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AGRICULTURAL RESEARCH AND DEVELOPMENT IN MALAYSIA

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ABSTRACT

Organized agricultural research in Malaysia only started in 1910 by the Department of Agriculture which was established five years earlier. This was followed by the establishment of private plantation crops research stations such as Dunlop Research Station, the Chemara Research Station and the Prang Besar Research Station. These private research stations focused their research on rubber. Agriculture research began to take an active role in the agriculture development of Malaysia only after Malaysian independence in 1957. The agricultural research and development became an established component of the national development plan during the 5th Malaysia plan (1986-1990) with the creation of the National Council on Scientific Research and Development (NCSRD). In 2002, total R&D expenditures were USD446.7 million (0.69 percent of Malaysia's GDP), of which the private sector involvement in R&D was merely 5 percent, mostly related to the plantation crops. In 2008, the total R&D expenditure increased to RM6.07 billion, which is equivalent to 0.82% of Malaysia's GDP. Research in agricultural sciences in 2008 constitute 5.8% of all researchers carried out in 2008. The main focus of agricultural research now is commodity based where the Malaysian Agricultural Research and Development Institute (MARDI), being the principal government agricultural research agency focused on food crops, while the private sector focused mainly on plantation crops.

INTRODUCTION

Malaysia obtained her independent 55 years ago and agriculture has contributed substantially to its gross domestic product. Currently about 11% of Malaysia's GDP is from agriculture. Agricultural research in Malaysia started in the early 1900's, when Dunlop Research Station was established in 1910. This was followed by the establishment of Chemara Research Station in 1920 and Prang Besar Research Station in 1921. All these were established by the British and research was focused mainly on rubber. The Department of Agriculture was established in 1905 and their research was on other crops. Only in the 5th Malaysia plan (1986-1990) agricultural research and development became an establish component of its national development plan. The focus of agricultural research and development has been crop based, where the government agencies deal with the food crops while the private agencies focus mainly on the plantation crops. The establishment of the Malaysian Agricultural Research and Development Institute (MARDI) in 1969 has intensified agricultural research and development.

Science and Technology Policies

Science and technology have played a significant role in Malaysia's development. The first National Science and Technology Policy (1986-1989) was developed to promote the utilization of science and technology as a tool for economic development and social improvement. The policy encompassed the promotion of scientific and technological self-reliance in support of economic activities through the enhancement of research and development capabilities. This was done through the creation of conducive environment for scientific creativity and the improvement of scientific, educational and other relevant infrastructure.

Formulation of the policies in the area of science, research, technology and innovation was lead by the Ministry of Science, Technology and Innovation (MOSTI). It also implements programs related to S&T and national R&D activities. For instance this year, 2012, has been declared as the Year of Science and National Innovation Movement (SGI 2012). This is an on-going effort by the government to promote and develop the culture of science, technology and innovation to all segments of the society.

A National Action Plan on Industrial Technology Development (1990-2001) was formulated to focus on three thrusts – strengthening institutions and support infrastructure for technological development, ensuring diffusion and application of technology, and elevating science and technology public awareness.

To sustain knowledge-based economy, the government of Malaysia recognized that research and development as well as technological innovations are essential, thus the launching of the Second Science and Technology Policy (NSTP2) which was formulated in 2002 and runs until this year (2012). The NSTP2 provides a framework for improved performance and long-term growth of the Malaysian economy with a special focus on seven strategic thrusts:

- Enhancing national capability and capacity for R&D, technology development and acquisition
- Promoting partnerships between public funded organizations and industries
- Accelerating the transformation of knowledge into value added products, processes, services or solutions
- Positioning Malaysia as a technology provider in key strategic knowledge industries
- Fostering societal values and attitudes that recognize science and technology as critical to future prosperity
- Utilizing science and technology that are in conformity with sustainable development
- Developing new knowledge-based industries.

