

Oil palm R&D: Malaysia

ABSTRACT

The first commercial oil palm estate in Malaysia was set up in 1917. Since then the industry in Malaysia has grown by leaps and bounds and the country is now the largest producer and exporter of palm oil in the world, accounting for 52 percent of world production and 64 percent of world exports in 1997.

As in all industries, research and development (R&D) is critical, particularly since palm oil competes with 16 other oils and fats on the world market. There is a need to generate information, increase production and processing efficiency and expand uses of palm oil through R&D. The palm oil industry has been able to do this through the establishment of the Palm Oil Research Institute of Malaysia (PORIM).

PORIM, established by law in 1979, is funded mainly from a research cess (tax) imposed on palm oil millers, which brings in about 70 million ringitts³¹ each year. The Governing Board of PORIM, which includes representatives from the industry and the government, is advised on the research programmes of the institute by a Programme Advisory Committee, the members of which are experts in their own fields appointed by the Board.

Various links, such as the PORIM-Industry Forum and PORIM-Industry committees have been established to ensure that R&D in PORIM is in line with industry needs and that research findings are disseminated to the industry and offered for commercialization.

Since industry expectations are high, PORIM must be able to develop a strong and dedicated workforce to meet such expectations and an autonomous Board with full powers over remuneration, rewards and promotion is essential for attracting and retaining such a workforce.

Although oil palm is native to Africa, Malaysia was the first country to embark on large-scale planting and processing. It had to develop its own technology and adopt innovative policies in order to boost production. Key elements of this policy were R&D through the establishment of PORIM and the levy of a cess on industry **to defray R&D expenses.**

The PORIM approach is an innovative experience that could be replicated in other developing countries.

³¹As at February 1999, 3 799 ringitts = US\$1.

INTRODUCTION

The oil palm, *Elaeis guineensis*, is native to Africa. Its commercial value lies mainly in the oil that can be obtained from the mesocarp of the fruit – palm oil – and the kernel of the nut – palm kernel oil. Palm oil is used mainly for cooking (cooking oil, margarine, shortening, etc.) and has non-food applications (soap, detergent, cosmetics, etc.)

The first commercial oil palm estate in Malaysia was set up in 1917 at Tennamaran Estate, Selangor. The growth of the industry has been phenomenal and Malaysia is now the largest producer and exporter of palm oil in the world, accounting for 52 percent of world production and 64 percent of world exports in 1997.

However, since palm oil competes with 16 other oils and fats on the world market, R&D is important for sustaining the growth and competitiveness of the industry *vis-u-vis* other oils and fats. Potential threats such as shortage of labour and land, lack of information, skills and technology and other issues need to be addressed through R&D.

An industry left on its own may not develop in an orderly, cohesive, progressive and efficient manner, primarily because not all industries have the resources to carry out meaningful R&D. Those with the resources may only want to carry out R&D insofar as it serves their immediate interests or there may be duplication and waste of resources.

In order to support the development of the industry in Malaysia, a planned and coordinated effort to carry out R&D was therefore necessary. Government intervention and control through legislation and subsequent implementation of programmes by agencies such as the Ministry of Primary Industries and PORIM were critical in supporting such development.

An unusual problem facing development of the oil palm industry in Malaysia was that there was no existing progressive oil palm industry elsewhere in the world to use as a model or to turn to for advanced technologies or innovations. The oil palm is native to Africa but there was no large-scale commercial planting of the palm there and hence no advanced technologies. Malaysia was the first country to embark on large-scale planting and processing of oil palm.

This brought with it the problem of the lack of readily available custom-made technologies or relevant existing R&D findings and technologies to support development of the industry. There was also a lack of technical information on palm oil compared to other oils such as rapeseed, sunflower or soybean, which are more commonly used in developed countries. In order to expand the market for palm oil, more information on its uses, performance, characteristics and other qualities had to be researched and disseminated. The problem with R&D,

however, is that it requires high investments with uncertain results and even if the results are positive, benefits from research are normally only reaped in the long term.

