

ASEAN Economic Community 2015

Opportunities for Trade and Investment in Thailand's Biotechnology Sector

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Under the ASEAN Economic Community (AEC), a single regional common market and production base will be created by 2015 comprising the ten member countries of ASEAN: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. There will be free flow of goods, services, investment capital and skilled labor following the liberalization. This strategic move will create unparalleled opportunities for trade and investment in biotechnology in Thailand.



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ASEAN's GDP in 2010 reached USD 1.85 trillion, or 3% of global GDP, with total trade of over USD 2 trillion, comprising 6.8% of world trade.

The global biotechnology business is valued at USD 282 billion with an estimate growth rate of 7.7%. This value is estimated to increase to USD 453 USD billion in 2016, and the locus of future growth in this sector has shifted to the Asia-Pacific region. The growth of the business revenue during 2010–2013 is approximately 19% higher than other regions in the world. Located at the heart of ASEAN and representing its second largest economy, Thailand is an ideal place for trade and investment in biotechnology.

Current Status of the Thai Biotech Business

Thailand is taking the necessary steps to avoid falling into the middle income trap by shifting the sources of growth from investment and technology adaptation to technology innovation. With almost 30 years of experience in research and development (R&D) in biotechnology, Thailand has the human resources and the necessary infrastructure for the development and application of new advanced biotechnologies.

With the implementation of Thailand's National Biotechnology Policy Framework

(2004–2009) there has been a focus on developing biotechnology businesses as a means to building national prosperity. The first goal focuses on increasing the number of biotech businesses as well as increasing the national budget for R&D. Various kinds of government programs are in place which offer tax incentives, access to research infrastructure; and other services are provided to support the biotech business, both start-up companies and well as more established businesses. Though still in a growth phase of development, many advanced technologies have been developed in R&D institutes and universities across the country, and are being licensed both to local companies as well as multinationals.

Currently, the number of biotech companies in Thailand is estimated at over 200 companies with a market value around USD 2 billion due to the strong policy and government support as well as the necessary R&D support. More than 90% of these companies are SMEs, most of which build their R&D capability through joint research projects with universities and national research centres.

Thailand: The "Kitchen of the World"

By 2050 the world's population will reach 9 billion people and it is predicted that by

2030 the world will need to produce 50% more food and energy, together with 30% more available fresh water, while mitigating and adapting to climate change. The rising demand for agricultural commodities and food, due to a significant increase in the world's population, will negatively impact global energy and food security in the long run. However, for Thailand, a key contributor to the global food supply, the food crisis may support development of agricultural commodities for export expansion.

Thailand has earned a reputation as the "kitchen of the world". The Thai agro-industry and food business remains the country's main source of income, serving domestic demand and contributing significantly to exports.

In 2010, Thailand produced agricultural commodities and food valued at close to USD 40 billion or 8.3% of GDP. Food exports in 2011 were worth USD 26 billion, and Thailand was among the top five net food exporter countries globally. The nation holds the record in exports of rice, cassava, canned tuna, canned and frozen seafood, canned pineapples and sugar products. Between 2009 and 2011, the value of exports fluctuated but they are currently on an upward trend.

Around 41% of total land in Thailand is used for agriculture; as a result, more than 80% of raw materials are sourced from domestic producers at low prices. This is a major competitive advantage for the Thai food and food processing industry which is comprised of more than 116,000 companies (96% of which are SMEs).

As Thailand's agricultural exports grow, so does its commitment to quality, safety, sustainability and human rights. Thai authorities inspect all seafood, fruit and vegetable facilities and their products before they can be exported, ensuring that they are free of harmful antibiotics and chemicals. The Ministry of Agriculture and Cooperatives and other agencies have implemented a rigorous, advanced system of quality assurance and traceability. Farmers, buyers, processors and exporters must adhere to Thai and international guidelines and apply best practices at each step of the food production chain.

A sophisticated Thai traceability system called TraceShrimp allows major importers to quickly detect and prevent any possible contamination via the Internet, where they can track the lot's history from the hatchery to the processing plant. Thailand's inspection and control system has been recognized by the European Union, Russia, Japan, Korea, Canada, Australia, New Zealand, South Africa and China.

Maintaining its reputation as the "Kitchen of the World" can only be achieved by continuing to enhance the country's competitive edge in agriculture and food with research and innovation. The National Science and Technology Development Agency (NSTDA), universities and related government agencies are working together to boost the competitiveness of this sector through the application of science and technology through the whole value chain from planting to harvesting, and from food manufacturing to logistics. Research successes include being part of the international team which successfully cracked the genetic code of Japonica rice, and the development of drought, flood and salinity-resistant rice varieties; smart greenhouses; smart farming technologies; new environmentally-friendly chemicals for processing of liquid latex; and seed improvement technologies. As well as supporting commodity exporters, many of these technologies are being deployed to

rural agricultural communities to increase their ability to be self-reliant.

