Bioscience and its impact on developing countries

A view from Thailand • *by Jisnuson Svasti*

The beginning of the third millennium will be remembered as a milestone in scientific history as it marks the publication of the Human Genome sequence. Indeed, we are at the beginning of a century that will most likely be shaped by advances in the life sciences. This has enormous repercussions, not only for further exploring the frontiers of bioscience, but also in offering exciting promises to help the health and welfare of mankind. Yet the countries that are best positioned to make use of this knowledge are those with a well-developed scientific infrastructure and sufficient manpower in research. Further advances in this post-genomic era are also expected to lead to the development of new biotechnology products that will further boost an already existing billion-dollar industry. Again, the countries that will benefit most are those with developed technological capability and established links between academia and industry. So the question must be raised as to whether the dramatic new advances in biosciences will really benefit developing countries and improve the quality of life of their people, or whether they will widen the economic and social gap between the rich, developed countries and poorer, developing countries even further.

Here, I will consider the case of Thailand in illustrating the problems of adjusting to the 'new bioscience', since it is an example of a developing country that is striving to progress from an agrarian to an industrial society. Thailand is a constitutional monarchy, with an area of 511 000 km^2 and a population of 61.2 million, of which 95% are Buddhist. Population growth has stabilised now at about 0.9%. The country is self-sufficient in its food supply and is a net exporter of food, with agricultural products contributing 18% of its export earnings, manufactured goods about 60% and tourism about 20%. Some 54% of the labour force is engaged in agriculture, 15% in industrial production and 31% in services. In the 1980s and 1990s, Thailand witnessed a remarkable economic upturn; many manufacturing industries emerged, based on imported technology coupled with low local wages. The failure of this strategy led to economic collapse in 1997, which triggered a wave of economic turmoil in other South East Asian countries, most notably Indonesia, The Philippines and Malaysia. Consequently, industrial policies since 1997 have aimed towards adding value to industrial products, lowering production costs, increasing the knowledge base of the industrial sector, lowering pollution from manufacturing and expanding industrialisation to the provinces.

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Modern science in Thailand began just 30–40 years ago. In the early years, funding for research was very limited, and many scientists had to look for research grants abroad. With the creation of the National Science and Technology Development Agency (NSTDA) and its National Centre for Genetic Engineering and Biotechnology (BIOTEC) in the 1980s, and the Thailand Research Fund (TRF) in the 1990s, research funding for the life sciences at universities improved considerably. However, gross expenditure on research has stayed below 0.2% of GDP for many years. Furthermore, up to 1997, the private sector has contributed little funding for biological research.

Much of the research done in the academic sector aims at solving local problems, partly because of funding considerations, and partly because limited manpower and resources make it difficult for Thai scientists to compete in areas at the forefront of modern science. Yet, despite the emphasis on 'applied research'—which is more easily justified to bureaucrats and parliament—success stories of commercialisation of academic discoveries are few and far between, partly owing to the lack of interaction between academia and industry. Nevertheless, Thailand has developed excellence in some research areas, most notably in terms of diseases such as thalassemia and malaria, as well as in the chemistry of natural products.

Lack of qualified manpower in science and technology is another serious problem for Thailand's research landscape. In terms of educational management, the Ministry of Education supervises primary and secondary education, as well as non-formal, vocational and religious education, while the Ministry of University Affairs supervises tertiary education. The latter covers 24 public universities, including two open universities, and 50 private universities, colleges and research institutes. These produced a total of 126 661 graduates in the year 2000. Of these, 105 067 were at Bachelor level, 18 452 at Master's level, 2970 at Diploma level and only 172 at the doctoral level. Of the bachelor degree graduates, some 25% are in science and technology, including 10.8% in engineering, 8.1% in medicine and health science, and 5.9% in the natural sciences. The low popularity of the natural sciences reflects the poor career prospects in this field, since government salaries are low and industry makes only small investments into research and development.

But there are efforts being made to improve this situation. The new National Education Bill will see the merger of the two ministries into the Ministry of Education, Religion and Culture. Universities will become more autonomous, which will hopefully increase their efficiency and enable them to afford higher salaries in order to attract better-educated people. Twelve years of education will be made compulsory, which should improve levels of education within the general populace, enabling them to better understand scientific issues. In addition, there are plans to increase the number of science and technology graduates to 2000 at PhD level, 20 000 at Master's level and 200 000 at Bachelor level by the year 2020. 'Science Talent' scholarships are being awarded at every level from school to university, including overseas graduate training for particularly talented students. 'Split-mode' PhD programmes supported by the Thailand Research Fund and the Ministry of University Affairs not only offer the chance for students to spend 6–12 months with an overseas advisor, but also help to strengthen local PhD programmes through international co-operation. These plans are, of course, praiseworthy and will eventually strengthen scientific and technological capability in Thailand, but it will take many years for them to produce results. A more immediate approach is the 'Reverse Brain Drain' scheme, in which Thai scientists living abroad obtain money to spend short periods in Thailand sharing their expertise with local scientists.