One of the policy's goals is to enhance national capacity in R&D by creating a competent work force of at least 50 researchers per 10,000 workers. The NSTP2 shows that there has been a steady increase in the gross expenditure on R&D (GERD), leading to a substantial increase in Malaysia's GERD/GDP from 0.22 per cent in 1996 to 0.82 per cent in 2008. GERD increased substantially from RM0.55 billion in 1996 to RM6.07 billion in 2008 (Anon, 2012).

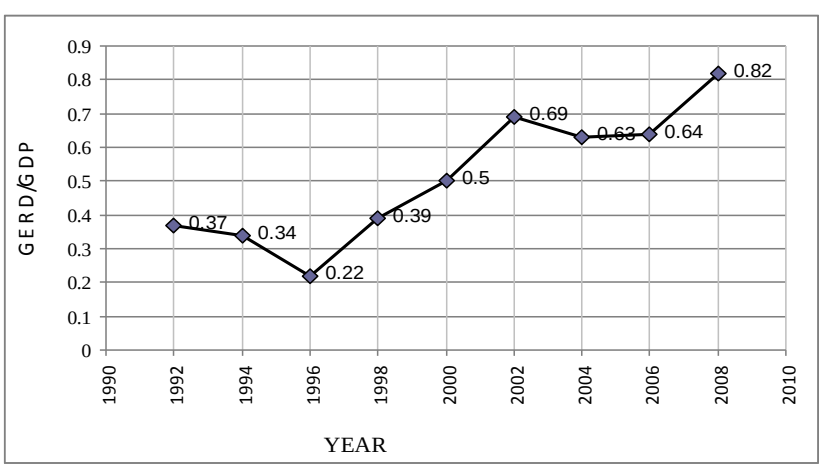

Fig. 1. Gross expenditure for R&D over GDP (%) from 1992 – 2008

In terms of human resource in R&D in Malaysia, in 2008, there were a total of 40,840 research personnel including researchers, technicians, and support staffs (Figure 2). Of this total, 77 per cent were researchers, followed by technicians (6.6 per cent) and support staff (16.4 per cent) (Anon, 2012). The researcher headcount was estimated at 31,442 with a ratio of 28.5 researchers per 10,000 workers. It has increased significantly (76.7 per cent) over a period of seven years (2002 to 2008). However, the target is 50 researchers per 10,000 workers by 2015.

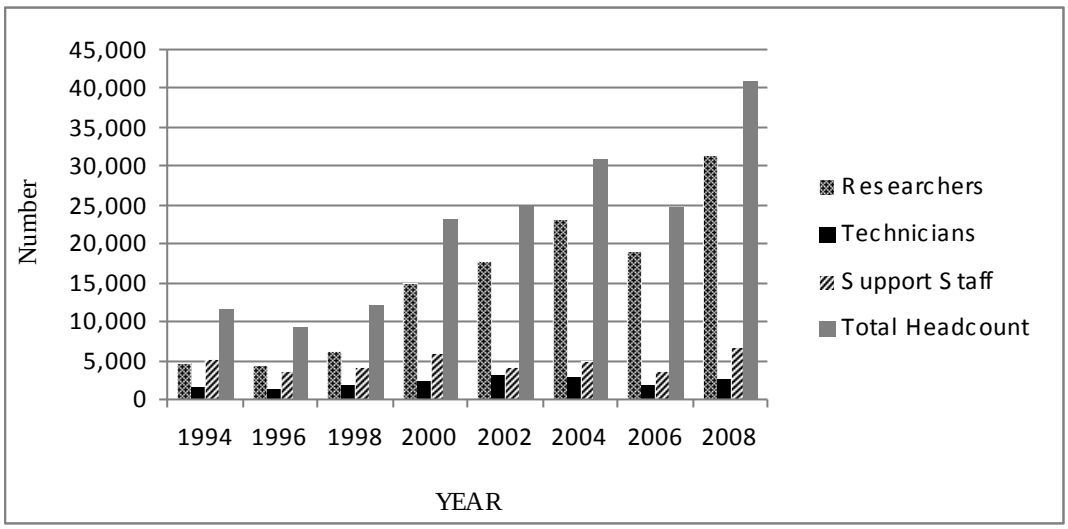

Fig. 2. Number of researchers involved in Malaysian R&D 1994-2008

Institutes of Higher Learning (IHL) in Malaysia had the best qualified researchers, with PhD and Master qualifications (Figure 3), compared to Government Research Institutes (GRI) and the private sectors.

