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Overview: Malaysian Agricultural Biotechnology



The Malaysian Agricultural Biotechnology Sector


A Frost & Sullivan Whitepaper
2009



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Introduction

Biotechnology has many applications in agriculture, including diagnostics, vaccines and therapeutics for animal health; DNA fingerprinting for managing animal stocks and identifying specific plant varieties, animal and plant propagation; and the use of marker assisted selection, intragenics and genetic modification (GM) to develop improved plant and animal varieties.

The term agricultural biotechnology encompasses a variety of technologies used in food and agriculture, for a range of different purposes such as the genetic improvement of plant varieties and animal; genetic characterization and conservation of genetic resources; plant or animal disease diagnosis; vaccine development; and improvement of feeds (FAO,2009a). Some of these technologies may be applied to all the food and agricultural sectors, such as the use of molecular markers or genetic modification, while others are more sector-specific, such as tissue culture (in transgenic crops and forest trees), embryo transfer (livestock) or sex-reversal (fish).

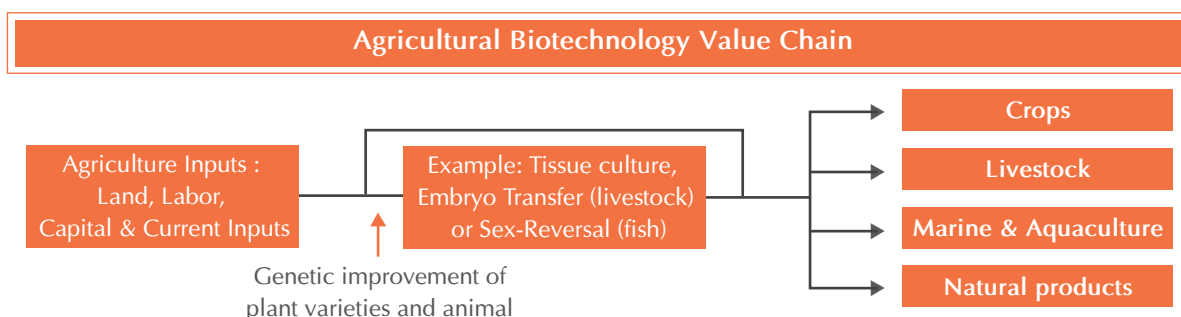
As we face global population growth, increased competition for land and water resources from industrial and urban growth, climate change, and the need to protect the environment, solutions are needed to increase agricultural productivity to combat hunger and poverty. Agricultural biotechnology offers an important tool, which along with traditional breeding, new technologies, and improved resource management can enhance crop, livestock, and aquaculture productivity. This increases agricultural production in an environmentally sustainable way by reducing excess pesticide and fertilizer use that are threats to biodiversity and health, developing new crop varieties that are resistant to plant diseases and pests and climate changes, and enabling better livestock disease diagnosis and the development of more effective livestock vaccines among others.¹ (Source: USAID)

Malaysia has a strong foundation for agricultural biotechnology, with it being the third engine of growth for Malaysia after the manufacturing and services sectors. Being the world leader in the production of several industrial crops, like oil palm, rubber, cocoa, pepper and tropical timber, Malaysia has a strong agriculture base. This coupled with her rich biodiversity and strong Information and Communication Technology (ICT) infrastructure, puts Malaysia in an advantageous position to drive forward in its goal of biotechnology as the next platform for economic growth for the country.

Further emphasizing its importance in the Malaysian economy, agriculture provides employment for up to 40% of Malaysia's population. It is projected in the 9th Malaysia Plan that 220,000 new jobs will be created annually; of which 44,000 will be graduates who will be attracted to agriculture jobs. The career prospects of agriculture includes employment in the industries related to food, environmental control, waste-treatment and manufacturing.

Key research areas for the agriculture sector are agricultural genomics, tissue culture technology, livestock farming, animal health and nutrition, bio-pesticides and bio-fertilizers, extraction of metabolites and nutritionally enhanced agriculture products. The science is in place in local research organizations, local research universities and in private biotech companies, and there is no lack of research publications.

This is also to boost the level of commercialization within the industry, which has hence-far been limited. While there are companies emerging in this space, and it is one of the highest potential areas for biotechnology growth for the country, international partnering is going to be one of the key areas for future growth.



Goals and Strategies for the sector

Biotechnology has the potential to increase crop and animal productivity; improve nutritional quality; broaden tolerance of crops for drought, salinity, and other environment related stresses; and increase resistance of crops to pests and diseases.

Malaysia has a long tradition as a leader in tropical plantation technology. Agriculture is still the backbone of the Malaysian economy, the nation has moved from traditional agriculture toward a modern outlook of the sector. Agricultural biotechnology answers the drive to ensure ample food supply and a sustainable production of food for Malaysia.

Having done various crop science and plant technology studies and implementation for palm oil and rubber based industries, the nation is heading towards a more diversified outlook on other natural resources and products it has potential to offer. Industries targeted for improvement under the policy include palm oil, rice, cocoa, lumber and forest species, fruits, flowers, ornamentals, vegetables, spices and other minor crops and plants.

Historically agricultural biotechnology development in Malaysia can be traced back to its preparation of a national biotechnology program. The goals were defined in terms of improving the nation's food security and commercialization for economic growth, as well as raising its competitive position in the global agricultural markets with quality products.

The government planned to achieve its agricultural biotechnology goals through several key measures. These included a public financed research system, investment to enhance the innovative capacity (both human and physical capacity) of the national biotechnology research program, and creation of institutions and regulations.

The Malaysian Biotechnology Policy

The Malaysian Government has identified the biotechnology sector as one of the key strategic sectors that will support the growth of the Malaysian economy. It is anticipated that growth in the sector will be supported by leveraging on the strength of the country's diverse natural resources and cost effective human capital talent pool. The Government has identified the need to create a strong supporting framework to facilitate the long term growth of the sector. In 2005 the Malaysian government enacted the Malaysia Biotechnology Policy to achieve this goal. The policy detailed nine focus areas deemed critical to creation of a sustained biotechnology sector, one of which is to support the growth of the industrial biotechnology sector.

The biotechnology industry is expected to contribute approximately 2.5 % of national GDP by 2010, 4.0% by 2015 and 5.0% by 2020. Furthermore, it is estimated that the industry will create 280,000 new jobs – both directly and indirectly – by 2020.

The National Biotechnology Division (BIOTEK) under the Ministry of Science, Technology and Innovation is responsible in enforcing the National Biotechnology Policy.

Through the policy, the government has established BiotechCorp (Malaysian Biotechnology Corporation), a one-stop centre for biotechnology; and three national R&D institutes, namely the Malaysia Agro-Biotechnology Institute (ABI), Institute of Pharmaceutical and Nutraceutical Malaysia (IFNM) and Malaysia Genome Institute (GenoMalaysia). The policy also allows the government to provide various fiscal and tax incentives to biotechnology companies.



The Nine Thrusts of the National Biotechnology Policy

Agricultural Biotechnology	Transform and enhance the value creation of the agricultural sector through biotechnology.
Healthcare Biotechnology	Capitalise on the country's biodiversity for commercialising the discoveries of health related natural products and bio-generic drugs.
Industrial Biotechnology	Leverage on the country's strong manufacturing sector to increase opportunities for bio-processing and bio-manufacturing.
Research & Development, Technology Acquisition	Establish centres of biotechnology excellence, through research & development, as well as technology acquisition.
Human Capital Development	Build the nation's human capital through education, training and research activities, with the aim of producing knowledge generation capabilities.
Financial Infrastructure	Provide the right financial support via competitive lab to market funding and incentives to encourage committed participation from academia and the private sector, including Government-linked companies.
Legal & Regulatory Framework	Strengthen the legal and regulatory framework by reviewing ownership of intellectual properties and regulations relating to biotechnology processes and business.
Strategic Development	Build international recognition for Malaysian biotechnology and find a niche in the global technology value chain.
Government Support & Commitment	Realise the execution of policy through the establishment of a dedicated and professional Government agency to spearhead the development of the biotechnology industry with the incorporation of Malaysian Biotechnology Corporation Sdn Bhd (BiotechCorp).

The 9th Malaysia Plan

The 9th Malaysia Plan announced on the 31st March 2006 further defined and detailed the goals of the Malaysian government in relation to the biotechnology sector. Importantly the Plan reviewed the amount of funding support committed to developing the sector in Malaysia (as described below). It is anticipated that the agricultural biotechnology sector will benefit from all of these investments, including the funding support directed to agro-biotechnology projects which, in part, will focus on the development of novel crops, livestock, aquaculture and marine areas.