Thailand produces and exports more rubber than any other nation in the world. In 2010, Thailand exported 2.7 million tons totaling USD 7 billion. Rubber plantations, traditionally found in southern Thailand, are beginning to spring up in the north as well. Thailand spends more on rubber research and development than its two biggest competitors, Malaysia and Indonesia, and has an ample water supply and sophisticated infrastructure to ensure continued availability and ease of export.

Green Energy and the Environment

As a net importer of hydrocarbons and with a gap between demand and supply expected to grow in the future, Thailand has, for the past decade, advocated energy conservation and initiated programs to develop renewable sources of energy.

Thailand's 15-year Alternative Energy Development Plan seeks to replace imported fuels with alternative energy as a major energy source, thus helping ensure a secure and sustainable energy supply. The goal is to have alternative energy account for 20% of all energy used by the year 2022, and to promote the use of energy from green



communities and to support the alternative energy production of bio-fuels, as well as the development of energy efficient technologies.

Biogas technology developed by BIOTEC and King Mongkut's University of Technology Thonburi has been deployed in factories across Thailand, resulting in significant energy savings for factory owners. In the case of one factory the savings amounted to more than USD 2.5 million over 3 years.

Bioremediation Agent "KEEEN" is a commercial product of Hi-Grimm Environmental and Research Co., Ltd. developed in partnership with researchers at BIOTEC to screen for oil-degrading bacteria and to develop into a commercial bioremediation product. It won the Semi Grand Prize at the Seoul International Invention Fair 2012 and also picked up the Gold Prize and Special Prize from the Association Russian House for International Scientific and Technological Cooperation at the same event. It won the Environment Innovation Award at the SME Thailand Inno Awards 2012.

Thailand's Science and Technology Ministry is pushing Thailand to become a bio-plastic hub of ASEAN within 3 years as well as to improve and preserve the environment. The Ministry is cooperating with the National Innovation Agency and the Thai Bioplastics Industry Association in helping Thai bio-plastic entrepreneurs enhance their business capacity by transforming cassava into bio-plastics to replace polyethylene plastics which are very harmful to nature. It is targeting to make Thailand the bio-plastic hub of the ASEAN region within 3 years' time. International bio-plastics companies such as Purac and NatureWorks have identified Thailand as a production hub in the region. Globally, demand for biodegradable plastic is expected to rise to 1.7 million tonnes in 2015, up from 700,000 tonnes in 2010, replacing about 1% of the world's consumption of petroleum-based plastics.

Empowering People

Thailand's strength is its people. Recognizing that knowledge is the engine for sustainable

growth, Thailand has continued to put efforts into strengthening the educational system to prepare a new generation of scientists to be responsible global citizens who can actively participate in finding solutions to some of the most urgent problems facing the world today. Recent initiatives include expanding science schools, setting up research universities, creating research centres of excellence, expanding science parks and incubation centers, as well as providing funds for programs that foster lifelong learning.

Recognizing the need for human resource development in science and technology in neighboring countries, coupled with the available resources of high-caliber Thai researchers and state-of-the-art infrastructure at the Thailand Science Park, BIOTEC initiated the Human Resource Development Program in Biotechnology for Cambodia, Laos, Myanmar and Vietnam (CLMV). This program specifically addresses the underlying causes of the shortage of skilled manpower in the field of biotechnology in CLMV, which are the lack of facilities, equipment, technical know-how, limited research and development in biotechnology and inadequate training facilities and equipment. The Program offers short-term training courses to young researchers from these countries to work and train in laboratories in Thailand, and is conducted under the guidance of BIOTEC researchers. The number of applications grew from 40 in 2003 to 74 in 2008, proving that the program effectively addresses the needs of these countries. The Program expects to offer 10-15 scholarships annually.

Thailand: A Regional Medical Hub

Thailand has successfully emerged as a regional medical centre in terms of the capabilities of its increasingly renowned doctors, attainment of international health delivery standards, and provision of excellent health services at relatively affordable prices. Along with enticing tourist attractions, Thailand is becoming a popular medical

tourism destination, attracting visitors from all over the world.

Thailand's Ministry of Public Health estimates that the national income directly generated from medical tourism, not including the spending of persons accompanying patients, will reach THB 80 billion (USD 2.7 billion) in 2012, with an annual revenue growth between 5.5 to 7.0%.

At present, Thailand is the market leader in medical tourism in ASEAN in terms of number of international patients with 1.48 million coming to Thailand each year for medical treatment and services.