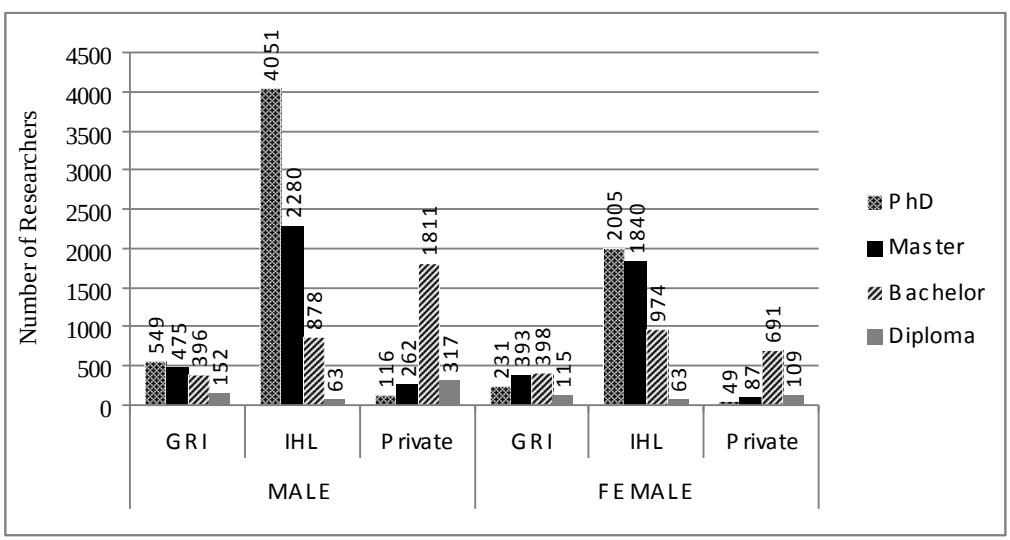

Fig. 3. Qualifications of researchers in GRI, IHL and the private sectors in Malaysia, 2008.

Source: National Survey of Research and Development 2008: Summary (MOSTI)

The implementation of the NSTP2 has aided a range of groups including public research institutes, institutions of higher learning, science and technology-based NGOs, industries especially Small and Medium Entrepreneurs (SMEs) , and science, technology and innovation agencies and communities. These groups benefited through the various initiatives and programs that were implemented by MOSTI including the enhancements of national capability and capacity for R&D, the forging of partnerships between public-funded research organizations and industries, the enhancement of commercialization of R&D outputs.

Presently MOSTI is working on the third National Science, Technology and Innovation Policy (NSTIP), which will come into effect from 2013 to aid the significant economic challenges that the country faces. The NSTIP will be aligned to support the New Economic Model in achieving the goals of a high-income economy, inclusiveness and sustainability by 2020.

R&D in Malaysia

R&D in Malaysia has been implemented using a centralized grant system set up by the government to finance S&T research in public institutions and research agencies since 1988. MOSTI has been given the task of managing this fund through various research funding schemes. The government has accorded high priority to R&D and the gross expenditure on R&D as proportion to GDP increased considerable (Figure 4). This is relatively high compared to countries in the region, except Singapore, but well below those of India, China and the developed countries like United States of America, Japan and Korea (Stads et al., 2005).

Malaysia's R&D expenditures are generated through government budgetary sources and were generated through internal sources. In 2008, 66% of the total R&D expenditure came from business enterprise's own funds (RM 4.3 billion - 70.3%). The government research institutes and institute of higher learning spent 29.5% of total research funds (Figure 5).