Oil palm is the highest yielding oil crop, producing on average about 4-5 tonnes of oil per hectare per year, about ten times the yield of soybean oil. It is already very profitable to invest in the industry, even using existing technology. The price of palm oil is consequently high – above 2 000 ringitts per tonne – and the cost of production relatively low – about 600-800 ringitts per tonne – so investors do not see the need for R&D. There may also be reluctance to embark on R&D, since its results often filter down to end-users eventually, inducing the latter to wait for others to cover the costs.

The experience described here refers to the setting up of PORIM as a means to tackle these problems. Through its activities and programmes, the institute was able to implement measures to promote, develop and enhance the competitiveness and progress of the oil palm industry through R&D, thus ensuring the orderly growth of the industry and helping make it more competitive and sustainable in the long term.

PRE-INNOVATION

Before the establishment of PORIM there had been no centralized effort to plan and implement R&D for the oil palm industry as a whole, although research had been carried out separately by different bodies, such as universities conducting research projects or by individual industry players pursuing their own interests. Large plantation companies such as United Plantations, Kumpulan Guthrie and Golden Hope Plantations had their own research units carrying out agriculture research and were able to utilize R&D resources effectively to support their plantation operations. This has enabled these companies to enhance their planting materials through breeding research programmes, carry out their own agronomic trials to optimize plantation output, conduct pest and disease research and design new machines for mechanizing some field operations, among other improvements. The same cannot be said of the smaller estates and smallholders, where virtually no R&D was carried out.

Research in the milling sector was also minimal. It has often been claimed that mill machinery and overall operations have not changed much in the last **30** years, although there have been many refinements in individual processes. Mill designers often construct on the basis of existing conservative but tested designs and are reluctant to experiment with new untested ideas or equipment. Mill managers are generally unwilling to experiment with new designs or concepts offered by equipment salesmen because of the risks involved.

There is a similar lack of research in the refining sector. In the oleochemical sector, most oleochemicals produced are exported and finished oleochemical-based products re-imported for local consumption. Very little **R&D** is carried out by local companies to develop indigenous technology on the production of intermediate and end products using oil palm-based oleochemicals.

There are also some areas of research which have critical and strategic importance in the industry but which had not been carried out. For example, information on the nutritional and health attributes of palm oil is of critical importance when competing with other oils and fats but, generally speaking, **R&D** on this aspect had not been carried out.

A similar situation existed regarding the use of **R&D** to classify the properties of palm oil products, lay down specifications and establish acceptable test methods. Members of the industry were reluctant to carry out **R&D** unless absolutely necessary, for example when they themselves required information for their own use or it had been requested by the buyers of palm oil products.

Some other areas of research are of long-term and strategic importance but are not carried out by many in the industry because of the large investments required and the uncertain or long-term nature of results and consequent returns. One example is in the field of biotechnology research to obtain better plant varieties.

In terms of technical support for the market promotion of palm oil, sellers of palm oil products looked for their own markets and provided whatever technical support was required. There was no concerted effort in terms of market promotion and technical support.

Information on palm oil and its products was not widely disseminated or stored centrally for ease of reference and there was no integrated and systematic effort to provide effective training to ensure proper growth and development of the industry.

INTRODUCING INNOVATION

The innovation involved the setting up of a centralized body, PORIM, to carry out **R&D**, disseminate information, organize the technical promotion of palm oil and provide training for the industry.

The institute was formed by an Act of Parliament, Act 218, in 1979. It has a governing Board **whose** functions are clearly spelled out in the Act, including mandates to:

- conduct and promote research into production, extraction, processing, storage, transportation, marketing, consumption and uses of palm oil and oil palm products;

- exercise such other functions as the Minister of Primary Industries may from time to time direct.

