of Malaysia in the 1970s, and its share of total agricultural production is projected to continue to increase. Between 1960 and 1993, the production of crude palm oil (CPO) increased from 90,000 metric tons to 7.4 million tons per year. Currently, 2.4 million hectares are planted with oil palm, covering 42 percent of all agricultural land in Malaysia.

Unlike rubber, oil palm production remains largely an estate crop. Due to the high level of organization and large capital investment involved, there are significant economies of scale in oil palm production. Only about 10 percent of the oil palm area is operated by small holders, and the rest by large estates. Half of the oil palm area is in the hands of large private plantations, and the remaining 40 percent by state-owned plantations, the largest operated by the Federal Land Development Authority (FELDA).

As with rubber, Malaysia is gradually expanding its downstream processing capacity for palm oil products. Most palm oil is processed into food products such as cooking oil, but an increasing share is being used for nonfood products, such as soaps, detergents, and oleochemicals. In 1995, about 20 percent of Malaysian palm oil production went for nonfood uses, up from 10 percent in 1979.

Malaysian oil palm and rubber companies are expanding their plantation holdings in other countries due to declining land availability and labor shortages at home. Several Malaysian-owned corporations have invested in new plantations in Indonesia and Vietnam. So far, these investments have been primarily for raw material production of latex and crude oil palm. Further downstream refining takes place in Malaysia.

Cacao is a third estate crop that grew steadily in the 1980s but declined in Malaysia in the 1990s due to a sharp drop in world cocoa prices. Economic forecasts of world cocoa demand suggest that low prices will likely continue into the future, mainly due to the development of cocoa substitutes such as vegetable oils for cocoa butter in chocolates. Plantations that invested in cacao production are replanting these areas to oil palm, leaving cacao production primarily to small holders.

Other areas where the estate sector is active are in tropical fruit production, tropical hardwoods, and sugar cane. These are relatively small activities at present. Many of the oil palm and rubber plantation companies are diversifying into manufacturing and real estate development.

## Animal Sector

Poultry is the largest component of the animal sector in Malaysia. The Malaysian poultry industry supplies domestic demand for poultry products and also exports some products, mainly to Singapore. Per capita consumption of chicken and chicken eggs in Malaysia is among the highest in the world (table F-2). Poultry products are the principal source of meat protein because local cultural and religious norms place no dietary prohibitions on chicken consumption, while some religious or ethnic groups will not consume beef and pork.

During the past three decades, the Malaysian poultry industry has evolved from small back-yard operations into relatively modern, large-scale commercial operations. One of the factors contributing to the growth of the poultry sector is the replacement of local breeds with high-quality poultry breeds from the United States, Europe, Canada, and Australia. A second factor is the growth of highly efficient integrated production systems. Six of the largest broiler operations are now fully integrated with breeder farms, feedmills, processing plants, and in some cases, retail outlets (table F-3). The integrated firms account for two-thirds of broiler production in Malaysia and are steadily increasing their market share. There are about 5,000 smaller broiler operations, nearly all of which also use modern breeding stock and production methods. Chicken egg production has also moved rapidly toward large-scale production, but has not seen the same degree of integration as in the broiler industry.

In 1994, there were two grandparent broiler breeder farms in Malaysia that produced 65 percent of day-old parent stock, the rest being imported. A third grandparent farm is expected to begin operation in the near future. There are also 82 parent broiler stock farms. For layers, all grandparent stock is imported. There are 14 parent layer stock farms in the country. There are no pure-line stock farms for either broilers or layers.

**Table F-3—Integrated poultry firms in Malaysia**

| Company | Grandparent stock farm |
|---|---|
| Charoen Pokphand Jaya Farm | yes |
| Leong Hup Poultry Farms | yes |
| Dindings Broiler Breeder Farm | |
| Goldkist Breeding Farm | |
| KFC Breeder Farm & Hatchery | |
| Sinmah Multifeed | |

Source: Agricultural Counselor, U.S. Embassy, Kuala Lumpur, Malaysia.

After poultry, swine is the next largest component of the Malaysian animal industry. Pork is consumed by non-Muslim Malaysians who make up a significant minority of the population. While pork production tripled between 1970 and 1993, future growth in swine production may be constrained due to environmental and religious concerns. Regulations limit the areas in which swine can be produced and how waste products are handled.