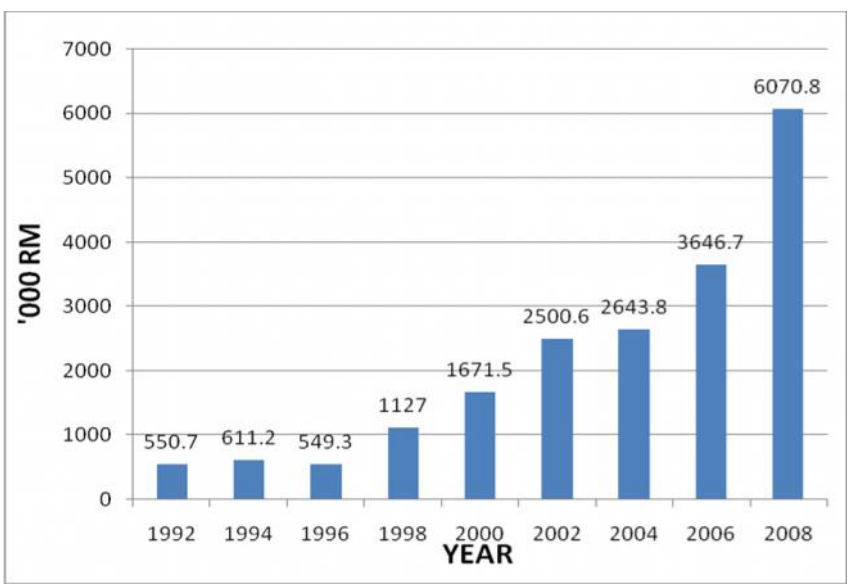

Fig. 4. Total R&D expenditure 1992-2008

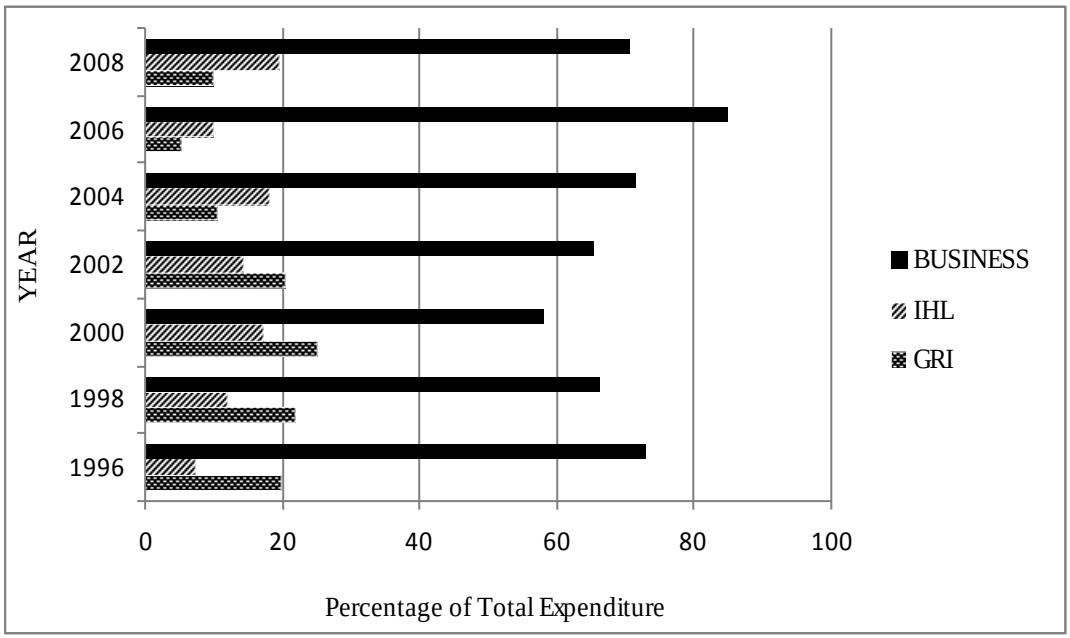

Fig. 5. R&D Expenditure by sector 1996-2008

National Research System

The Malaysian Research and Development Classification System (MRDCS) was first introduced in the 1992 National Survey of Research and Development. It was designed for classifying and describing research activities in Malaysia to the highest detail and accuracy. These classifications provide the basis for the measurement and analysis of R&D activities and statistics that are useful guidelines to the government policy makers, industrialists and researchers. It is also a useful indicator on the direction of R&D and technological change. The sixth edition of MRDCS outline the latest updates and address any technological gaps and barriers. The standard framework set up in these classifications support distinct and highly distinguishable R&D activities for ensuring efficiency and effectiveness in setting priorities, providing funds, maximizing national R&D efforts and also as indicators for international comparisons.

Research, development and technological innovations are essential in the government's strategy of sustainable development and knowledge based economy. The 9th Malaysia Plan which outline Malaysia's mission for the 2006-2010 and the country's vision 2020 defined the generation of new knowledge-intensive activities and employment in ICT and Biotechnology as well as raising the country's knowledge, creative and innovation capacities as the central national aims. One of the means for turning Malaysia into a developed country is through development of human capital of the highest quality.

In 1986, the government introduced a centralized Grant System for R&D. This "Intensification of Research in Priority Areas Programme (IRPA)" was established as a tool to select, prioritize and monitor the national R&D activities. The IRPA was enhanced with the establishment of two new schemes, namely the Science Fund and Techno Fund. The Science Fund support R&D projects within five specific research clusters – ICT, Biotechnology, Industry, Sea to Space and Science and Technology Core. While the Techno Fund funded research projects that are at the pre-commercialization and intellectual property acquisition stage.

Structure of Research System