The Act provides that the Board shall comprise representatives from various government and industry bodies. Government bodies include the Ministry of Primary Industries, Treasury, Federal Land Development Authority, Palm Oil Registration and Licensing Authority and representatives of the Sabah and Sarawak state governments. Industry representatives normally include those from the Malaysian Oil Palm Growers' Council and the Palm Oil Refiners' Association of Malaysia.

The Board decides the annual programmes and budget of the institute. Since it contains wide representation from both industry and government, the Board is able to formulate, implement and monitor the activities of the institute in line with the needs of the industry and the nation.

The Board has virtual autonomy in the appointment and promotion of research scientists and other personnel. Although the grades of staff and conditions of service generally follow those of the civil service, promotion for high achievers is generally faster because of this autonomy, a feature that has attracted and retained good scientists.

Funding for the institute's operations is mainly derived from a research levy imposed on the palm oil industry. Millers and kernel crushers are required by law to pay the levy, currently 7.25 ringitts per tonne of crude palm oil and crude palm kernel oil, to the Board. Through this mechanism, the Board collects about 70 million ringitts a year for its operations. In addition, the institute bids for government research grants, including development grants for the construction of buildings, facilities and oil palm research stations. The latter also generate revenue from the sale of oil palm fruits harvested at the stations.

To assist the Board in ensuring that research programmes and activities are justifiable, scientifically sound and in line with industry needs and national aspirations, a Programme Advisory Committee appointed by the Board vets research proposals and monitors research progress each year. The committee is made up of eminent researchers, scientists and university professors from foreign and local institutions. Experts in their own fields, they are able to offer sound independent advice, suggest directions for research and check the quality and standard of research activities carried out by the institute.

Since it is funded by the industry, the institute always takes steps to ensure that research activities are in line with industry needs. A PORIM-Industry Forum is held each year to obtain direct feedback from the industry on its research requirements and to disseminate research results to the industry. Members from a wide cross-section of the industry are invited, ranging from oil palm planters,

oil palm smallholders, palm oil millers and refiners to oleochemical producers. The views and requests of the forum are formulated into research proposals and submitted to the Programme Advisory Committee and the Board for approval.

In addition, there are small PORIM industry committees on specific areas of research, which meet regularly to discuss and resolve issues related to their areas of specialization. The Farm Mechanization Committee, the Oil Palm Tree Utilization Committee and the Oil Palm Breeders' Committee keep members up to date on contemporary issues and enable them collectively to map out action plans.

Another key feature of the innovation process is that the institute is able to evaluate industry research requirements and distribute the research to other institutions. This may be necessary for a number of reasons, such as the need to expedite research or obtain neutral third-party findings. The distribution of research on the nutritional effects of palm oil consumption meets both necessities, for example. The distribution of research on biotechnology, however, results from the first requirement, since it is slow and expensive to develop local expertise and facilities in some specialized areas such as clonal abnormalities.

Where research findings give rise to commercial products or processes, these are offered to the industry or other entrepreneurs for commercialization through licensing and technology transfer agreements. Royalties are imposed on the licensees for the commercialization of such research findings.

POST-INNOVATION

With the establishment of PORIM in 1979, it became possible to carry out R&D in an organized and more effective manner. Clear research directions beneficial to the industry as a whole could be pursued, as opposed to research motivated primarily by narrow individual interests. Important R&D activities that might not have been cost effective if carried out by individual companies could now be carried out by a central organization.

In research on nutrition, for example, it would not be cost effective for single palm oil producers to conduct their own studies on the health effects of palm oil consumption. With the setting up of PORIM, however, such studies could be carried out centrally for the benefit of all producers. To date, PORIM has conducted and commissioned over 132 local and worldwide nutritional studies on palm oil to provide scientific information about the nutritional attributes of palm oil. Some of this activity provided scientific ammunition to thwart the anti-palm oil campaign of the American Soybean Association in the 1980s, which was fought on health issues.