9th Malaysia Plan Biotechnology Sector Spending	Allocation (US\$, M)	Allocation (RM)
R&D Development	\$129.9	\$463.0
Biotechnology R&D	\$101.9	\$363.0
Biotechnology Commercialization Fund	\$28.1	\$100.0
Technology Acquisition Programme	\$28.1	\$100.0
Biotechnology Business Development	\$148.7	\$529.8
Technology and IP Management	\$28.1	\$100.0
Entrepreneurship Development	\$14.0	\$50.0
Agro-Biotechnology Projects	\$22.4	\$79.8
Institutional Support and Equity	\$84.2	\$300.0
Biotechnology Infrastructure	\$260.6	\$928.5
Total	\$567.3	\$2,021.3

Source: 9th Malaysia Plan, Economic Planning Unit

The Agro-Biotechnology Institute is working closely with various public and private research institutions to ensure continuous Research, Development and Commercialization projects related to agro-biotechnology.

Examples of projects realized in 2008 among Malaysian Agricultural Biotechnology Companies are shown in the next table.

Projects Realised Status in 2008 - Malaysian Agricultural Biotechnology Companies	
Company	Activity
Medical Biotherapy Sdn Bhd	Medical Biotherapy Sdn Bhd has establish a commercial production unit to produce the larvae of <i>Lucilia cuprina</i> to be packed and market as a medical device for wound debridement. Medical Biotherapy Sdn Bhd has signed a technology transfer agreement with the Institute of Medical Research. They have started operation by conducting clinical trials of the products with collaboration of several hospitals and clinics.
Green World Genetics Sdn Bhd	Green World Genetics Sdn Bhd is a seed production company employing biotech processes. The company plans to set up the main R&D facility and pilot farm for its products in Malaysia, as well as contract research / farming for the seeds developed for local use and export market.
Handalas Sdn Bhd	Handalas intends to be a nucleus farm producing Jamnapari goat by employing Artificial Insemination (AI) tools.
Bio Alpha R&D Sdn Bhd	Bio Alpha R&D is involved in the processing, production, cultivation and R&D activities relating to extraction of cordyceps.
Bionic Life Sciences Sdn Bhd	Bionic Life Sciences proposes to expand their business in the production of papain and bromelian enzymes from papaya and pineapple fruits for the wound healing and skin care application.
Furley Bioextracts Sdn Bhd	Furley Bioextracts is involved in the commercialisation of NASE (Natural Antioxidant Standardised Extract) and NASWE (Natural Antioxidant Skin Whitening Standardised Extract). The company has expressed its interest to collaborate with Nine Bio Sdn Bhd (9Bio) to assist in the marketing of its products.
Invitrotech Sdn Bhd	Invitrotech is involved in the production of fruit, medicinal, aromatic and ornamental plantlets using tissue culture technology.
Natural Wellness Biotech Sdn Bhd	Natural Wellness Biotech Sdn Bhd is involved in the manufacturing as well as R&D of nutraceuticals, traditional herbs and phyto-pharmaceutical products from local herbs.
Tropical Bioessence Sdn Bhd	Tropical Bioessence Sdn Bhd is involved in the extraction process of essential oil and herbal products.

Source: *BiotechCorp, 2008*

The Global Agricultural Biotechnology Market

The biotech industry is expected to continue to grow by about 10 to 15 percent globally reaching USD271 billion by 2011. The healthcare segment is the largest contributor to the overall biotechnology sectors revenues. Bio-agriculture is the second largest segment, accounting for 11.5 percent or around USD17 billion of the total revenues in 2007 (Frost & Sullivan, 2009). Other key contributors are in areas such as industrial biotechnology and bio-fuels.

As the economic growth is projected to slow in the second half of 2009 and is expected to stage a modest recovery in the first half of 2010, the diversified biotechnology sector may see a disproportionate impact based on areas of application. There are an increasing number of biotechnology companies growing globally. Asia Pacific alone is expected to house 57 % of the total number of biotechnology companies by 2014. Malaysia is expected to post double digit growth for number of biotechnology companies in their respective countries.

Number of Biotechnology Companies (World), 2009

Region	2007	2008	2009	2010	2014	CAGR%
Australia	470	505	530	551	603	3.62
China	1,069	1,144	1,213	1,279	1,518	5.14
India	508	528	546	563	609	2.62
Japan	627	662	691	718	785	3.26
Malaysia	42	56	97	116	154	20.40
New Zealand	77	82	87	91	105	4.53
Singapore	64	71	78	86	129	10.53
South Korea	729	747	764	779	827	1.82
Taiwan	349	377	402	422	482	4.72
Asia - Pacific	5,942	6,180	6,417	6,615	7,226	2.83
World Total	9,852	10,360	10,835	11,243	12,611	3.59

* CAGR % is calculated from 2007 to 2014.

Source: Frost & Sullivan, 2009

In recent times, there have been many instances of companies replacing their conventional methods of production with biotechnology or accelerating their existing biotechnological processes. This had helped to scale-up production processes.

In 2006, BASF in collaboration with Molecular Plant Breeding Cooperative Research Centre (MPBCRC) entered into an agreement to develop yeast that is high yielding and more tolerant to drought and fungal diseases.

DSM, a key supplier of food ingredients is also looking at biotechnology to cut costs and improve production processes. For example, the company has replaced the chemical process for vitamin B2 production with a new fermentation process involving genetically modified organism, *Bacillus subtilis*. DSM claims that this process has helped to reduce production costs by almost 50 per cent. In addition, the fermentation process requires a single step compared to the five step conventional process and is also environment friendly.

In most Asian countries the agricultural biomass resources of plant, animal, fish or tree origin, can provide vast opportunities for preparing value-added products.

Within applications of biotechnology in Asian agriculture, several features confer comparative advantages to the region.

- The richness of biological and ecosystem diversity.
- Presence of skilled resources and scientific capabilities coupled with existing and planned infrastructure for undertaking biotechnological research and development in this field.



Biotechnology is already being applied to increasing yield in the region by

- Minimizing pre- and post-harvest losses
- Increasing actual yields closer to the current production potential; and
- Increasing the production potential.

Examples include the use of in-vitro culture techniques in potatoes, cassava and plantation crops, haploids in rice, diagnostic kits for disease identification, new and recombinant vaccines and embryo transfer. Other examples are, transgenic fish through chromosome set manipulation for polyploidy induction, and improved breeding induction and hypophysation, hybridization, for example, of catfish, use of probiotics in feed, fish pond and fish health management.

In some countries in the region, commercial production of transgenic cotton and soybean is increasing fast. These techniques provide opportunities for refining, standardisation and efforts to increase cost-effectiveness to improve their transfer to and adoption by the majority of small farmers.



Malaysian Agriculture: Over the years and today

Malaysia has around 4.06 million hectares of agricultural land distributed throughout 14 states. Most (75%) of this land is cultivated with primary crops such as palm oil, rubber, cocoa, coconut and pepper, the remaining portion is dedicated to agro-food production. Thus Malaysian agriculture has a profound impact on the country's environment, economy and people.

Malaysia is blessed with fertile soil, abundant rainfall and suitable climate for food production. It is still a net food importer and has never achieved a food trade balance surplus. The government is focusing to develop the local agro food industry in tandem with the growth of the primary commodities.

In 1960, agriculture sector contributed 44% to the Malaysia's Gross Domestic Product (GDP), mainly from the rubber and palm oil industry. But the contribution of agriculture sector in GDP was shrinking over time since 1960 until present. In 2007, Malaysian agricultural sector contributed 8% to the country's GDP and it became the third engine of growth next to the manufacturing sector and service sector. Issues on poverty and infrastructure development have always been related with this sector. The Government has introduced strategies and programs to help people in agriculture especially those in rural areas to exit from this situation. Since 1984, 3 National Agriculture Policy plans (NAPs) were formulated to develop the sector. The policies will place precedents to all agro related industries within the sector.

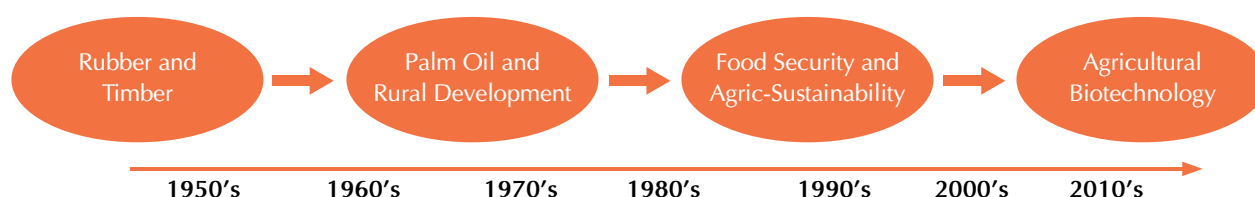
Agro related Industries (Malaysia)



The industry has evolved tremendously with the support of the government, industry players, research centres and local farmers. Over the years, the agriculture industry has reformed from rural agriculture to commodities based agriculture practices.

The country is moving from an agrarian based economy, with the agriculture sector its main thrust in early 1960s, to an industrialized economy in the 2000s, with the manufacturing sector and service sectors taking precedence in its economy.