As with poultry, Malaysian pig farmers have adopted modern breeds and production methods. Genetic improvement has played an important role in the development of the Malaysian swine industry. Breeding stock are imported primarily from Taiwan, Europe, North America, and Australia. There is currently only one pig breeding farm in Malaysia (a joint-venture with a Taiwanese company). In 1994, there were about 4,000 pig producers in Malaysia. Twenty percent (800 farms) had over 1,000 head and accounted for 70 per-

**Table F-2—Animal production in Malaysia, 1995**

| Type | Population | Production | Consumption per capita |
|---|---|---|---|
| | *1,000 head* | *1,000 metric tons* | *kg* |
| Poultry—broilers | 377,000 | 661 | 32.91 |
| Poultry—layers | 20,000 | 5.9 billion[1] | 331[1] |
| Swine | 3,282 | 230 | 32.35 |
| Beef (cattle & buffalo) | 846 | 18 | 4.38 |
| Mutton (goat, sheep & lamb) | 570 | 1 | 0.97 |
| Milk (cow & buffalo) | | 43 | 46.2 |

[1]Egg production and consumption in number of pieces.

Source: Production and number of live animals except poultry from FAOSTAT; Number of poultry broilers and layers and consumption per capita from Agricultural Counselor, U.S. Embassy, Kuala Lumpur, Malaysia.

cent of total pork production. Small operations are steadily being replaced by large intensive operations. Animal diseases remain a major problem and are exacerbated by increased rearing density of herds.

Cattle and ruminants are relatively unimportant in the Malaysian livestock industry, mainly because of the lack of pasture land. There have been some attempts to integrate livestock production with plantations using the undergrowth as pasture for cattle or sheep. But so far, these schemes have not been successful.

### Agricultural Chemicals

The use of agricultural chemicals in Malaysia is dominated by the plantation sector, which accounts for three-fourths of all sales. Herbicides are widely used in plantations to reduce undergrowth so that the trees face less competition for soil nutrients and are easier to reach for pruning and harvesting. Herbicides account for about 75 percent of the total value of pesticide sales in Malaysia, and more than 90 percent of the pesticides used in plantations. Insecticides account for 15 percent of total sales, and are used primarily in vegetable and rice production. Fungicides are primarily applied to horticultural crops. Rodenticides are applied in oil palm plantations to protect fruit from damage by rats.

### Farm Machinery

Increasing labor costs in the rapidly developing Malaysian economy have increased the demand for agricultural machinery (table F-4). Rice production is now mostly mechanized, with tractor tilling, mechanized seeding, and combine harvesting. Efforts have also increased to mechanize operations in the plantation sector, but progress has been slow. Rubber-tree tapping and oil palm harvesting remain manual activities. Transporting raw materials from the field to the mills has been mechanized.

**Table F-4—Malaysian imports of agricultural machinery**

| | 1985 | 1991 |
|---|---|---|
| | *US$1,000* | |
| Tractors | 25,494 | 49,177 |
| Irrigation pumps | 18,649 | 104,491 |
| Chemical sprayers | 3,198 | 23,093 |
| Poultry incubators | 1,665 | 12,516 |
| Power tillers | 2,638 | 12,419 |
| Combine harvesters | 3,083 | 4,278 |

Source: Nasarudin, 1995.

Several foreign agricultural machinery firms from Europe, Japan, and North America have affiliates or partner companies in Malaysia. Tractors Malaysia, for example, a part of the Sime Darby group of companies, has a Ford agricultural machinery franchise for Malaysia. Most agricultural machinery companies in Malaysia import foreign machinery or parts for assembly and distribution locally. Only one local firm designs and manufactures farm implements directly (Nasarudin, 1995). Recently, there have been some attempts to modify imported designs to suit particular local needs or requirements. For example, Tractors Malaysia modified some imported machinery to make them more suitable for in-field transport of oil palm fruit bunches.

## Private-Sector Investment in Agricultural Research

### Plantations

During the past 10 years, private-sector investment in research for plantation crops shifted almost entirely into oil palm, while private research on rubber and cacao was reduced. This trend was driven by expected future market potential for these crops. As discussed above, high labor costs in rubber production and low prices for cocoa reduced the prospects for these crops in Malaysia while the outlook for oil palm remains optimistic.

Private research on oil palm is closely linked to public research at the Palm Oil Research Institute of Malaysia (PORIM). PORIM is the world's premier research institute on oil palm production and utilization. For oil palm production, private plantations rely on PORIM for basic and pre-technology research. Plantations focus on applied problems, especially breeding, soil and fertility management, waste management, pest and disease control, and mechanization. PORIM collects, maintains, and evaluates oil palm germplasm from around the world. Private breeding programs can access this germplasm for promising new traits. For post-harvest processing and product development, PORIM plays a leading role in both pre-technology and applied research. The private sector has been reluctant to allocate research resources to new product development until the market prospects for these products are more certain.