The formation of PORIM also facilitated the expansion of palm oil into new markets, through provision of technical support and advice to existing and

potential consumers. Visits were made to key organizations concerned with the import and utilization of palm oil to provide them with the latest technical and commercial information on palm oil products. PORIM maintains a mailing list of users and keeps them informed of developments through its publications, such as the *Palm oil technical bulletin*, *PORIM technology* and *Palm oil developments*.

PORIM was also able to assist major buyers overcome technical problems arising from the use of palm oil products. Research projects were conducted to eliminate potential or perceived constraints or limitations of using palm oil for various applications in these markets. Many of these projects were carried out on a collaborative basis with potential users. For example, a research project on blending of vegetable oils was carried out in collaboration with the China Vegetable Oil Corporation: various blends of cooking oils were successfully formulated using palm oil, thus increasing the potential market in China. Another research project carried out in Turkey with the Marmara Scientific and Industrial Research Institute (TUBITAK) was successful in blending palm olein and local oils for cooking purposes. The positive results of this collaboration led to review of a regulation prohibiting blending of oils in Turkey, thus increasing the market potential for palm oil in Turkey.

To support the use of palm oil in wider applications, PORIM has carried out many projects to increase information on its characteristics and uses, the results of which have been published in international and PORIM publications. The institute has also documented and published its *Test methods* for palm oil.

In oil palm breeding, research has been carried out by PORIM to obtain improved planting material. It has collected germplasm material from various parts of the world, especially Africa and Latin America, which has been planted in its research stations in different parts of the country, mostly in Kluang. From its germplasm collection, PORIM has been able to identify and disseminate good germplasm materials for joint trials and development by the industry. In addition, the institute has single-handedly developed planting material which has higher yield and shorter height increment than normal commercial planting material.

Biotechnology is an area of research that few in the industry want to enter, because of uncertain and long-term returns and high investment. With the establishment of PORIM, however, the availability of centralized funding has made this type of research more economically viable and many programmes have since been implemented.

Early efforts to mass-produce oil palm plantlets by tissue culture had generally been unsuccessful, for example, because of a high incidence of clonal

abnormalities. This problem can now be tackled in a cost-effective and systematic fashion by PORIM, including distributing research to renowned research institutions overseas. PORIM has also achieved progress in genetic engineering by successfully introducing a foreign gene into the oil palm using a biotechnological method. Although these are small steps towards the efficient production of genetically transformed palm with desired characteristics such as high oleic acid content, they could not have started or progressed as fast had a body such as PORIM not existed.

Progress in palm oil milling would have been difficult without central intervention. With the establishment of PORIM, new concepts could be researched and experimented using central funds and equipment manufacturers with new designs or concepts can approach PORIM for joint evaluation trials. In this context, the institute was able to obtain funds to set up a 20 million ringitt experimental palm oil mill to conduct research and carry out tests of new equipment, thus providing a catalyst for the technological advancement and increased efficiency of oil palm milling.

PORIM has also been able to facilitate vertical integration of the industry into downstream activities, setting up the Advanced Oleochemicals Technology Centre to carry out research in oleochemicals. Research results are offered to the industry for commercialization. Successful implementation of these research findings and technologies will spur the development of local producers of oleochemical-based products, thus saving the country foreign exchange that would otherwise have been expended in importing such products or technologies.

Finally, PORIM has been able to provide training to industry members, helping to ensure that properly trained human resources are available and able to grow in tandem with the demands of the industry. The institute runs courses such as the Intensive Diploma in Oil Palm Management and Technology, the Diploma in Palm Oil Milling Technology and Management and the Palm Oil Mill Laboratory Conductors' Course, drawing expertise from PORIM itself and the industry.

LESSONS LEARNED

It is possible for the government to ensure proper and sustainable development of an industry through adequate legislation and implementation of research activities, which can be financed through imposition of an industrial cess. Members of the industry themselves have a say in the management of the funds collected, which will ultimately be used for their benefit through R&D and market development activities.