Evolution of the Agriculture Sector (Malaysia)



Agriculture in Malaysia has transformed over the years. Riding on the motto of "agriculture is business", the new approach has enabled the agriculture producers to penetrate new markets abroad, recording an average increase of 13 per cent yearly from 2003 to July 2008. (MOA, 2009)

The real value of the agriculture sector rose from RM33 billion in 2003 to RM40 billion in 2008. A total of 7,258 agro business entrepreneurs have emerged during the period while 996 existing ones registered an increase in earning with a minimum income of RM2,000 per month. Around 45 permanent food parks covering 3,800ha have been developed involving 789 participants while 17,400ha have been planted with vegetables under contract farming by 10,600 participants. (MOA, 2009)

Although Malaysia officially launched its National Biotechnology Policy only 4 years ago in 2005, Malaysia has had a long heritage of use of biotechnology techniques in its premier plantation industry which has remained a world leader for decades. This heritage will allow it to forge ahead and overcome its late start, as already demonstrated in just a few years.

Biotechnology has been recognized as one of the new high technologies that will bring about desired changes in the agricultural sector. The sector aims to increase productivity and yield of agriculture produce; the diagram below shows the aspiration of production of key agriculture produce under the 3rd National Agriculture Policy and the 9th Malaysia Plan.

Key Agriculture Production in '000 MT (Malaysia), 2007 -2010

	2007	2010
Crude Palm Oil	15,824	18,900
Paddy	2,316	2,900
Vegetables	623	1,200
Beef	34.3	45
Fishery	1,648	1,800
Herbs	NA	103

Source: Various, Frost & Sullivan (2009)

An interesting note is the connection between agriculture production and the consumption model for agro food produce. The following table depicts the consumption of agro-produce per person in Malaysia for 1995 as compared to 2005.

Key Agro Food Consumption (Malaysia), 2007

Year	1990	2005	Differences
Consumption per person	kg	kg	%
Potato	3.2	6.4	100.0
Duck and Goose meat	2.1	4	90.5
Vegetables	26.1	49.2	88.5
Sugar crops	206.9	383.2	85.2
Wheat	32.6	57.6	76.7
Bovine meat	2.8	4.7	67.9
Sweet potato	0.3	0.5	66.7
Chicken meat	20.1	31.8	58.2
Maize	6.1	9.3	52.5
Sheep and Goat meat	0.6	0.9	50.0
Meat	35.3	47.6	34.8
Milk, whole, fresh	32.9	43.5	32.2
Fish	48	57.3	19.4
Cereal	160.3	171.6	7.0
Fruits	55.2	57.9	4.9
Pulses	2.7	2.6	-3.7
Starchy roots	26.1	22.8	-12.6
Eggs	14.1	12	-14.9
Rice	118.2	99.9	-15.5
Oil crops	133.9	90.4	-32.5
Cassava	20.9	13.6	-34.9
Pig meat	9.7	6.2	-36.1

Source: Various, Frost & Sullivan (2009)

The overall demand for starch and wheat, livestock and poultry and even vegetables is set to increase in the next few years. Consumers are rather careful in selecting the food they consumer, opting for healthier choices and a more balance diet in their daily intake. This trend is expected to continue and is the basis that would shape future agriculture production.

Consumer acceptance toward agro – biotech produce is important to ensure continuous market for the produce. In a 2002 survey by the International Service for the Acquisition of Agri-biotech Applications (ISAAA), the acceptance of Malaysians towards agricultural biotechnology is moderate and can be deduced to the following results:

- Moderately to very interested in biotechnology
- Perceive the benefits of biotechnology to be between moderate to high
- Have a very high regard for the role of science in the development of agriculture in Malaysia (89%)
- Rate themselves as having a moderate understanding of biotechnology
- Have moderate score on factual knowledge about biotechnology

Malaysian Agricultural Biotechnology Focus Areas

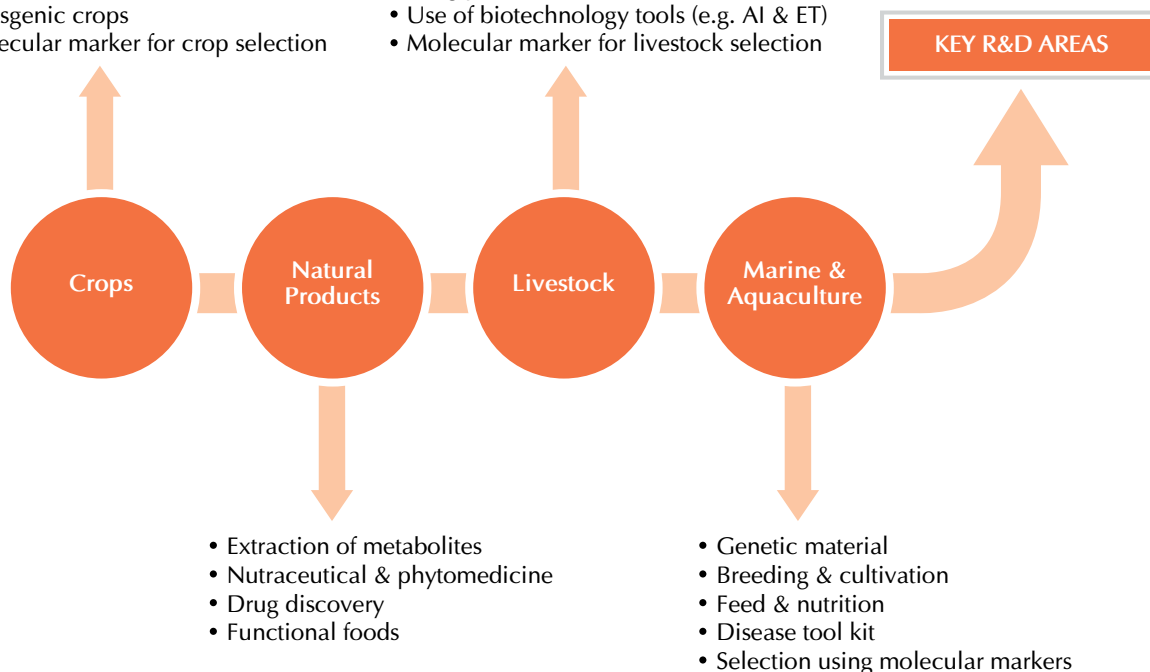
The agricultural biotechnology sector is broad and Malaysia focuses on the 4 key areas below in which the country is able to leverage on its natural strengths and capabilities to develop an internationally competitive position in the market. The 4 focus areas are the crops, natural products, livestock and marine & aquaculture as depicted below:

Sector Strengths	Crops	Natural Products	Livestock	Marine & Aquaculture
Vast natural resources/ biodiversity	✓	✓	✓	✓
Agricultural Corridor Development	✓		✓	✓
Promoting Downstream and Value Adding Activities	✓	✓	✓	✓
Agricultural Knowledge & Development	✓	✓	✓	✓
Cost competitive skilled labour	✓		✓	
Enhanced Infrastructure & Agri-based Supply Chain	✓		✓	✓
Globally recognized halal certification			✓	✓

The following section will focus on the key R&D areas depicted below:

- Plant tissue culture
- Bio pesticides & bio controls
- Bio fertilizer
- Transgenic crops
- Molecular marker for crop selection

- Feed & feed additives
- Vaccines & Diagnostics
- Drug production
- Use of biotechnology tools (e.g. AI & ET)
- Molecular marker for livestock selection



Source: Frost & Sullivan, 2009

Focus Sector Overview 1: Crops

The development of the crops sector in Malaysia will be particularly strong due to her vast biodiversity and government support in developing and improving the yield specific agriculture corridors for commodity and food crops.

A crop is the annual or season's yield of any plant that is grown in significant quantities to be harvested as food, as livestock fodder, fuel, or for any other economic purpose.

In Malaysia, crops can be divided into commodity crops and food crops. Some commodity crops of great economic significance for the country are palm oil, natural rubber, timber products, cocoa and pepper. Food crops include paddy, vegetables and fruits.

Palm oil has been one of the biggest success stories for Malaysia. Most plantations can be found mostly on the Malay Peninsula and Sabah, together it produces more than seventeen million tonnes of oil per year, nearly of the world's supply. In the last thirty years palm oil has grown to be the second biggest vegetable oil behind soybean, and the increasing demand for vegetable oils, particularly in Asia.

The productivity of the Malaysian industry has been steadily improved at all levels, including the quality of planting material, cultural practices, processing methods, genomic discovery and marketing strategies. Export earnings of oil palm products rose to record RM65.2 billion in 2008 from RM45.17 billion the previous year. The industry provides employment to more than half a million people and livelihood to an estimated one million people. In Malaysia there are 270,000 smallholders involved in the industry, other than the mid-sized and large companies such as Sime Darby and IOI Plantation. Estates can now yield up to 4.08 tonnes of oil per hectare, which almost double the yield of any other oil crop under intensive cultivation.