The increase in the aging population in the region will be an important driver for this medical tourism business. The United Nations has forecasted that the proportion of aging population (people above the age of 60), will jump from 11% in 2010 to 15% in 2025 and 22% in 2050. Singapore will rank first among ASEAN, with a proportion of 30% in 2025 and 35% in 2050, increasing from the current ratio of 16%. Thailand will come in second with an increase from the current 12% to 27% by 2050.

Examples of biotech products and services to serve these patients are genetic testing for disease prevention and therapy, regenerative therapies and personalized medicine.

The Thailand Center of Excellence for Life Sciences (TCELS) in partnership with the UNC Institute for Pharmacogenomics and Individualized Therapy of North Carolina and two local hospitals is developing a National List of Essential Medicine based on the Thai genetic database. By accounting for ethnic genetic differences, populations can be grouped to ensure that drugs are used most economically with no adverse side effects. Hospitals in Thailand are able to offer patients from ASEAN advance screening for such drugs such as Carbamazepine, Allopurinol, Abacavir, and Nevirapine to ensure drug effectiveness while avoiding adverse allergic reactions such as Severe Cutaneous Adverse Reaction which can be lethal.

Other niche services such as stem cell and in vitro fertilization with pre-

implantation genetic diagnosis are also available. There are 14 stem cell banks in the country and a number of hospitals are providing stem cell treatment to patients suffering from blood diseases such as thalassemia, leukemia and lymphoma.

As well as being an international hub for medical tourism, Thailand also has a strong foundation in medical research including tropical diseases and medical diagnostics; it is a recognized leader in tropical medicine. The Wellcome Trust–Mahidol University–Oxford Tropical Medicine Research program is recognized as an excellent program for tropical disease research and since 2005 has provided more than USD 30 million to support research in the country.

Malaria is one of the leading causes of death in the world. The problem is increasingly alarming as a result of widespread multi-drug resistant malaria. Thai researchers are employing a target-based drug discovery approach to design new antifolate inhibitors against the malaria dihydrofolate reductase–thymidylate synthase (DHFR–TS) and other enzymes in the folate pathway to develop new drugs to combat these resistant strains of malaria.

Thailand is recognized as being internationally competitive as a provider of clinical trials where it is estimated that customers can save up to 60% of US-based trial costs. Furthermore, Thailand offers a much higher patient concentration per trial site than the US and Europe. It has become a well-regarded clinical trials provider with over 400 private–industry clinical trials being run in country.

Access to state-of-the-art facilities is critical to the success of vaccine development. King Mongkut's University of Technology Thonburi and Thailand's National Science and Technology Development Agency (NSTDA) have established the National Biopharmaceutical Facility (NBF) which will be a centre of technology transfer for vaccine production and will help position Thai industry to meet international standards and gain a competitive advantage in the AEC. Pharmaceutical and biotech industries can

request to use the first biopharmaceutical cGMP pilot plant in Thailand. The plant provides scale-up study and production of recombinant proteins for clinical trials as well as training services.

Research collaboration accelerates the product development process which can ultimately benefit the public. An outstanding example of such collaboration is BioNetAsia Co., a vaccine-focused biotech company that has worked closely with NSTDA and with scientists in South Africa in pediatric vaccine development. Together they have successfully developed a 5-in-1 or 'cocktail' vaccine covering diphtheria, tetanus, pertussis, hepatitis B and meningitis in one shot. This vaccine is due for release within the next 5 years.

The company is also conducting research on a vaccine against bordetella pertussis, which causes whooping cough, and against Haemophilus influenzae type b (Hib) which is a pathogen that can cause meningitis and severe pneumonia. It is estimated that despite recommendations from the World Health Organization, three-fourths of children worldwide are not yet immunized against Hib disease. One reason behind the insufficient vaccination program is the high cost of Hib vaccine; BioNet is working on the development of a low cost vaccine using high yield fermentation and conjugation technologies.

On 21 February 2011, NSTDA, Chiang Mai University, Mahidol University and BioNet-Asia Co., Ltd. announced a licensing agreement for a chimeric dengue vaccine. The agreement enables BioNet-Asia Co., Ltd. to further develop and produce the vaccine for testing in pre-clinical and clinical stages of vaccine development into a commercial product. BioNet-Asia Co., Ltd. is a biotech company based in Thailand with core business in the development and marketing of vaccines in emerging economies. It is expected that this collaboration will lead to a commercial dengue vaccine available to Thais and eventually expanded to the ASEAN market and beyond.

Thailand's National Science and Technology Development Agency (NSTDA)

NSTDA was established twenty years ago to enhance Thailand's competitiveness through research and development. NSTDA researchers and their partners in universities have developed technology-based solutions to address national and regional needs. NSTDA's R&D strategy is built around five clusters which directly reflect national social and economic priorities: foods and agriculture; health and medicine; energy and environment; bioresources, communities and the underprivileged; and manufacturing and service industries.