Seven plantations account for most research conducted outside of PORIM (table F-5). The extent to which this research is classified as “private-sector research”

**Table F-5—Private and public plantation research in Malaysia, 1995**

| Company | Crop | Research | SY |
|---|---|---|---|
| | | *1,000 RM/yr* | |
| Golden Hope | oil palm (70%)<br>rubber (20%)<br>cacao, fruit (10%) | 10,000 | 20 |
| Guthrie | oil palm | 5,000 | 10 |
| United Plantations | oil palm | 2,000 | 4 |
| Sime Darby | oil palm | 7,300 | 14 |
| East Plantation Agency | oil palm | 2,000 | 4 |
| FELDA | | 7,500 | 15 |
| KL Kepong | oil palm | 2,000 | 4 |
| Perlis Plantation | oil palm<br>sugarcane<br>fruits, tobacco | 1,000 | 2 |
| Total private plantation research | | 36,800 | 73 |
| Cocoa Board | cacao | 1,410 | 5 |
| Palm Oil Research Institute of Malaysia | oil palm | 45,422 | 130 |
| Rubber Research Institute of Malaysia | rubber | research: 49,000 | 77 |
| | | (extension: 21,000 | 33) |
| Total public plantation research | | 95,832 | 212 |
| Total plantation research | | 132,632 | 285 |

Source: Industry estimates from author's survey.

requires some qualification. The government invests directly in many of these companies through stock holdings managed by the National Investment Board (PNB). PNB holds at least 30-percent ownership in three of the largest plantation companies (Golden Hope, Guthrie, and Sime Darby). Two more plantations are state-owned or state-run (East Plantation Agency and FELDA). The other two plantations with research programs are United Plantations and KL Kepong. Together, these seven companies are estimated to have spent about 36.8 million Malaysian Ringgits, or $14.7 million, on R&D in 1995. Nearly all of this was for oil palm research. A small amount went for rubber, fruit crops, and tropical forestry.

Three companies maintain their own breeding program and produce most of the improved oil palm seeds (Guthrie, Golden Hope, and FELDA). PORIM itself is restricted by law from selling seeds to plantations, although PORIM does provide oil palm seed for small holders. Due to the continuing expansion of oil palm area and the need for replanting old trees, there is a large demand for high-yielding oil palm seeds. Other plantations are beginning their own seed production programs.

Research on rubber production is increasingly dominated by RRIM, since private plantations account for less than 20 percent of total production and their share continues to decline. RRIM allocates about 70 percent of its scientific and technical resources to research and about 30 percent to extension. RRIM also conducts research on rubber post-harvest and processing. In addition, Sime Darby maintains its own in-house laboratory in tire research. The private sector is represented in RRIM research programs through the Malay Rubber Producers Council for production research and through the Malay Rubber Product Manufacturers Association for processing research.

The Malaysian plantation research institutes also maintain formal linkages with research institutes in other countries. Through collaborative research activities, new sources of technology and plant germplasm are introduced into the Malaysian plantation economy. RRIM is a member of the International Rubber Research and Development Board (IRRDB), which has its secretariat in the U.K. IRRDB has sponsored collections of landraces of rubber germplasm. The world rubber germplasm bank is maintained by RRIM in Malaysia and is accessible to all members. RRIM also supports research in other countries. RRIM has supported research since 1938 at a U.K. lab that focuses on rubber utilization and demand. For several years RRIM also maintained a research lab in Brazil (in collaboration with the Brazilian rubber research system) to study blight diseases; this lab was closed in 1990.

## Agricultural Chemicals

Three agricultural chemical companies maintain research stations in Malaysia with a fourth reportedly to open possibly by 2002. For two of the companies (Novartis and Zeneca), their Malaysian research facilities form part of their worldwide testing network for agricultural chemical development. In addition to testing new chemical compounds, these research stations develop crop protection technology for local markets, primarily in the plantation sector. Local R&D also supports the registration of chemicals for sale in Malaysia. Agricultural chemicals must be reregistered every 3 years under the 1974 Pesticide Act.

The multinational linkages are important for technology development and transfer. For example, Zeneca holds 25-percent ownership of CCM Bioscience, a local chemical firm that manufactures agricultural chemicals and fertilizers. CCM Bioscience maintains a 23-acre research station in Malaysia (it will be moved to a larger, 43-acre site possibly by 2003). These research stations form part of Zeneca's global research system. Zeneca maintains research laboratories in the U.K. and United States for synthesizing new chemical compounds. These compounds are then tested for efficacy and environmental effects at Zeneca's global network of 12 field research stations. Four of Zeneca's stations are maintained in the Asia-Pacific region (Malaysia, Philippines, Thailand, and Japan). Zeneca's Malaysian station is designed to test weed and rodent control under tropical conditions.