Malaysia is also the world's leading supplier of natural rubber, 80% of which is produced by smallholders in both eastern and western parts of the country.

Rice is the dominant food crop, commonly grown in the hilly areas, with domestic production meeting roughly 80% of demand. There are about 50 varieties of vegetables grown in Malaysia, including the highland and low land varieties. The vegetables are categorized into 4 divisions namely fruity (brinjal, cucumber, tomatoes, french beans, long beans, okra, small and bitter gourds), leafy (spinach, cabbages, kailan, kangkung and mustard), spices (chilli) and roots (ginger).

Local fruits crops such as melon, papaya exotica, durian, star fruit, banana, pineapple, mangosteen, rambutan and jackfruit were also exported to some extent. Good progress from both public and private research centres has been made in developing genetic manipulation and transformation systems, and inserting genes of interest into several plants including rice, papaya, banana, orchid, pineapple, oil palm, and rubber. Research centers focusing on these areas are, for example the Malaysian Agricultural Research & Development Institute, Malaysian Palm Oil Board, Malaysian Rubber Board and Sime Darby Technology Centre.

Technology Drivers – Shaping the future use of Crops Biotechnology

- 1. Discovery:** Genomic mapping, tissue culture and micro propagation protocols for the regeneration of several useful tropical forest plants and woody trees, as well as plantation crops and horticultural crops
- 2. Optimization:** Marker Assisted Selection (MAS) technology to be used in precise selection of superior or preferred plant in any breeding programmes
- 3. Implementation:** Creating crop yield enhancements through tissue culture technology and genome mapping via field testing and best practice crop management (bio fertilizers & bio pesticides)



Focus Sector Overview 2: Natural Products

A natural product is a chemical compound or substance produced by a living organism - found in nature that usually has a nutraceutical or biological activity for use in drug discovery and drug design.

Here in Malaysia, natural products have exhibited its potential as new growth area. Natural products are referred to herbs, plant extracts and other traditional medicine.

With the Earth's oldest rainforest and 13,050 indigenous species including 1,200 species of medicinal plants, Malaysia is classified as one of the world's twelve "mega-diversity" countries and is the fourth most bio-diverse nation in Asia after India, China, and Indonesia. The country's natural resources, coupled with its unique melding of the traditional remedies of the Malay, Chinese, and Indian cultures, position Malaysia as a valuable source of extracts and materials for the preparation of new formulae to ensure their growth and high yield will be sustainable for viable resource-based manufacturing and downstream activities.

Malaysia presently has 142 herbal manufacturers with GMP qualifications operating. Its GMP and TCM guidelines are in accordance with those of the WHO, UNIDO, and the Pharmaceutical Cooperation Scheme (PIC/S).

The natural product sector is determined as a new growth area for agriculture biotechnology. The production of herbs and spices grew from 7,098 MT in 2005 to 13,251 MT in 2007.

Annual sales for Malaysian herbal products is presently estimated at RM4.6 billion and is expected to expand to RM8.0 billion by 2010. Malaysian herbs are primarily used in health foods & beverages, herbal and traditional medicines, health enhancing products, dietary supplements, flavors and fragrances, cosmetics, and toiletries.

Traditional herbs are making its way as functional food and beverage ingredient. In terms of functional foods, coffee and tea fortified with herbs became very popular in 2005.

The local dietary supplements segment is heavily dependent on imports, especially from the United States and Australia. Vitamins B complex, C, E, multi-vitamins and calcium are popular among Malaysians. Other popular supplements include evening primrose oil, omega-3 fish oil, ginkgo biloba, ginseng, lecithin, royal jelly, spirulina, ginseng and cod liver oil.

The following table shows examples of herbs used as functional ingredients in Malaysia:

Herbs used as functional ingredients in Malaysia (2009)	
Plant Extract	Active Ingredient and Application (plant)
Eurycoma longifolia (Tongkat Ali)	Eurycoma longifolia has become popular for its alleged testosterone-enhancing properties. It has therefore been included in some herbal supplements for bodybuilders. Historically, South East Asia has utilised the herb for its suggested antimalarial, antipyretic, antiulcer, cytotoxic and aphrodisiac properties. In other studies, fractions of Eurycoma longifolia extract have been shown to induce apoptosis in breast-cancer cells and to be cytotoxic to lung-cancer cells
Centella Asiatica (Pegaga) Extracts	Centella Asiatica (also known as gotu kola, Indian pennywort, pegaga), classified as Centella asiatica, are popular as an alternative to standard Western allopathic medicine for a variety of problems, including senility, rheumatism as well as skin conditions. Other benefits for extra vitality, increasing brain power and concentration, lowering blood sugar levels, treating poor circulation, arthritis and varicose veins
Ginseng	The generic term Ginseng includes Eleuthero or Siberian Ginseng and Panax, or Asian Ginseng. Ginseng contains several active compounds of which ginsenosides are the best-known substance group. Ginsenosides belong to the substance group of the saponins. Concentration of ginsenosides in standardized extracts range from 5 to 80 percent. Ginseng effects are due not only to the ginsenosides, but also to other substances such as the polyacetates, glycans, peptidoglycans, and g-aminobutyric acid. Ginseng is the most popular herb used to boost energy, improve stamina and resistance to stress, and it is also said to improve virility.
Green Tea	Green Tea Extract's main active compound are catechins, a compound from the flavonoid family. Standardized Green Tea Extract usually contains 50 percent catechins. Green Tea Extract is a popular nutraceutical used for its antioxidant properties, with recent also underlining Green Tea Extract potential slimming properties.
Labisia Pothoina (Kacip Fatimah)	Labisia pumila (Myrsinaceae), popularly known as "Kacip Fatimah", has been used by many generation of the Malay women to induce and facilitate childbirth as well as a post-partum medicine. Other claimed traditional uses of the plants include used effectively to treat dysentery, rheumatism and gonorrhoea. It is also used as antifatulence and anti-dysmenorrhoea, all these properties is due to the presence of phytoestrogens that is naturally found in the plant.
Andrographis (Hempedu Bumi) Extracts	Andrographis paniculata is used for treatment, upper respiratory infections, fever, sore throat and herpes. Other reported applications include its use in cases of malaria, dysentery and even snakebites. The herb improves gall bladder function, increases bile flow (thereby aiding digestion), and has been found to be as effective as silymarin (active compound in milk thistle) in protecting the liver. Andrographis extracts are cytotoxic (cell-killing) against cancer cells. Positive results have been seen in relation to stomach, skin, prostate and breast cancer cells in test-tube studies.
Morinda Citrifolia (Mengkudu)	Mengkudu juice helps recovery some diseases, such as: cancer, heart disease, digestive disturbances, diabetes type 1 & 2, stroke, and several other diseases. The juice contains Xeronine substances which is one of the important functions of proteins and specific cell-cell human body.
Orthosiphon Stamineus (Misai Kucing) Extracts	Misai Kucing extract contains a high level of antioxidants which will inhibit the inflammatory of the joints associated with gout. Thus, the extract will reduce the pain surrounding the joints involved. In fact, the extract exhibit diuretic ability which will flush out excessive uric acid in our body to prevent them from accumulating in the joints to form harmful crystals; and also in aiding the cure of kidney stones, high blood pressure, diabetes and rheumatoid arthritis

Focus Sector Overview 3: Livestock

Livestock is the term used to refer to a domesticated animal intentionally reared in an agricultural setting to produce things such as food or fiber, or for its labor. Raising animals or animal husbandry is an important component of modern agriculture. It has been practiced in many societies, since the transition to farming from hunter-gather lifestyles.

In Malaysia, the term livestock is referred to the poultry (broiler and egg), ruminant and swine industry. Poultry and swine farming represent by far the major proportion of the livestock industry in terms of output value. The 2008 ex-farm production value of chicken and duck eggs was estimated to be RM1917 million and poultry meat output are estimated to be in the region of RM4756 million while the swine industry contributes about RM1446 million during that year. These sub-sectors are operated largely in a commercially oriented manner and are increasingly managed as private or public limited companies.

The ruminant sector lags far behind with the majority of cattle, goat and sheep still owned by individual farmers who rear these animals as part of their overall rural agricultural activities. The trend is expected to change by the recent development of livestock nuclear farm establishments utilizing artificial inseminations and embryo transfers. The total ex-farm output value of beef and milk is estimated to be about RM759.6 million and mutton about RM50.01 million in 2008. The main potential for cattle rearing appears to be in oil palm plantations where there is ample edible herbage available for grazing. The self sufficiency for goat meat is 9.2% and that for cattle is 25.9% (DVS Malaysia, 2008)

Technology Drivers – Shaping the future use of Livestock Biotechnology

- 1. Discovery:** Artificial inseminations, embryo transfers and genetic modification protocols for the regeneration of livestock.
- 2. Optimization:** Marker Assisted Selection (MAS) technology to be used in precise selection of superior or preferred animal in any breeding programmes. The technology would enable the reduction in the number of breeding cycle and time whilst allowing for the selection of precise traits in the animal of choice.
- 3. Implementation:** Creating parent stock farms via field testing and best practice in animal husbandry. Creating value added product such as omega 3 fatty acid eggs which is low in cholesterol.