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With its strengths in agriculture, it is not surprising that Thailand has strong food production and food processing industries. The interests of these industries in terms of biotechnology include genetic improvement of plants, livestock and aquatic species, food processing to improve added value and pest control in agriculture. However, national policy towards GMOs is rather ambivalent, since research on GMOs is supported yet import of genetically modified seeds for production is banned to preserve Thailand's status as an organic producer. In the biomedical field, a limited number of companies are developing and/or improving imported diagnostics and these might benefit from the development of novel diagnostics. Production of pharmaceutical agents is even more limited and focuses on generic drugs. This scenario suggests that Thailand may only gain limited benefit from the biotechnology boom. But there are some initiatives under way. One is the 80-acre Science Park, soon to be completed in Rangsit, 20 km from Bangkok, which will provide incubator units, pilot plants, greenhouses and accommodation as well as finance, management and legal support. NSTDA, BIOTE and two other NSTDA centres, namely the National Electronics and Computer Technology Centre (NECTEC) and the National Materials Technology Centre (MTEC), are scheduled to move there this year, which should provide the critical mass needed to attract private investors.

The situation in the biosciences reflects the overall condition of science in Thailand. Recombinant DNA and gene expression technologies are well established. Indeed, Thailand participated in two genome projects—the rice genome, an important economic crop, and the genome of the bacteria *Burkholderia pseudomallei*, responsible for the disease melioidosis. A limited amount of proteomics is underway, but equipment is still incomplete and macromolecular X-ray crystallography facilities will not be available until 2002. But as the biosciences develop rapidly throughout the world, it will be harder for Thai scientists to compete in forefront areas. After doing research in Thailand for nearly 30 years now, I have come to accept that due to the various limitations here, work takes three times longer to accomplish, and, in the end, it is difficult to match the quality one is used to achieving abroad. In addition, molecular biology research increasingly depends on expensive hardware, which developing countries can ill afford. Furthermore, new and improved technologies are constantly being developed, making it a burden to keep up. Thus, younger people will find it harder to establish a reputation and remain competitive when they choose to stay in Thailand.

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Actually, the importance of genomic research has been recognised for many years. It forms one of the pillars of modern bioscience research of the country (Figure 1), according to the strategy formulated by two major funding agencies, the TRF and BIOTEC. Concerning the three cornerstones of bioscience research, the Biodiversity Research and Training Program (BRT) was initiated in 1996, the Tropical Disease Research Program (T-2) in 1997 and the Thailand Postgenomics Program (THAIGENOME), although approved, has been delayed due to difficulties in establishing an appropriate research strategy and management. However, greater efforts have been made to obtain information on local expertise and local needs, to bring together interested parties from various institutions and to draw up a working draft on how to operate the programme. Eventually, the programme is likely to consist of a collection of research projects that cover the biomedical area, as well as research on animals and plants, focussing on areas where Thailand has an advantage in terms of the local interest and/or expertise. Biomedical areas include research into malaria, dengue haemorrhagic fever, thalassemia, hepatic carcinoma and melioidosis. Food and agricultural biotechnology might include rice, papaya, shrimp and other aquatic species, and livestock. Preliminary plans have earmarked 500 million baht (13 million Euro) over the next 5 years. This is not a large sum by international standards, but it is a

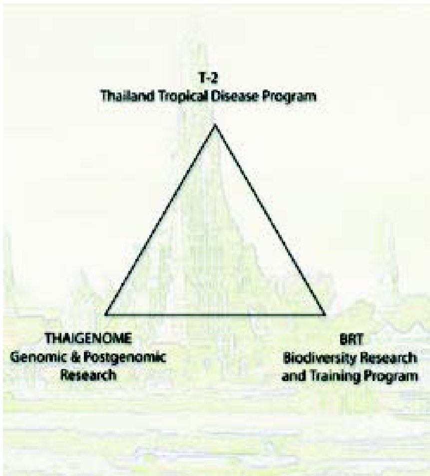

Fig. 1. Thailand's research triangle on biosciences.

reasonable start, given the limited number of scientists available and restrictions in the country's budget. However, the start of the project has already been delayed by 4–5 years, and we cannot afford to delay it any longer.

There is no way that laboratories in developing countries can compete with the scientific and financial power of major academic institutions in developed countries, let alone the vast resources of commercial enterprises. Yet developing countries must do their best to correct the inherent weaknesses in their scientific and technological infrastructure, and make whatever modest gains they can afford in selected areas of particular relevance. Failure to do so will not only result in the loss of commercial benefits, but more importantly, will also lead to a decay in scientific manpower resources and capability to such an extent that they can no longer fulfil the country's development objectives. And while the necessary steps to improve the scientific infrastructure may be well recognised by scientists and technocrats, any action is unfortunately subject to the whims of the government that may have other priorities on its agenda.

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