The National Council on Scientific Research and Development (NCSRD) was established and function as advisory and coordinator of the national R&D. The R&D policy was then formulated by the Ministry of Science and Technology and Innovation (MOSTI), which acts as the secretariat to NSCRD. In December 2010, the Malaysian Cabinet approved the establishment of National Science Research Council (NSRC) to replace NSCRD. The new NSRC was mandated to ensure Malaysia's investment in science and technology make the greatest possible contribution to a high-value economy through an increase in productivity, environmental quality, stimulation in R&D and enhancement of skills of the workforce. Under the NSRC, 10 expert working groups (EWG) have been identified in various science based focus area. These EWG's are:

1. Environmental Sciences
2. Advanced Material Sciences
3. **Agricultural Sciences**
4. Life Sciences
5. Chemical Sciences
6. Mathematics & Physical Sciences
7. Computer Sciences and ICT
8. Health & Medical Sciences
9. Engineering Sciences
10. Humanities & Social Sciences

Research Funding in 10 Malaysia Plan (2011-2015)

As a nation that aspires to become a developed country, Malaysia nourishes its research culture. The public sector still contribute significant funding to agricultural research. The government ministries that are coordinating these research are:

1. Ministry of Science Technology and Innovation (MOSTI)

MOSTI has been provided funds to finance research under the following grants:

a. **Science Fund**: Grant provided by Government to carry out R&D projects that can contribute to the discovery of new ideas and the advancement of knowledge in applied sciences, focusing on high impact and innovative research. The objectives are:

i. to support research that can lead to the innovation of products or processes for further development and commercialization and/or;
ii. to generate new scientific knowledge and strengthen national research capacity and capability.

ScienceFund covers preliminary research leading to laboratory proof of concept or towards the development of new products or processes. The quantum of fund approved will be determined based on the merit of each application. Maximum quantum given is RM500,000 for a duration of 30 months. It's research priority areas are include: Life Sciences, Computer Sciences and Information & Communication Technology (ICT), Agriculture Sciences/Agricultural Engineering, Environmental Sciences, Advanced Materials Science Chemical Sciences , Physical and Mathematical Sciences, Engineering, Medical and Health Sciences , Social Sciences and Humanities

b. **TECHNOFUND** (Pre-commercialization Fund): TechnoFund is a grant scheme which aims to stimulate the growth and successful innovation of Malaysian enterprises by increasing the level of R&D and its commercialization. The scheme provides funding for technology development, up to

pre-commercialization stage, with the commercial potential to create new businesses and generate economic wealth for the nation.