Similarly, Novartis maintains a research facility in Malaysia as part of its global testing network for new chemical compounds developed at its Swiss laboratories. Novartis conducts field research in Thailand, Indonesia, and Japan in Asia, Egypt and South Africa in Africa, Brazil in South America, as well as in the United States and Europe. This network allows Novartis to test new chemical compounds year-round under different environmental conditions. The Malaysian facility focuses primarily on testing herbicides, fungicides, and insecticides for use on plantation crops (oil palm and cacao), rice, and horticultural crops.

Private agricultural chemical research in Malaysia was estimated at about 4.5 million RM in 1995 (table F-6), and likely increased in 1996 and 1997 when AgrEvo (formerly Hoerchst) opened a new station and CCM Bioscience moved its research to a larger facility.

## Farm Machinery

Increased wages and labor scarcity in Malaysian agriculture have increased the demand for agricultural machinery. Most mechanization involves the direct importation of foreign machines or their designs for local manufacture with little or no modification. Rice production in Malaysia is now mostly mechanized. Rice paddies are tilled with tractor-based implements, seeded with motorized spreaders and harvested with combine harvesters. Rice mechanization reduced the labor component of rice production from 845 man-hours per hectare to 145 man-hours per hectare (Nasarudin, 1995). For oil palm and rubber, however, suitable equipment for harvesting, tapping, and field transportation of palm fruit bunches was not available. Three local companies, some plantations, and PORIM have experimented with design modifications or new designs for these specialized purposes. Engineering research by manufacturing companies is carried out in close collaboration with plantations. Tractors Malaysia, for example, is owned by the same holding company as Sime Darby plantations, and the two companies collaborate in research for oil palm mechanization. Tractors Malaysia is estimated to spend about

**Table F-6—Private agricultural chemical research in Malaysia, 1995**

| Company | Foreign links |
|---|---|
| Novartis | Switzerland |
| CCM Bioscience (Zeneca) | United Kingdom |
| ACM (Agricultural Chemical Malaysia) | Japan |
| AgrEvo (Hoerchst): opened field station in 1996-97 | Germany |
| Annual sales of agricultural chemicals | US$110,000,000 (76% herbicides, 15% insecticides, 9% fungicides and rodenticides) |
| Total agricultural chemical research: | US$3,900,000 |
| SY | 15 |

Source: Industry estimates from author's survey.

400,000 RM/yr on agricultural machinery design modification and testing.

Two other companies have also made investments in design modifications for plantation machinery. A small family company developed a “grabber” for palm kernel harvesting based on a Scandinavian design. A Jahore-based plantation firm built an in-field transporter based on a Taiwanese tricycle design that involved some machine design and modification.

So far there has not been much success in mechanizing oil palm and rubber harvesting. Some prototype models for in-field transportation of palm fruit bunches and a raised platform for palm fruit harvesting have been developed. But there had been no commercial sales as of 1998. Agricultural machinery manufacturers face an uncertain market for these products until their efficiency is convincingly established. This uncertainty is a major constraint to moving from the design stage to the commercialization stage. Total private-sector agricultural mechanization research is estimated to be 700,00 RM ($280,000) annually.

Another factor affecting the demand for agricultural mechanization (and therefore agricultural machinery R&D) is immigration policy. The agricultural sector (particularly plantations) has made extensive use of foreign workers to overcome rising local wage rates and increasing scarcity of agricultural labor. The Asian Development Bank estimates that 1 in 8 workers in Malaysia in 1995 were from other countries. Many of these are employed in the agricultural sector. To the extent that Malaysia is willing to allow (or unable to restrict) low-wage foreign workers, private investment in agricultural machinery research is likely to remain low.

## Summary of Private Agricultural Research Investment in Malaysia

Table F-7 summarizes our estimates of agricultural research expenditures in Malaysia. Estimates from Pray's 1985 survey are also presented for comparative purposes. The estimate for total private agricultural research in 1995 is $16.8 million, most of which was conducted by plantations. In inflation-adjusted dollars, private research increased from $13.6 million in 1985, or by about 2.4 percent per year. Public agricultural research also increased over this period, but not as rapidly. As a percentage of total agricultural research in Malaysia, private-sector research increased from 19 percent in 1985 to 21 percent in 1995.