Legislation is necessary, as there is a general unwillingness to contribute

voluntarily to such funding. It must also be recognized that there is vertical integration in the industry, from the oil plantations, to palm oil millers, palm oil refiners, oleochemical manufacturers, food processors, non-food processors, palm oil exporters and so on. The point on the chain at which the cess is collected is important. For the oil palm industry, it comes from the palm oil millers, thus ensuring an increase in the cess collection level in tandem with an increase in palm oil production. For the rubber industry, the cess is collected at the point of export but with the increase in rubber utilization within the country, exports have fallen, leading to a considerable decrease in the cess collection level over the years.

Because industry pays a cess, it makes high demands on and has high expectations of the institute. Feedback mechanisms, such as the PORIM-Industry Forum, merely create channels for communication with the industry, which will ultimately be looking for beneficial results. The institute must quickly establish itself as a reliable provider of information and technology and must be able to anticipate and solve industry problems. These are very difficult roles to play, particularly that of problem solver, which requires considerable expertise and experience that cannot be obtained overnight. Many problems referred to the institute are inherently difficult to solve. Industry experts themselves have already tried for years and failed to solve them. Take, for example, the cases of inventing a good mechanical harvester for oil palm fruits or finding a cure for *Ganoderma*, a fungal disease which attacks oil palm trees. Although some progress has been achieved in these areas, the final harvesting machine or cure for *Ganoderma* is still far off. This means that the institute must be able to contain any unrealistic expectations from the industry in these and similarly difficult areas and at the same time be able to show positive results in other research.

Good results cannot be achieved without good workers. Government-sector workers are generally poorly remunerated compared with their counterparts in the private sector. To attract and retain good workers, the institute's Board must be able to offer good career prospects and move away from the limitations imposed by a government salary bureaucracy. Although a quasi-government body, the Board must be given full authority and autonomy to decide on staff appointments, salary scales and promotion. It takes considerable time and money for expertise to be built up in the institute in a field of research and if a researcher leaves the organization, a substantial amount of such knowledge will also leave. This problem of retaining knowledge is common to all research or technology-based institutions. PORIM has introduced various measures, listed below, to induce researchers to report as much of their research findings as possible so that such knowledge does not leave with them.

- All research progress must be recorded in official research notebooks provided by the institute. An executive summary of monthly progress is recorded in the notebook and a copy is sent monthly to the Director-General of the institute.
- Completed research projects must be presented to a Viva Committee where the results are scrutinized and the final report endorsed. Useful results are published, disseminated to the industry or offered for commercialization and hardcover copies of the final report are deposited in the library for future reference.
- Researchers are required to publish their findings and to transfer technologies to the industry. Career advancement and rewards within the institute are linked to performance and based predominantly on the ability of researchers to produce results, publish findings and transfer technology to the industry.

As a further incentive for good and experienced researchers to remain with the institute, senior researchers are allowed, subject to approval, to use up to one-third of their official working time to provide consultancy services to the industry. They may charge consultancy fees for services rendered, part of which goes to the institute with the bulk going to the researcher. Junior researchers may be allowed to provide such services and charge consultancy fees but only in relation to any of their research findings that are taken up for commercialization.

Another incentive is the sharing of royalties with inventors for those technologies that are commercialized. For royalties collected by the institute, 20 per cent goes to the inventor until the moment of resigning from PORIM.

The need for research may grow beyond the available resources in the institute and it may be more cost-effective to distribute certain types of research to other institutions. However, care must be taken, especially in contract research agreements, to ensure that intellectual property arising from such contracted research belongs to the institute. It must also be clear that where such research is carried out overseas, the laws of some countries give intellectual property rights to the inventors and such rights may not be contracted away.

Finally, it may be more expedient for a central body to handle all aspects of the industry and not merely the R&D aspects. For oil palm, two statutory bodies had been established by law: the Palm Oil Research Institute of Malaysia to handle R&D and the Palm Oil Registration and Licensing Authority (PORLA) to handle licensing and enforcement. The government found it more synergistic to merge these two organizations into a single body called the Malaysian Palm Oil Board, which is better able to serve industry interests.