The objectives of TechnoFund are:

- to undertake the development of new or cutting edge technologies or further develop/value add existing technologies/products in specific areas (Section 7) for the creation of new businesses and generation of economic wealth for Malaysia;
- to undertake market driven R&D towards commercialisation of R&D outputs;
- to encourage institutions, local companies and inventors to capitalise their intellectual work through intellectual property (IP) registration; and
- to stimulate the growth and increase capability and capacity of Malaysian technology-based enterprises, Malaysian Government Research Institutes (GRI) and Institutions of Higher Learning (IHL) through both local and international collaborations.
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The quantum of funding is between RM 1.5-3.0 million for up to 30 months. The same priority areas of research is maintained. Eligible applicants can be researchers and other individuals from:

- Small and Medium Enterprises;
- Institutions of Higher Learning;
- Research Institutes; and
- Science, Technology and Innovation (STI) Agencies.

c. **INNOFUND** (Pre-commercialization Fund): Innovation contributes to productivity, economic growth and societal wellness. It can be the recombination, fusion or integration of technologies that lead to new products, processes or services or the refinement of existing technologies with improved value enhanced efficiency or cost reduction. The final result of innovation is new products, processes or systems by which value can be created for customers, businesses and society. Realizing the importance of innovation for wealth creation and social well-being, the Government initiated the Innovation Fund.

The objectives of Innofund are:

a. Enterprise Innovation Fund (EIF)

-The Enterprise Innovation Fund is to increase the participation of micro-businesses, individuals in innovative activities and encourage technological innovation of new or existing products, process or services for commercialisation.

b. Community Innovation Fund (CIF)

-The Community Innovation Fund is to assist community groups in translating knowledge and ideas into products, processes or services that improve the socio-economic standing and quality of life of the community.

2. Ministry of Higher Education (MOHE)

Under the 10th Malaysia Plan and in line with strengthening research and innovation, the Ministry of Higher Education has been allocated research funding of RM741 million for the years 2011 and 2012. This is intended to finance five (5) research programs as shown in Table 2.

a. Fundamental Research Grant Scheme (FRGS):

FRGS promotes research involved in early discovery of knowledge that can contribute to the increased level of intellectuality, the creation of new technologies.

Exploratory research is research which has one of the following characteristics:

- Preliminary work on untested and novel ideas
- Ventures into emerging and potentially transformative research ideas
- Application of new expertise or new approaches to "established" research topic.
- Having severe urgency with regards to availability of, or access to data, facilities or specialized equipment, including quick-response research on natural or anthropogenic disasters and similar unanticipated event.
- Efforts of similar character likely to catalyze rapid and innovative advances.

Research funded by FRGS is for a duration of 3 years with maximum funding of RM 250,000

Table 2. 10MP MOHE Research Grant

No.	Scheme	2011	2012	Allocation (2011-2012)
1	Fundamental Research Grant Scheme (FRGS)	81,000,000	219,000,000	RM 300,000,000
2	a. Exploratory research Grant Scheme (ERGS)	25,000,000	68,000,000	RM 93,000,000
	b. Long Term Research Grant Scheme (LRGS)	45,000,000	121,000,000	RM166,000,000
	c. Prototype Research Grant Scheme (PRGS)	11,000,000	30,000,000	RM41,000,000
3	Research Incentive	11,000,000	30,000,000	RM 41,000,000
4	MOHE Special Project	27,000,000	73,000,000	RM 100,000,000
	TOTAL	200,000,000	541,000,000	RM 741,000,000

b. Exploratory Research Grant Scheme (ERGS):

The ERGS covers basic areas that can support the country's strategic agenda. The areas identified are:

1. Pure and Applied Sciences
2. Technology and Engineering
3. Clinical and Health Sciences
4. Social Sciences
5. Arts and Applied Arts
6. Natural Sciences and National Heritage
7. Defense and Security

c. Long Term Research Grant Scheme (LRGS) include:

- fundamental research that need more than 3 years
- must be Multi-Institutional and Multi-Disciplinary
- problem-based research, inter-discipline, inter-institution
- programme/cluster-based
- Duration 3-5 years (at least 3 years)
- Ceiling fund of RM3million/project

There are two types of LRGS projects:

(i) top-down (programme leaders only from RUs, members from other IPT can be project leaders within the programme)
(ii) bottom-up (leaders can be from other IPTs)

d. Prototype Research Grant Scheme (PRGS)

PRGS finance the pre-commercialization
- Duration ± 1-2 years
- Ceiling fund - RM500k /project

3. Research University Grant Scheme

The five leading Research Universities are also allocated large sums of money by the Ministry of Higher Education since 2007. As an example, UPM has financed a large number of projects under this funding (Fig. 6).

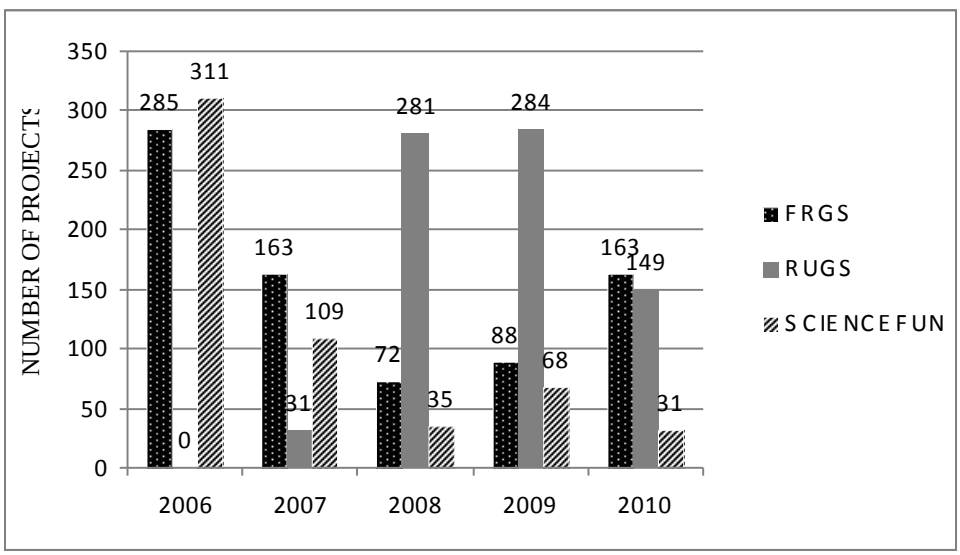

Fig. 6. Number of projects financed by three main government funds at UPM 2006-2010.

Agricultural R&D

Agriculture's contribution to Malaysia's economy has significantly declined over the years, but the government continues to regards the sector as strategically important. Thus Malaysia has been categorized to be at the advanced stage of economic transformation (Raitzer, et al., 2009). The production of sufficient food for the population featured prominently in the First National Agricultural Policy (NAP1) – 1984-1991 and subsequently in the Third National Agricultural Policy (NAP3) – 1998-2010. The NAP1 aimed at achieving at least 80 percent self-sufficiency level (SSL) for major food items. However, the SSL of rice, the staple food for the country, decreased from 91 percent in 1972 to 72 percent in 2005 (Pazim@Fadzim, 2005), mainly due to the increase in population and reduction in agricultural areas due to changes to non-agricultural uses over the same period. In view of these, the NAP3 again aims at increasing domestic food production and sourcing of food strategically to ensure adequate supply of and accessibility to safe, nutritious and high quality food at affordable prices (Govt. of Malaysia, 2000).