**Table F-7—Private-sector investments in agricultural research in Malaysia, 1985 and 1995**

| Item | 1985 | | 1995 | | SY |
|---|---|---|---|---|---|
| | Companies | Value | Companies | Value | |
| | *Number* | *Mil. dol.* | *Number* | *Mil. dol.* | |
| Seed | 0 | 0 | 0 | 0 | 0 |
| Crop protection | 3 | 0.5 | 3 | 1.6 | 15 |
| Plantations | 9 | 10.0 | 7 | 14.71 | 69 |
| Animal | NA | NA | NA | NA | NA |
| Ag machinery | NA | NA | 3 | 0.3 | |
| Total private ag R&D | | 10.5 | | 16.6 | |
| Total public ag R&D | | 44.4 | | 63.5 | |
| Total ag R&D | | 54.9 | | 80.1 | |
| Private ag R&D % of total | | 19% | | 21% | |
| Ag value added | | 6,600 | | 11,090 | |
| Private ag R&D as % of ag value added | | 0.16% | 0.15% | | |
| Total ag R&D as % of ag value added | | 0.83% | | 0.72% | |
| Private ag R&D in 1995 dollars | | 13.6 | | 16.6 | |
| Public ag R&D in 1995 dollars | | 57.7 | | 63.5 | |
| Total ag R&D in 1995 dollars | | 71.3 | | 80.1 | |

NA = not available.

Note: Adjusted for inflation. Calculated at an exchange rate of 2.50 RM per $1.00 U.S.
[1]Includes $8 million and 19 SY's from parastatal estates (EPA and FELDA).
Source: 1985 estimates from Pray (1987). 1995 estimates of private agricultural R&D from author's survey. Estimates of 1995 public research from table 8.

## Impact of Private Agricultural Research

The most significant impact of private-sector research in Malaysia has been in the plantation sector. The productivity of rubber and oil palm has risen steadily over the past several decades. It is difficult to separate out the impacts of public research by PORIM and RRIM from research by private plantations, however, given the close cooperation between public and private research. These public institutions are the leaders in developing improved germplasm, pest and waste management, and new industrial uses for oil palm and rubber. Plantations play a major role in finding the optimal varieties and agronomic practices for specific areas.

In oil palm, PORIM and the plantations have invested heavily in developing tissue culture methods for rapid multiplication of true clones of high-yielding palms. Despite more than 20 years of interest in this technology, tissue culture currently supplies only a small fraction of seed needs. Major technical difficulties, such as vegetative and reproductive abnormalities in clones, remain. Nevertheless, the use of tissue culture propagation continues to be an important goal for the oil palm industry, and six Malaysian companies are doing research in tissue culture along with PORIM. Successful cloning is expected to raise yields immediately by 20 percent and eventually lead to important traits such as uniform maturation and improved oil quality (Davidson, 1991).

Public and private research on oil palm increased yields from 14 fresh-fruit bunches (FFB)/hectare in 1960 to 25 FFB/ha in the early 1990s. Oil extraction rates in Malaysia remain low, however, at an average of only 18-19 percent, compared with about 23-25 percent in Indonesia. Utilization research has resulted in an increase in the proportion of oil palm production used for nonfood purposes, from 10 percent of production in 1980 to 20 percent of production in 1990.

Similarly, RRIM has an impressive history of developing and extending improved rubber technology for Malaysian producers. Pee (1977) estimated the annual rate of return on rubber research in Malaysia between 1932 and 1973 to be 24 percent. Average latex yields increased from only 200-250 kg/ha in 1976 to 1,400-1,500 kg/ha in 1996. Experiment station yields from improved clones reach 3,000 kg/ha. This compares with average yields of only 400-500 kg/ha in the second largest producer of natural rubber, Brazil.

RRIM has achieved important progress in research on rubber biotechnology. In addition to tissue culture propagation, RRIM has developed a capacity for producing transgenetic rubber varieties. It achieved the world's first successful genetic transformation in rubber and has applied for a U.S. patent for this technology.

## Policies and Private Agricultural Research

The Government of Malaysia has taken an active role in promoting the development and transfer of agricultural technology. It supported the early establishment of specialized research stations, first for rubber and then for oil palm production and processing. In particular, it helped organize a system of commodity taxes on oil palm, rubber, and cocoa to support research. For rubber, a tax is levied on each kilogram of latex that is exported. The export tax provides most of the operating budget for the Rubber Research Institute of Malaysia. However, the research assessment as a percentage of total production has fallen as an increasing share of Malaysian rubber is exported in the form of processed products. In 1997, the research tax was extended to exported rubber products based on their rubber content.

In the 1970s, the government established a similar system for oil palm. A tax is levied on each ton of crude palm oil that is milled from raw palm fruit bunches.[1] This tax is the principal source of funds for the Palm Oil Research Institute of Malaysia, established in 1979.

The commodity taxes to support research for rubber and oil palm have worked well. These taxes have been supported by industry and have provided a stable source of revenue for research. An estimated 57 percent of the $63 million spent on agricultural research at public institutions in Malaysia in 1995 came from the private sector, mostly through the commodity taxes (table F-8). One reason for their success is that the private sector is actively involved in setting the research programs at RRIM and PORIM. The majority of the Board members at each institute are from the private sector, representing both large plantation estates and small holders. The government also appoints a share of the Board members of the institutes. A second reason for the success of the research tax is that it is relatively

[1] In 1995, the research tax, or cess, on oil palm was 5 RM/ton of crude oil palm processed.