Focus Sector Overview 4: Marine & Aquaculture

Fisheries are harvested for their commercial, recreational or subsistence value. They can be saltwater or freshwater, wild or farmed. Marine fishery involves the capture of wild fish whereas; aquaculture is the raising fish through fish farming. Close to 90% of the world's fishery catches come from oceans and seas, as opposed to inland waters. Most marine fisheries are based near the coast. This is not only because harvesting from relatively shallow waters is easier than in the open ocean, but also because fish are much more abundant near the coastal shelf, due to coastal upwelling and the abundance of nutrients available there.

In Malaysia, the fisheries sub sector is a very important component of the overall marine biotechnology area. More importantly, the livestock production industry are under going structural change from traditional small scale backyard farming to large integrated farming utilizing technology to improve efficiency and bio-security. This has created huge demand for modern farming systems, improved breeding and animal nutrition and health products. The downstream meat processing sector has also witnessed strong growth driven by domestic demand and exports, especially for chicken, beef and swine meat.

With a production of 1.56 million tonnes valued at RM6.32 billion in 2007, the fisheries sub sector was 93% self-sufficient and it is expected to reach full self-sufficiency by the year 2010. By sector the production, marine fishery production contributed RM 4,984 million or 89% of the nation's fish production whilst the aquaculture production contributed RM 1,338 million or the remaining 11.4%.

About 60% of the locally captured fish are processed. Malaysia produces a wide range of fishery products that are doing well in the global trade. Products are usually frozen prawns/ shrimps (cooked and uncooked), fish balls, canned fish and sea food, preserved fish, fish burger, frozen tempura prawns, fish cake, prawn floss, surimi, fish fillets, fish sausages and fish fingers.

Technology Drivers – Shaping the future use of Marine & Aquaculture Biotechnology

- 1. Discovery:** Genetic and modified re-breeding, management of water quality for aquaculture, aquaculture design and system, live food culture, seed production technique and ichthio-physiology (example: Sex reversal) protocols for the regeneration of aquaculture.
- 2. Optimization:** Marker Assisted Selection (MAS) technology to be used in precise selection of superior or preferred animal in any breeding programmes. The technology would enable the reduction in the number of breeding cycle and time whilst allowing for the selection of precise traits in the animal of choice.
- 3. Implementation:** Creating aquaculture extension and hatchery centers for aquaculture and best practice (Echo Sounder, Sound Navigation and Ranging, Refrigerated Sea Water) protocol in marine fishery.



Key Opportunities

Agriculture is the third engine of growth for Malaysia, and the agricultural biotechnology industry is one with large local opportunities in future. Frost & Sullivan sees 4 major key opportunities for Agriculture Biotechnology in Malaysia; discovering its rich biodiversity, achieving self sufficiency levels, potential global halal supplier and development of safe GM foods.

Investment Highlights – The Malaysian Agriculture Biotechnology Sector

- 1. Rich Bio-Diversity:** Malaysia's world class ecological diversity harbors a broad range of plant products. This would particularly benefit companies with established screening capabilities.
- 2. Achieving Self Sufficient Level:** Malaysia's drive and its determinacy to achieve National Food Security and Self Sufficiency Level would benefit companies that have established presences in the targeted focused areas.
- 3. Global Halal Hub:** Malaysia is well-poised to enter the halal market due to the nation's reputation for high-quality, well regulated and safe agri-food products.

Discovering Its Rich Biodiversity

Malaysia is listed as the 12th most bio-diverse nation in the world and ranks fourth in Asia with over 15,000 flowering plants and over 3000 species of medicinal plants. Of the 3000 listed medicinal plants, only about 50 are used commercially and even less are being researched scientifically for their medicinal properties. Vast research development for the herbal medicine area is needed; this has led the government and research entity to focus on nurturing, identifying and sustaining the value of these traditional herbs. For instance, the government is able to nurture Cordyceps Stroma and decrease the price greatly instead of importing it entirely from China. Recent studies on the Bintangor plant from Sarawak, has exhibited its potential as a possible cure for AIDS. Further research capacities and opportunity awaits new investors or early birds.

Historically, as an agriculture-based country, there is great potential for research in herbal medicine and to produce healthcare products. New health markets emerge with bioinformatics, and food supplements and personalized medicine are growing markets.

Through research and biotechnology, the Malaysian government will continue to achieve more notable discovery. The herbal medicine sector will also provide new opportunity for agricultural biotechnology in Malaysia.

Achieving Self Sufficiency Levels

The development of the agro-food sector will help the country to reduce the Import Bill and increase its Self Sufficient Levels for these food produce. The country's food import bill is continuously increasing. Total food imports has increased from RM7.7 billion in 1995 to RM 10.0 billion in 1997 and RM 30.8 billion in 2007.

Self Sufficient Levels for Agro Produce (Malaysia), 2007-2010

Agro Produce	Self Sufficient Rate (%)	
	2007	2010
Fruits	118%	138%
Poultry	115%	122%
Eggs	108%	115%
Fishery	91%	103%
Paddy	73%	86%
Vegetable	60%	108%
Beef	24%	28%
Mutton	8%	10%
Milk	4%	5%

Source: Frost & Sullivan, 2009

The new focus on agriculture and agro-based products has placed stronger emphasis on a more commercial approach to agriculture in order to enable those involved to earn higher incomes. These projects will boost the productivity and profitability of the particular area and the country and is seen as key opportunity areas for agricultural biotechnology development.

Malaysia has initiated five high impact projects namely: The Permanent Food Production Park (TPKM), Aquaculture Industry Zone, The National Feed Corporation, Contract Farming and Developing Agripreneurs. (BNM, 2008).

The Permanent Food Production Park (TKPM) areas are gazetted and rented to entrepreneurs for commercial planting of fruits and vegetables. With a minimum of 30 hectares set aside for vegetables and a minimum of 50 hectares allocated for fruit trees planting, a total of 60 TKPMs will be developed by 2010 benefiting 834 participants. This project aims to produce 161,300 metric tonnes with a value of RM 172.5 million through value added biotechnology methods and modern plant management systems.

To achieve its targeted 28% self-sufficiency level for beef production the National Feedlot Corporation was formed. Its commercial interest is to develop an integrated and sustainable beef industry through the development of best practices in farming and animal husbandry methods.

A total of 49 areas will be gazetted as Aquaculture Industry Zones (AIZ) promoting the production of high quality fishery produce and to meet rising demands. The ZIA project aims to produce 507,000 metric tonnes of aquaculture produce with a value of RM5 billion in 2010.

Potential Global Halal Supplier

The Halal industry is rapidly expanding business now reaching 1.8 billion consumers worldwide, and the global market worth for food and non-food; halal products is estimated at US \$2.1 trillion annually. Annual sales of halal food products alone are valued at USD \$580 billion, and rising incomes and consumption in key Muslim markets are boosting further growth.



The dynamics that drive the Global Halal Food Market

- Growth in the Muslim population, the primary market for Halal food
- Rising incomes in key markets for Halal food
- Increasing demand for safe, high quality food in primary markets
- Increasing demand for greater variety in primary markets
- Incidents of food marketed as Halal but failing to meet Halal requirements has spurred demand for genuine Halal products.

The commercial potential for halal certified products is bright, with consumers seeking out safe, genuinely certified and diversified halal products. Hence, Malaysia is well-poised to enter the halal market due to the nation's reputation for high-quality, well regulated and safe agri-food products.

SIRIM Berhad, Malaysia's very own quality and standards organization for industrial research, has developed 3 specific standards for Halal Food in 2004. The Malaysian Standard, MS 1500 "General Guidelines on the Production, Preparation, Handling and Storage of Halal Food" prescribes proper halal food practices such as sources of the ingredients, slaughtering processes, product processing as well as handling and distribution, product storage and display, hygiene and also sanitation, packaging and finally the legal requirements. The standard is implemented together with 2 other related standards - MS 1480 and MS 1514 on food safety and food hygiene respectively.

The Halal standard is utilized by the appointed Halal certification body, Department of Islamic Development Malaysia (JAKIM), for their Halal Certification scheme. The standard emphasizes the sources of Halal food, which include animals (land and aquatic), plants, mushrooms, microorganisms, natural minerals, chemicals and drinks.

Development of Safe GM Foods

The maximum area that can be planted to GM crops partly depends on the total arable land under cultivation. Two other main factors that determine the area planted to GM crops are regulations and the types of crops grown in each country. GM use is highest for countries with suitable growing conditions for the main GM crops to date: soybeans, maize, cotton, and rapeseed (canola). However, for Malaysia, it's strong plantation base will continue to enjoy high priority. Malaysia currently has 18,000 sq km or 5.48% of its arable land for plantation development.