Platform technology development and delivery mechanisms are carried out by four national research centres: the National Center for Genetic Engineering and Biotechnology (BIOTEC); the National Metal and Materials Technology Center (MTEC); the National Electronics and Computer Technology Center (NECTEC); and the National Nanotechnology Center (NANOTEC). The Technology Management Center (TMC) handles technology transfer and other related services.

NSTDA employs over 2600 researchers, scientists and support staff. They have typically generated 180 scientific papers and 180 patents a year. Each year NSTDA supports more than 1,200 research projects, over 400 post-graduate students, and more than 500 school-level students in their science projects.

NSTDA works closely with the private sector on projects ranging from identifying enzymes for alternative energy production, biocontrol production, utilization of wastewater from mungbean starch production, development of culture media to improve biomass and lactic acid production in the fermentation process, developing a closed plant production system (CPPS) to providing advice on setting up a tissue culture laboratory for sugarcane.

Thailand Science Park

NSTDA and its four National Research Centers as well as the Technology Management Center are all headquartered in the Thailand Science Park (TSP), located approximately 40 km north of Bangkok. TSP was opened in 2002, and is now home to over 1,600 researchers as well as 60 corporate tenants, 1/3 of which are biotechnology-based companies. As a hub for science and technology research, TSP is the preferred location for many world-leading high-tech companies. The park is situated adjacent to the Asian Institute of Technology, Thammasat University and the Sirindhorn International Institute of Technology and is also close to four large industrial estates. Phase 1 of TSP, with 140,000 m² of built-up space, is now fully occupied. .

Technology-based entrepreneurs in Thailand can access customized pre-incubator and incubator services and other

business and technology services to support their business endeavors. These include contract research, testing and analytical services, technology information services, and a technology sourcing and licensing service. TSP also offers financial services including research grants, low interest loans for technology development, and joint investment in S&T development projects, and its tenants are entitled to Board of Investment (BOI) privileges. In 2010 private sector tenants in Thailand Science Park, including Shiseido, Betagro and EcoLab, embarked on 259 new research projects, 51% of which were collaborative research projects with NSTDA researchers.

Construction began in 2008 on Phase 2 of the Thailand Science Park, also known as the Innovation Cluster 2 (INC II), which comprises of 4 interconnected towers spanning a total floor area of over 127,000 m². Thailand Science Park Phase II is scheduled to be completed by the end of 2013.

Thailand: The Preferred Biotechnology Research and Business Partner in AEC 2015

Good research and innovation bring added value to existing products and services while generating wealth and improving overall quality of life. Bridging the gap between the research and marketplace, Thailand has successfully created an alliance of universities, industry and government to link science to business and deliver research and innovation in biotechnology based on industrial needs.

Thailand will soon be integrated into a marketplace of more than 600 million people and is well positioned to enjoy the potential benefits of being part of this regional market. ASEAN is one of the fastest growing economic regions in the world, and biotechnology will play a fundamental role in this process of regional integration.

About the Author



After completing biology studies at Chulalongkorn University in Thailand, Dr. Morakot was appointed as a research assistant at the University of Rhode Island in the United States where she completed her post-graduate studies.

On returning to Thailand, Dr. Morakot was offered the position at King Mongkut's Institute of Technology Thonburi (presently King Mongkut's University of Thonburi – KMUTT) where she, together with Prof. Dr. Preda Viboolsawas and Dr. Krissanapong Kirtikara, founded the School of Energy and Materials. The school is taught at the graduate level and conducts research involving multidisciplinary technology. Dr. Morakot is a driving force for teaching and research in the field of energy generated from biomass, biomass production, energy balance of biomass production, bioproductivity and bioleaching. Subsequently, Dr. Morakot has founded the Division of Biotechnology in the School of Energy and Materials which was later transformed into the School of Bioresources and Technology. The school curriculum has been expanded to include the Division of Biotechnology, Natural Resources Management, Postharvest Technology and Biochemical Technology. From over two decades of contributing to KMUTT, Dr. Morakot has served as Dean of the School of Bioresources and Technology, as well as the School of Energy and Materials, and in so doing has provided guidance as advisor or co-advisor to over one hundred post-graduate theses and dissertations.

Dr. Morakot herself is a leading researcher in Thailand in the field of microbiology and biotechnology. Her specialty includes research and development of an anaerobic wastewater treatment for biogas production and algal technology research, and she is also a pioneer in biosensor research in Thailand. Dr. Morakot is also well recognized for her involvement at the regional and international level, being an active member and working on the executive of several societies and organizations, as well as serving on the editorial board of a number of noted international journals. Dr. Morakot was BIOTEC Director from 2000 – 2008. During her directorship, she also served as Chairman of the ASEAN Sub-Committee on Biotechnology (SCB), from 2005- 2008.