**Table F-8—Funding of public agricultural research in Malaysia, 1995**

| Agricultural research institute | Public funds | Private funds | Total |
|---|---|---|---|
| | | *1,000 Malaysian ringgits* | |
| Malaysian Institute for Nuclear Technology Research (MINT) | 400 | NA | 400 |
| Rice Research Institute of Malaysia (RRIM) | 5,770 | 43,230 | 49,000 |
| Palm Oil Research Institute of Malaysia (PORIM) | 1,272 | 44,150 | 45,422 |
| Malaysian Cocoa Board (LKM) | 1,410 | NA | 1,410 |
| Malaysian Agricultural Research & Devel Institute (MARDI) | 35,566 | 3,500 | 39,066 |
| Sabah Agricultural Department (JTSB) | 161 | NA | 161 |
| Forest Research Institute of Malaysia (FRIM) | 3,511 | NA | 3,511 |
| Sarawak Forestry Department (JPSK) | 1,000 | NA | 1,000 |
| Sabah Forestry Department (JPSB) | 461 | NA | 461 |
| Fisheries Research Institute (IPP) | 4,040 | NA | 4,040 |
| Sabah Fisheries Department (JISB) | 270 | NA | 270 |
| Sarawak Fisheries Department (JISK) | 134 | NA | 134 |
| Veterinary Research Institute (IPH) | 365 | NA | 365 |
| Sabah Veterinary Department (JHSB) | 240 | NA | 240 |
| National University of Malaysia (UKM) | 1,332 | NA | 1,332 |
| Agricultural University of Malaysia (UPM) | 10,292 | NA | 10,292 |
| University of Malaysia (UM) | 629 | NA | 629 |
| University of Science Malaysia (USM) | 1,080 | NA | 1,080 |
| Total (1,000 Malaysian ringgits) | 67,933 | 90,880 | 158,813 |
| Total (US$1,000) | 27,173 | 36,354 | 63,525 |
| | | *Percent* | |
| Allocation | 43 | 57 | 100 |

NA = Not available.
Source: Public funds from National Council for Scientific Research and Development, Ministry of Science and Technology and the Environment, Annual Report for 1995. Private funds from author's survey and annual reports of RRIM, PORIM, and MARDI.

easy to collect. For oil palm, the raw harvested product must undergo primary processing quickly after harvest in order to assure quality and yield. Each of the 275 mills is monitored and a tax of 5 Malaysian Ringgits is levied on each ton of crude palm oil milled. For rubber, production and processing are more decentralized. The research tax is therefore levied on each ton of latex that is exported in raw or processed form.[2] For processed products, the tax is levied on each of the 81 Malaysian rubber processing factories producing rubber products for domestic use and export. These firms are registered with the Malaysian Exchange and Licensing Board, which also has responsibilities for negotiating trade issues, monitoring export quality of raw materials, and announcing daily price information.

The Malaysian Government placed increased emphasis on research and development in its seventh 5-year economic development plan (1996-2000). To accomplish this goal, the Ministry of Science, Technology, and the Environment established the National Council for Scientific Research and Development (MPKSN) to coordinate and prioritize research resource allocations in Malaysia. MPKSN has overall responsibility for allocating public R&D funds to priority research programs at research institutes, universities, and ministries.

Another part of this strategy is to increase technology transfer linkages between the public and private sectors. For agriculture, this led to a major reorganization of the Malaysian Agricultural Research and Development Institute (MARDI), which is responsible for research on all agricultural commodities other than oil palm and rubber. Under the reorganization, MARDI aims to generate 60 percent of its revenue from the private sector by 2002. In 1995, private sector sources accounted for 10-12 percent of MARDI funds. To achieve this goal, MARDI will change its principal emphasis from working with farmers to working with

[2] A research tax, or cess, of 3.75 RM/ton is levied on raw latex exports. In addition, a replanting cess of 9.5 RM/ton is levied to encourage the adoption of new technology. Planters get back this tax when they plant new trees and follow RRIM's technical recommendations.

agribusinesses. Greater emphasis will be given to food processing, industrial crops, livestock, horticulture, and resource management, and less to food crops such as rice. MARDI established a separate corporation called MARDITECH in 1992 to develop partnerships with private firms. MARDITECH offers joint equity participation with private companies to commercialize promising new agricultural and food technology. By the end of 1995, MARDITECH had invested 1.6 million RM as venture capital in four companies (Rahman, 1996). In addition, MARDI plans to use some of its research facilities (land and buildings) to develop science parks. MARDI will use 600 acres of land to establish an agroindustry park that will specialize in food processing. MARDI also encourages its research staff to work as consultants to private firms. About 40 percent of the consulting fees are kept by the researcher, 40 percent goes to MARDI, and 20 percent to MARDITECH. The "corporatization" of MARDI is likely to significantly alter the kind of agricultural research supported by the public sector in Malaysia.