The Biosafety Act 2007 aims to ensure that the development and the exploitation of Genetically Modified Organisms (GMO) as well as the products derived from GMO do not negatively affect plant, animal, human health, agricultural systems, or the environment. Malaysia's continuous strive to develop and strengthen the agricultural system in order to regulate the biotechnology safety application for even small farmers can be admired.

Research and Development for Agricultural Biotechnology

Various developments have been done by local R&D centers to promote the development of biotechnology into agriculture application. For instance, MARDI is looking into producing hybrid rice which provides 15% to 20% higher yield than ordinary rice. MARDI is also attempting to substitute wheat flour with sweet potato flour. The local production of sweet potato flour could reduce the wheat import bill and the outflow of foreign exchange.

In May 2009, Sime Darby announced that they are the first company to completely sequence, assemble and annotate the oil palm genome with 30 times coverage and with 93.8% completeness. The breakthrough has been achieved through collaboration between Sime Darby Technology Centre (SDTC) and Synamatix Sdn Bhd, a bio-informatics company. The breakthrough would give Sime Darby the potential to double the yields in the next three decades and generate new varieties of the crop.

International collaborations between Malaysia and foreign institutions help to build a foundation for a sustainable agricultural biotechnology industry here. Some of Malaysia's local and foreign collaborative partners are shown in the table below.

Examples of Local and International Collaboration (Malaysia), 2009

Collaboration between	Field
SIRIM Berhad with Vinetech Sdn Bhd	The development of specialty vinegars such as pineapple vinegar, rambutan vinegar and Bario rice vinegar
J. Craig Venter Institute (JCVI) with Asiatic Centre for Genome Technology Sdn Bhd (ACGT)	The application of genome technology to improve oil palm and other crops
INTROP UPM with the Oak Ridge National Laboratory, the Woods Hole Ecosystems Centre and Rutgers University, USA	Assisting the Institute of Tropical Forestry and Forest Products (INTROP) Universiti Putra Malaysia (UPM) to provide adequate exposure towards the significance of trees and their function in preserving carbon facet of the forest.
Forest and Research Institute of Malaysia And Nimura Genetic Solution	To screen soil microbes for useful compound
Sarawak Biodiversity Center And Nimura Genetic Solution	Sign a research collaboration MOA on microbes
BioPerak (M) Sdn Bhd And Nimura Genetic Solution	Collaboration for research in bioresources of Belum Tropical Forest
SIRIM Berhad with Bio Essential Sdn Bhd	Product and process development for the extraction and preservation of natural produce and products using the Technology of Controlled Instantaneous Pressure-Drop vide DIC I and DIC III® patents. The DIC technology is a proprietary technology owned by ABCAR FRANCE, the parent company of Bio Essential Sdn Bhd.



Example of a Key R&D Centre

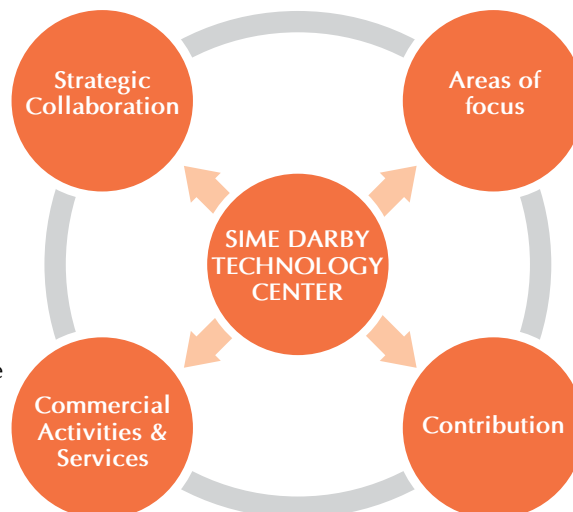
Malaysia's commercial plantation sector is well-poised to harness modern scientific techniques to increase not only its agricultural production manifold but also in the biotechnology industrial sector. A case in point is the Sime Darby Technology Centre, a part of the Sime Darby Group of Companies. The research and development center is well equipped with the latest state-of-the-art equipment and staffed by highly qualified and experienced scientific and technical personnel. A snapshot of the center is shown in diagram below.

The Sime Darby Technology Centre

- SDTC and Synamatix Sdn Bhd - to completely sequence, assemble and annotate the oil palm genome with 30 times coverage. (May 2009)

- Focused on plant biotechnology, bioprocessing, molecular diagnostics and natural products
- The R&D center for Sime Darby Group.

- Model paddy farm, developed on a 200 ha converted oil palm land in Bagan Serai, Perak was the collaboration of SDTC and R&D Quantum Leap. The farm produces eight to 10 tonnes/hectare/cycle compared to the nation's current average yield is 3.3 tonnes/ha/cycle



- Molecular diagnostics
- Protein purification
- Sequencing service
- Microbial culture collection
- Consultancy & contract research.

- Latest technologies in genomic sequencing and continuous support in breeding oil palms with improved traits.
- Genomics and proteomics, metabolic profiling and other new technology platforms are exploited to improve crop productivity.
- Identifying suitable biocontrol agents for economically important plant diseases.

Key Success Factors

Supported by a market-oriented economy and pro-business Government policies, Malaysia offers investors a dynamic and vibrant business environment. A politically stable country with a well-developed infrastructure and productive workforce, Malaysia also provides attractive incentives for investors in the biotechnology sector.

Investing in Malaysia		
Supportive Government Policies in a Dynamic Business Environment	<ul style="list-style-type: none"> • Pro-business policies • Responsive Government • Liberal investment policies • Attractive tax and other incentives • Liberal exchange control regime • Intellectual property protection 	Supported by a market-oriented economy and pro-business Government policies, Malaysia offers investors a dynamic and vibrant business environment with the ideal prerequisites for growth and profits. A politically stable country with a well-developed legal system, Malaysia also provides attractive incentives for investors.
Well developed Infrastructure	<ul style="list-style-type: none"> • Network of well-maintained highways and railways • Well-equipped seaports and airports • High quality telecommunications network and services • Fully developed industrial parks, including free industrial zones, technology parks and Multimedia Super Corridor (MSC) • Advanced MSC Malaysia Cybercities and Cybercentres 	Infrastructure in Malaysia is designed to serve the business community; it is one of the best in Asia. Telecommunications network served by digital and fibre optic technology, five international airports (all with air-cargo facilities), well-maintained highways and seven international seaports make Malaysia an ideal springboard to the Asia-Pacific market. There are also specialised parks that have been developed to cater to the needs of specific industries, as well as 5 economic corridors to stimulate economic growth.
Vibrant Business Economy, Excellent Quality of Life	<ul style="list-style-type: none"> • Market oriented economy, moving towards technological advancement • Well-developed financial and banking sector, including the Labuan International Financial Exchange • Wide use of English, especially in business Legal and accounting practice based on the British system • Large local business community with a long history in international business links • Large foreign business community in all business sectors & extensive trade links 	Malaysia is steadfast in providing for the modern day requirements of investor companies based in the country, and is one of the most technologically developed countries amongst industrialising nations in the ASEAN region. It also offers and excellent quality of life, a safe and comfortable living environment. Other advantages are excellent and affordable housing, modern amenities, good healthcare and medical facilities, and excellent international schools.
Economic Strength	<ul style="list-style-type: none"> • Natural resources - oil, gas, tin, timber, palm oil, rubber • GDP growth - 4.6% • Gross national savings - 37.9% of GNI • Debt service ratio - 2.7% • Unemployment rate - 3.7% • Inflation (CPI) - 5.4% • Export of manufactured goods 2008 - 70.0% of total exports 	Malaysia has used its natural resources to its advantage in developing high technology industries and creating jobs. Multinational corporations from more than 40 countries have invested in over 5,000 companies in Malaysia's manufacturing and related services sectors. Malaysia today is one of the world's top locations for offshore manufacturing & service-based operations. Many foreign companies have continued to show their confidence in the country's potential through expansions and diversifications in high technology projects.
Human Resources: An Educated Workforce	<ul style="list-style-type: none"> • Young, educated and productive workforce • Multilingual workforce, speaking two or three languages, including English • Comprehensive system of vocational, industrial and advanced skills training. • Harmonious industrial relations with minimal trade disputes 	One of Malaysia's greatest assets is her human resources. The workforce here is young, educated and productive, proving to be one of the best in the region. The Government's emphasis on human resource development ensures the continuous supply of manpower to meet the needs of the expanding biotechnology sector.