Table 3: Economic sectors contribution to Malaysia's GDP

Sectors	2000*	2015**
Services	58.5	61.1
Agriculture	7.6	6.6
Mining	7.9	5.9
Manufacturing	26.2	26.3
Construction	3.2	2.9

*2009/2010 Economic report (MOF); **MP10 Report (EPU)

The Malaysian agricultural sector can be grouped into three sub-sectors, namely:

1. The agro-industrial subsector: comprise of oil palm, rubber, cocoa and timber industries. They mainly serve the export market.
2. The food sub-sector which include rice, fruits and vegetables, livestock and fisheries, which serves the domestic consumption.
3. The miscellaneous group that include pepper, coconuts, sweet potato, cassava and tea, which cater to both domestic and export market.

Agricultural R&D only became an established component of the national development plan from Malaysia's fifth development plan (1986-1990) and agricultural research and technological improvements are and still will continue to be a prerequisite for increasing productivity and income of farmers. Currently there are more than 40 agencies that are involved in agricultural research in Malaysia, including Research Universities and private sectors laboratories. Agriculture research activities has been prioritized along commodity lines, where the five export commodities, vis, oil palm, rubber, cocoa, timber, and kenaf and tobacco have their own board to plan, execute and monitor the research of each of the commodities.

There are about 20 Public Universities and 20 Private Universities that are conducting research in science and technology. The national survey on R&D in 2008 (Anon, 2012) revealed that research in agricultural science as one of the three main field of research (FOR) and constitute 5.8%, with one of the three main socio-economic objectives (SEO) being plant products and plant primary products at 6.1%. R&D in government agencies and research institutions (GRI) which are mainly focused on agricultural research had a total expenditure of RM 603.1 million in 2008, which is a significant increase from 2004 (RM 296.9 million) and 2006 (RM 189.5 million). The main field of research (FOR) conducted were Agricultural Research, ICT and Biotechnology in 2008, while in 2006, the FOR conducted were agricultural science, forestry sciences, sciences, engineering science and biotechnology. The total headcount of R&D personnel was 5,899 constituting of 3,650 researchers and 2,249 technicians and support staffs.

The survey also showed that Institutions of higher learning (IHL) and business enterprise did not spend their research funds on agriculture as one of their three main FOR (Anon, 2012).

In the 10th Malaysia Plan, the National Key Economic Areas (NKEA) identified Malaysian herbs as one of the potential driver of economic activities. Herbal products has been listed as one of the entry point project (EPP) under this NKEA. The Ministry of Agriculture (MOA), established a special division, the Herbal Development Office to lead this group of increasing Malaysia's potential for herbal products. One of the main objectives set out in 2011 was to enhance R&D in herbs and to secure intellectual property right on local herbs. A total of RM2.1 billion has been allocated in the 10MP to do research on local herbs.

The five herbs identified to have potentials were:

1. Tongkat ali (*Eurycoma longifolia* Jack)
2. Kacip Fatimah (*Labisia pumila*)
3. Misai Kuching (*Orthosiphon stamineus* Benth)
4. Dukung Anak (*Phyllanthus amarus, P. niruri, P. urinaria* and *P. debelis*)
5. Hempedu Bumi (*Andrographis paniculata*)

In addition, funds are also provided by the government in the biotechnology sector. The areas of research conducted by the Malaysian Genome Institute (MGI) from 2006 – 2011 includes:

- Comparative Genomics and Genetics
- Genomics and Genetics
- Recombinant Expression Systems
- Metabolic Engineering
- Bioinformatics

A total of 25 projects were carried out by GRIs and IHL in collaboration with internal as well as external agencies (universities and private agencies).

CONCLUSION

Malaysia has been transformed from a country dependent on the production and export of primary commodities to an emerging multi-sector economy and a leading exporter of high technology products. Its growth currently is driven by services and manufacturing sector. The agriculture sub-sector is the 3rd contributor to its economic growth particularly in the palm oil and palm oil based products.

Agricultural research is funded mainly by the government especially to GRI and IHL. Private sector involvement is mainly in the plantation crop sector such as oil palm, and rubber. The food crop research is mainly undertaken by GRI. The agricultural biotechnology is currently in the advancement stage.

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