The Malaysian Government offers a range of other policies to encourage private-sector research. In 1986, Malaysia passed a patent law and in 1987 enacted a copyright law. Enforcement of intellectual property rights is encouraged. Trademark infringement has not been a major problem for foreign companies in Malaysia. Malaysia also offers tax incentives for private research. Companies can write off 200 percent of the value of their research investments as a tax deduction.

The government has also sought to maintain Malaysia's competitive advantage in plantation crops by restricting the transfer of agricultural technology outside Malaysia. Until 1993, the transfer of oil palm and rubber seeds to other countries was prohibited. However, rising labor costs and declining land availability in Malaysia caused local plantations to look to other countries, principally Indonesia, to expand their plantation holdings. In 1993, the government allowed Malaysian plantations to invest in plantations in other countries and to transfer improved seed stock to their holdings in these countries. Malaysian plantations are still prohibited from selling improved seed to companies located in other countries, and the transfer of processing technology is still prohibited as well. Similar restrictions apply to rubber. While this policy may have helped Malaysia maintain its position as the world leader in oil palm and rubber production, it also served as a disincentive for local research. Limiting access to foreign markets for new technology reduces the potential returns to research.

Agricultural chemical research is affected by pesticide regulation. The Malaysian Pesticide Act of 1974 established standards for the storage, transportation, labeling, and use of agricultural pesticides based on WHO and FAO guidelines. These regulations are probably the most strictly enforced in southeast Asia. The main effect of these regulations on research is to require health and efficacy tests for periodic reregistration. Although there appears to be no policy pressure to reduce chemical pesticide use other than through enforcement of safe-use regulations, researchers have put some effort into developing integrated pest management (IPM) for rice and plantation crops. IPM for rice uses scouting tools to time insecticide applications. By far the largest agricultural chemical market is herbicide application in plantations. Legume cover is an important alternative weed control method on plantations. As a result, only about a third of the oil palm plantation area is treated with chemical herbicides in any given year. Treated areas receive 2 to 6 applications per year (Kon, 1996).

Government-supported higher education and research institutions are the primary training ground for professional and technical workers in the private sector. Successful researchers at PORIM, RRIM, and MARDI often move to the private sector in mid-career. During the past several years, these institutes have been important sources of human capital for the rapidly growing palm oil, rubber, and food processing industries.

## References


Asian Development Bank. *Asian Development Outlook 1996 and 1997*. New York: Oxford University Press, 1996.

Basiron, Y., and Jalani Sukaimi. "The Oil Palm and its Products: Competitiveness and Opportunities in the 21st Century." 1995 National Outlook Conference, Malaysian Institute of Economic Research, December 5-6, 1995.

Chew, Tek-Ann, and M. Ghazali Mohayidin. "Plantation Agriculture: Its Genesis, Management, and Role in the Malaysian Economy," *Agribusiness* 11, 2 (1995): 139-45.

Davidson, L. "Management for Efficient Cost-Effective and Productive Oil Palm Plantations." Proceed-

ings, 1991 PORIM International Palm Oil Conference, Kuala Lumpur, Malaysia, 9-14 September 1991.

Kon, K.F. Personal communication. R&D manager, Plant Protection Division, Novartis, Petaling Jaya, Malaysia, November 1996.

Nasarudin, Anas Ahmad. "Agricultural Mechanization in Malaysia." Paper presented at the APO Seminar on Agricultural Mechanization, Asian Productivity Organization, Tokyo, 7-17 March, 1995.

Pee, T.Y. "Social Returns to Rubber Research in Peninsular Malaysia," Ph.D. dissertation, Michigan State University, 1977.

Pray, Carl E. "Private Sector Agricultural Research and Technology Transfer in LDCs," Economic Development Center, University of Minnesota, Minneapolis, MN, March 1987.

Pray, Carl E. "The Development of Asian Research Institutions: Underinvestment, Allocation of Resources, and Productivity," in *Research and Productivity in Asian Agriculture* (R.E. Evenson and C.E. Pray, eds.). Ithaca: Cornell University Press, 1991.

Pray, Carl E., and Keith O. Fuglie. "Private Food and Agricultural Research and Public Policy in APEC Countries," Paper presented at the Conference on Food and Agricultural Policy Challenges for the Asia-Pacific, Manila, Philippines, October 1-3, 1996.

Rahman, Abdul Azziz Abdul. "Progress and Issues in Agricultural Trade Liberalization: Malaysian Case Study," Paper presented at the Conference on Food and Agricultural Policy Challenges for the Asia-Pacific and APEC, Manila, Philippines, October 1-3, 1996.