Sources: Malaysia Industrial Development Authority (MIDA), Economic Report 2008/2009, Malaysia: Performance of the Manufacturing and Services Sectors 2008, Malaysia External Trade Statistic 2008 – Matrade

Biodiversity

Malaysia enjoys a comparative advantage in its biodiversity and natural resources, and ranks 12th in the world in biodiversity according to the National Biodiversity Index, based on vertebrates and vascular plants. The nation has vast natural resources including the oldest rainforests in the world which are bio diverse on a mega scale. Malaysia has an estimated 15,000 flowering plant species accounting for nine per cent of the world's total. There are 185,000 animal species, accounting for 16 per cent of the world's total. A National Policy on Biological Diversity was adopted in 1998 with the vision to transform Malaysia into a world centre of excellence in conservation, research and utilisation of tropical biodiversity by the year 2020. The potential is enormous for new growth areas and market entry in natural drugs and supplement discovery.

In essence its biodiversity provides a strong starting point for potentially significant achievements in genomic discovery. What is needed is to develop proper research and development and to make arrangements for the commercialization of these resources within a sustainable biotechnology environment. (BiotechCorp, 2007) Malaysia's unique richness in tropical biodiversity and natural resources puts in strong position to encourage the growth of a thriving agrobiotechnology industry of world class stature.

Leveraging on Malaysia's potential to be a global halal supplier, Malaysian products is set to cater for the global market as well as meet local needs. Halal food is prepared following a set of Islamic dietary laws and regulations that determine what is permissible, lawful and clean. Halal regulations are almost 1400 years old. Today, Muslims continue to require food products that conform to acceptable halal standards. Permissible food categories include meat, poultry, fish, seafood, milk, eggs, fruits and vegetables. The effective standards and halal certification has received global consumer recognition, Malaysia's halal products are reaching the global market.

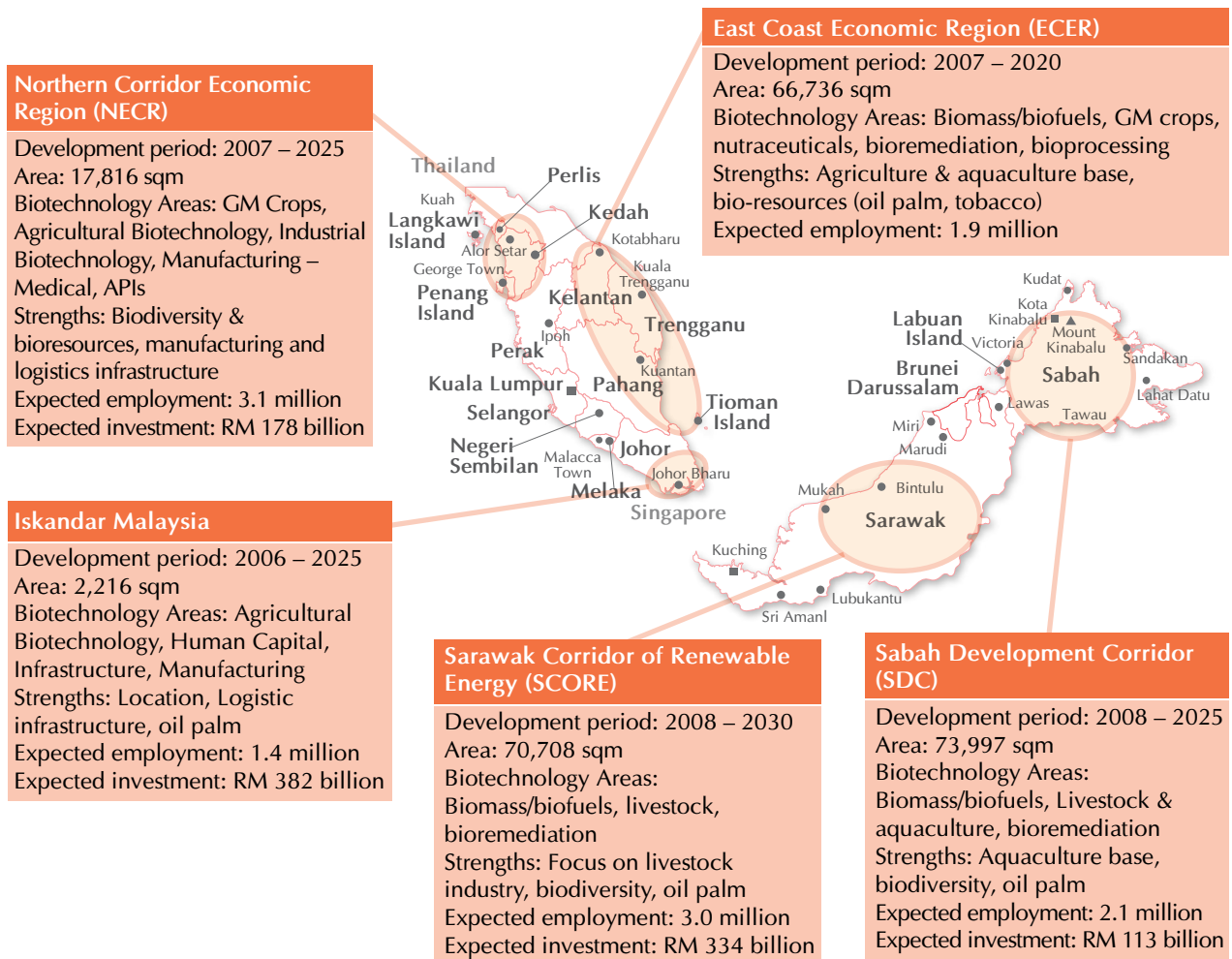
The corridors will encompass the five high impact projects (HIP) for agriculture namely: The Permanent Food Production Park (TPKM), Aquaculture Industry Zone, The National Feed Corporation, Contract Farming and Developing Agripreneurs. Investments and government incentives for these agriculture initiatives in 2008 are shown below.

Type of Development	Area (ha)	Investment Amount (RM million)		
		Cost	Gov. Funding	Balance Needed
National Feedlot Center	2024	420	80	340
Permanent Food Production Park	29338	1940.6	70	1870.6
Aquaculture Industry Zone	36905	2219	27	2192
Contract Farming	35924	175	34	141

Source: MOA & Frost & Sullivan, 2009

Designated Economic Corridors

Biotechnology is expected to drive the economic corridors in further developing the agricultural sector. Malaysia has launched 5 Regional Economic Growth Corridors; i.e.: the Northern Corridor Economic Region (NECR), East Coast Economic Region (ECER), Sarawak Corridor of Renewable Energy (SCORE) and Sabah Development Corridor (SDC) and Iskandar Malaysia. The corridors aim to encourage companies seeking a new growth opportunities in the area of agricultural biotechnology and its implementation.



Source: BiotechCorp, RMK, Frost & Sullivan (2009)

BioNexus

BioNexus Malaysia is essentially a network of centres of excellence throughout the country comprising companies and institutions that specialize in specific biotech subsectors. Three centres of excellence comprise BioNexus:

- The Centre of Excellence for Agro-biotechnology;
- The Centre of Excellence for Genomic & Molecular Biology;
- The Centre of Excellence for Pharmaceuticals & Nutraceuticals.

These three institutes are part of the BioNexus initiative whose goal is to coordinate and strengthen existing universities, laboratories, and research institutes. Through BiotechCorp, the Malaysian Government grants the “BioNexus Status” to eligible international and local biotech companies that qualify for fiscal incentives, grants and guarantees administered by BiotechCorp. (www.biotechcorp.com.my)



In order to achieve BioNexus status, the companies must be able to meet the following criteria:

- Establish a separate legal entity for the BioNexus qualifying business and activities
- Be a provider of a product or services based on life sciences, or substantially using life sciences processes in production or agriculture (mere blending, repacking, mixing, distributing or trading of biotechnology products shall not qualify)
- Possesses research capability and conducts research in thrust areas
- Employs a significant percentage of knowledge workers in its total workforce
- Complies with environmental and ethical laws and guidelines

Total investment from 42 companies with BioNexus status between 2005-2007 amounted to US\$ 246 million. The Malaysia Government had allocated USD 3 billion to enhance and strengthen the biotechnology sector. The number of BioNexus companies increased to 97 by end of 2008 with approved investment of USD 360 million, and revenue growth by BioNexus companies grew at an annual rate of 187%.

Government Incentives


Malaysia provides competitive financial incentives under existing packages that are applicable to companies in the biotechnology sector. In line with its goal to build a biotechnology sector across the entire value chain the incentives offered support biotechnology ventures at all stages of development. These include:

1. **Incentive for the holding company:** Tax deductions for holding companies that fulfils certain conditions and investment in approved subsidiary biotechnology entities;
2. **Tax exemption:** Approved biotechnology companies will be eligible for Pioneer Status, which entitles them to a 100% income tax exemption for a period of up to 10 years. Specific biotechnology product are import duty and sales tax exempt;
3. **Investment Tax Allowance:** 100% of qualifying investments over a period of 5 years can be set off against profits;
4. **Tax Exempt Dividends:** Dividends issued by biotechnology companies to shareholders will be treated as tax exempt income;
5. **200% deduction on qualifying expenditure on R&D:** which may expenses related to pre-clinical and clinical testing, except for companies carrying out these activities for revenue generation.

Human capital

Malaysia is a cost-effective location to conduct research. R&D can be done here more cheaply than in many other countries. This is a competitive advantage, but there are some issues in terms of the availability of talent. For this reason, apart from allocating funds to spur the growth of agricultural biotechnology with the nation, Malaysia is also building up her human capital capabilities and knowledge within the sector. Training and courses are more focused on the new technologies processes in line with market needs.

Malaysia's current National Education Policy emphasizes on science and technology in the country's 37 institutions of higher learning. To date, there are 13 universities offering biotechnology programs and 12 universities offering chemical engineering programs with about 3000 undergraduates studying biotechnology annually. The number is predicted to increase due to high interest among Malaysians to pursue careers in the biotech field. Approximately 23,000 research personnel and more than 5,000 R&D scientists and skilled workforce are expected to be available in the next 2 years.



The continued emphasis on creating and training a strong pool of talent for the biotechnology industry will ensure a stable supply of well trained workforce to meet staffing needs. Thus in thrust five of The National Biotech Policy focusing on building the nation's human capital in biotechnology via education and training. There is no doubt, biotechnology is built from the power of research and human intellect. The Malaysian Government therefore aims to enhance Malaysian's knowledge generation capabilities by nurturing research activities and by building a strong human capital base. At the same time, the Malaysia Government firmly believes in giving balanced attention to the entire biotechnology value chain, from R&D to commercialization to the market, and is planning for training and development to ensure that resources to support biotech ventures at all stages of development are available.

Funding

The commitment and the importance of the role of the Malaysian government in financing the biotechnology sector can be seen by the factor that the public sector remains the largest source of funding for biotechnology projects and companies in Malaysia. Currently a total of RM4.7 billion, allocated across 17 different funds, is available to be invested in biotechnology companies. As of Dec 2008 only RM1.6 billion of this amount has been allocated to existing investments. The amount of funding available strongly contrasts to the limited funding available to biotechnology companies in other parts of the world, where investments in the sector have dropped sharply in line with the deterioration in the global credit markets.

Venture capital funds are active in Malaysia, however the total capital offered by these investor is minor compared to government sources. By the end of 2008, it was estimated that RM394 million (USD 110 million) of private venture funding was available to biotechnology companies. The Malaysian capital markets represent an alternative funding source available to companies developed enough to be listed on the Bursa Saham Malaysia (BSM or Malaysian Stock Exchange). The global financial turmoil has delayed Malaysian biotechnology companies from seeking funding from this source, and in 2008 only two Initial Public Offerings (Sunzen Biotech Berhad and Asia Bioenergy Technologies Berhad) were conducted. The biotechnology segment of the Malaysia capital markets remains underdeveloped although recent regulatory changes by the securities commission will make it easier for biotechnology companies to access the market for development funding.

BSM has revised its listing guidelines to facilitate listing of not only established companies, but also those in their seed, start up and growth stage. Currently there are 1,238 companies listed on the Main Board, Second Board and MESDAQ. BSM aims to make itself a listing destination of choice for local and foreign companies offering huge potential and an attractive market for Initial Public Offerings. BSM and the BiotechCorp have been especially mandated to develop the capital market for the Malaysian biotechnology industry.

Another move by the Malaysian government has been the establishment of technology specific debt investment fund called the Malaysian Debt Ventures (MDV). Due to the risk involved, debt issues to companies without significant free cash flows (such as many biotechnology companies) are usually rare. The funding model pursued by MDV is an innovative model and the company has RM2.5 billion (USD 700 million) to invest in Biotechnology, ICT and other high-growth sectors in Malaysia. The fund is particularly suited to companies in the industrial biotechnology sector as it invests in projects and companies with short development time frames.

In 2007, MTDC has invested more than RM480.65 million in both local and foreign high-tech companies. Many of these companies have been successfully listed on Bursa Malaysia. Over the years, MTDC had established six private equity funds including Malaysian Technology Venture One Sdn. Bhd. (RM35 million), Malaysian Technology Venture Two Sdn. Bhd. (RM53 million), Malaysian Technology Venture Two (Agriculture) (RM17 million), Malaysian Technology Venture Three Sdn. Bhd. (RM75 million), Sumber Modal Satu Berhad (RM10 million) and East Malaysia Growth Corporation Sdn. Bhd. (RM12 million).

The Ministry of Agriculture and Agro based Industry provides 2 source of funding for the agriculture biotechnology sector, namely the Science Fund and the TechnoFund. The ScienceFund supports R&D projects which can generate new knowledge in strategic basic and applied sciences, and develop new products or processes necessary for further development and commercialization in agriculture. The outcome of research under ScienceFund which has commercial potential can be considered for additional funding under the TechnoFund. TechnoFund for “Dana R & D Pertanian” is a competitive funding to undertake development of new and improved technologies in four sectors namely Livestock, Crops, Food & Agro Based Industry and Marine/Aquatic.

Example of Funds/Grants for 9th Malaysia Plan, 2009

	Funds/Grants (Agriculture Biotechnology)	Allocation RMK 9 (RM million)	Cumulative Expenses (RM million)*	Balance Allocation RMK 9 (RM million)*	Allocation 2008 (RM million)
1	Science Fund	966.5	362.72	603.78	210.0
2	Techno Fund	1075.8	334.48	741.32	270.0
3	Inno Fund	200.0	11.98	188.02	30.0
4	Agro-Biotechnology R&D Initiatives	100.0	18.93	81.07	20.0
5	Genomics and Molecular Biology R&D Initiatives	100.0	35.50	64.50	20.0
6	DAGS Roll Out	100.0	5.23	94.77	18.3
7	Technology Acquisition Fund (TAF)	142.5	11.38	131.12	25.0
8	Commercialization of R&D Fund (CRDF)	115.0	25.54	89.46	20.0
9	Program Pembangunan Teknologi Berkelompok	80.0	7.00	73.00	20.0
10	Biotechnology Acquisition Programme	100.0	7.08	92.92	30.0
11	Biotechnology Commercialization Programme	100.0	2.34	97.66	26.0
12	Biotechnology Entrepreneurs Programme	50.0	5.20	44.80	11.0
13	Program Penggalakkan STI	40.5	27.48	13.02	5.3
14	Human Capital Development	500.0	141.51	358.49	74.0
15	Brain Gain	50.0	12.15	37.85	8.2

Source: Bahagian Pembangunan, MOSTI

*as of March 2008

Conclusion

Malaysia's rich biodiversity offers vast opportunities for investors venturing into the fields of genomics, proteomics, and structural biology for discovery of new products or improved existing products. Early investors and adopters would have a competitive advantage against other players, in terms of securing market entry strategy and higher penetration rate at this stage. New and existing product development with value added properties and attractive to consumer trends will take precedents in the market place.

Biotechnology is set to be a major contributor to Malaysia's economic growth. Although it is still in its development stage, the potential biotechnology brings is enormous. Malaysia is set to gain from its biotechnology development and has the potential of being a key global biotechnology player.

Publicly funded research assists in the delivery of products and technologies that have real commercial value, but the key driver will be alliances and partnerships that are needed to fund the 10-15 year development cycles that commercialization is associated with.

It is this commercial focus that will drive the success of the industry forward. With notable exceptions, international collaboration has been limited and Malaysia is now looking keenly at international commercially-focused collaborations. This will also need strategic thinking in terms of the choice of biotechnology projects that are chosen to invest in.

Malaysia has an influential voice among the developing countries as well as in the Islamic world. With its ambition to becoming a global player in the biotechnology industry, Malaysia could be a strong partner with the U.S. in the development of agricultural biotechnology and be a powerful, vocal advocate of biotechnology in the international arena. Malaysia's leadership on 'Halal' issues is also recognized in the Organization of Islam Conferences.

The BiotechCorp is committed to support areas like agro-biotech where Malaysia has a competitive advantage, and international partnering will be key to the success of the Malaysian biotech industry in the global marketplace.


Forging Ahead into a World Class Agro-biotech Industry

Malaysia has clearly put into place an agenda for a thriving biotechnology industry. It welcomes the world to participate in the growth of this industry which is in it's infancy but poised to achieve high rates of growth. All the ingredients for this have put into place to make Malaysia the choice destination of a world-class booming and well-regulated biotech industry. Some examples of the Malaysian biotechnology companies that have achieved world class status and listed in major bursa globally are Sime Darby, IOI Corporation and Ecogloves.



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Malaysian Biotechnology Corporation (BiotechCorp) is a central contact point for biotechnology and life science companies in Malaysia. BiotechCorp is the industry's one-stop-centre providing support, facilitation and advisory services.

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