Tiong, Gan Lian, and Ho Chai Yee. "Impact of Rising Labour Cost on Choice of Plantation Crops for the Estate Sector." International Planters Conference, Kuala Lumpur. October 24-25, 1994.

# Appendix F—Companies and Officials Interviewed, May/June 1996

Mr. K.K. Woo
**Federal Flour Mills Bhd**
16th Floor, Wisma Jernah
Jalan Sultan Ismail
tel. (603) 242-4077
fax. (603) 241-4059

Dr. Neoh Soon Bin
**Soon Soon Group of Companies**
2448 Lorong Purusahaan 2
Prai Industrial Estate
13600 Prai, Penang
tel. (604) 390-7277
fax. (604) 390-8197

Dr. Ratna Kumar Duraisingam
Managing Director
**GoaTrade Farming Sdn Bhd**
United GTF Holdings Sdn Bhd
No. 42 Jalan 6/31
46000 Petaling Jaya
Selangor Darul Ehsan
tel. (603) 792-9075
fax. (603) 792-9692

Cary B. Sifferath
Assistant Director
**U.S. Feed Grains Council**
Wisma SOCFIN
Peti Surat #06
Tingkat Tig
Jalan Semantan
50490 Kuala Lumpur
tel. (603) 255-9826
fax. (603) 256-2053

W.C. Hiu
Managing Director
**CCM Bioscience Snd Bhd** (formerly ICI Agrochemicals)
Lot P.T. 200 Persiaran Selangor 40000 Shah Alam
P.O. Box 7433 40714 Shah Alam
Selangor Dural Ehsan
tel. (603) 542-8818
fax. (603) 542-8878

Mr. Bachu Ratilal
President Director & past pres. of Malaysian Ag Chem Assoc.
Ms. Ku -- regulator affairs
**Novartis (M) Sdn Bhd**
Lot 9 Jalan Api-Api
26/1, Kaw Perindustrialn
Hicom, Shah Alam

Yoong Kee Sin
Manufacturing and Development Manager
**Tractors Malaysia**
11th Floor, Wisma Tractors
7 Jalan SS 16/1
Subang Jaya
tel. (603) 734-6688
fax. (603) 734-6623

Dr. Radzuan Abdul Rahman
Group Director - Plantations
**Golden Hope Plantations Berhad**
Tingkat 9-16, Menara PNB
201-A, Jalan Tun Razak
50400 Kuala Lumpur
tel. (603) 261-9022
fax. (603) 261-8221

Ng Ah Lek
Plantation Development Manager
**Perlis Plantations Berhad**
17th Floor, Wisma Jerneh
38 Jalan Sultan Ismail
50250 Kuala Lumpur
tel. (603) 241-2077
fax. (603) 241-8242

Dr. Gan Lian Tiong
General Manager-Research
**Sime Darby Plantations**
Ebor Research
Locked Bag No. 7202, Batu Tiga
40706 Shah Alam
Selangor Darul Ehsan
tel. (603) 559-0237
fax. (603) 550-3728

Dr. Jalani Bin Sukaimi
Deputy Director General
**Palm Oil Research Institute of Malaysia**
P.O. Box 10620
50720 Kuala Lumpur
tel.o. (603) 825-9155
tex.h. (603) 774-7258
fax. (603) 825-9446
email: jalani@porim.gov.my

Dr. Wan Abdul Rahman W.Y.
Assistant Director (Biology)
**Rubber Research Institute of Malaysia**
P.O. Box 10150
50908 Kuala Lumpur
tel.o. (603) 456-7033
tel.h. (603) 719-5658
fax. (603) 457-3512

Dr. Mohd. Sharif Bin Ahmad
Director General
Dr. Saharan Haji Anang - Deputy Director General
(Commodity Research)
**Malaysia Agricultural Research and Development Institute**
P.O. Box 12301
50074 Kuala Lumpur
tel. (603) 943-7111
fax. (603) 948-3664
email: saharan@mardi.my

A Shafri Man-General Manager
Anas Ahmad Nasarudin - Head, Commercialization Services
**MARDITECH Corporation Sdn. Bhd.**
No. 19-21-2, SHL Business Center
Jalan SR 8/1, Off Jalan Serdang Raya
43300 Seri Kambangan
Selangor, Malaysia
tel. (603) 943-9835
fax. (603) 943-9887

Kent Sisson-Agricultural Counselor
Raymond Hoh Tuck Youen
**USDA/FAS**
U.S. Embassy
376 Jalan Tun Razak
50400 Kuala Lumpur
tel. (603) 248-9011
fax. (603) 242-1866

# List of Tables