



Thailand's Biodiversity

:Thailand's Competitive Advantage

Biological diversity, also called biodiversity, is fundamental for human life, as well as being vital for creating environmental balance. Mankind has benefited from biodiversity, as it provides natural services such as fresh water and clean air, biological resources such as medicinal plants and food, as well as socio-economic benefits of tourism. Increasingly, countries are recognising the importance of biodiversity as an asset that can be developed to add value to their economies. These countries are making it a priority to preserve their "natural capital" and foster sustainable development. Thailand is one such country.

Biodiversity in Thailand

Thailand is situated in "Indo-Burma" – a biodiversity hotspot that is ranked as the eighth most bio-diverse region in the world. The country itself has one of the world's highest biodiversity per unit area. Hosting several forest types and aquatic habitats, Thailand supports up to 10,000 species of plants, 980 species of birds, 300 species of mammals, 490 species of reptiles and amphibians, 2,800 species of fishes and 150,000 species of microbes – accounting for about 10% of all species of living organisms in the world. This rich natural environment enables Thailand to generate economic value from its biological resources and enhance its competitiveness in emerging fields such as green and clean technologies.

Tapping into Thailand's Biodiversity

Thailand has long benefited from its wealth of biological resources. Traditionally, Thai people have made use of these resources in many areas such as the preparation of medicine from herbs and the preservation of food through fermentation e.g. pickled fish, fermented pork, etc. Such traditional knowledge and practices can be combined with modern technologies to create many economic opportunities. For example, research into pure starter culture for fermented pork production and new enzymes for fish sauce fermentation have shortened production times and produced higher quality products. There are other instances of such developments which have created opportunities for Thai companies in various sectors. The following are some examples.

Agriculture

Thailand is a major agricultural country. Its native plant and animal species have been used to breed commercial crops and livestock that are tolerant to warm climates or resistant to diseases. Biological substances from certain herbs as well as specific microbes have also been found to be effective against agricultural pests. Thailand imports no less than 10 billion baht's worth of pest-killing chemicals each year, which represents a sizeable market. Thai companies such as Applied Chem Co., Ltd., TFI Green Bio-Tech Co., Ltd. and Agro Bio Mate Co., Ltd, have developed and are now selling more environmentally-friendly pest control products that are made from biological substances derived from plants and microbes found in Thailand.

Thailand is also a main producer and exporter of aquaculture products such as prawns. It used to import over 500 million baht of *Artemia* (brine shrimp) each year to be used as feed for prawn larvae and fishes. However, the local discovery of a new species of Thai Fairy Shrimp *Streptocephalus sirindhornae*, which can be used as a substitute for *Artemia*, led to the development and growth of Fairy Shrimp culture in Thailand. Thai Fairy Shrimp culture has become a major community business, providing farmers on average with approximately 8,000 baht of monthly income.



Food

Thailand's fermented food industry is valued at around 18 billion baht per year and is growing at 10% annually. The use of pure starter culture in the fermented food industry ensures that products have consistent quality and are safe. It also shortens the fermentation time.

Fish sauce is considered an important Thai export product – in 2010, the export value of fish sauce was approximately one billion baht. Using enzymes derived from microbes in fish sauce fermentation can reduce the fermentation time from 18 months to 11 months, thereby bringing down production costs and raising productivity. Similarly, when pure starter culture is used in fermented pork production, it helps improve product quality consistency. It also improves food safety because of the reduced chance of microbial contamination of the food ingredients.

Animal Food

Animal food manufacturers have turned to mixing microbes and enzymes into their food products for livestock such as pigs, dairy cows, chickens and aquatic animals, in order to build up the animals' immunity without using antibiotics. With this approach, animals tend to consume more food, resulting in higher meat yield per animal.

In 2007, the Association of Animal Health Products estimated that the local biological supplements market for commercial

livestock was worth about 3.5 billion baht annually. Of this, approximately 1.5 billion baht were attributed to biological supplementary products for pigs. In comparison, Thailand imported 1.1 billion baht of enzymes in 2008, which indicates a relatively underserved local market. Thai companies that are capable of developing enzymes that are comparable to commercially-available ones are starting to emerge. These promising players include Asia Star Animal Health Co., Ltd. and Micro Innovate Co., Ltd.

Traditional Medicines

Thai people have a long history of using herbs as medicines. The use of herbs is not only associated with healthcare, but it also has cultural values because it represents wisdom that has been inherited from earlier generations.

The annual market value of herbs and herbal products in Thailand is approximately 48 billion baht. This is small compared with the value of the global herbal products market, which is worth about 4.4 trillion baht. Given Thailand's rich biodiversity, the number of herb plant species here that can potentially be used in the production of health and medicinal products has been estimated to be over 13,000. Herbal products are set to be one of the fastest growing agriculture product segments in Thailand. Thailand therefore has the opportunity to become Asia's herbal product manufacturing hub and could take on an important role as the world's top ranking herbal product exporter.

Environment and Tourism

Thailand has forest and marine protected areas of approximately 88,450 km² and 6,231 km² respectively. These areas conserve significant biological resources including plants, animals and microbes. They are also home to some of the world's best known tourist attractions. For example, the island archipelago along the Andaman coast has abundant and beautiful coral reefs that attract local visitors and international tourists alike. Given that tourism is a major industry in Thailand, one which generates about 720 billion baht in 2010, these attractions are important sources of income for many communities in these areas.

Furthermore, marine and coastal resources contribute significantly to the fishery sector and coastal aquaculture. In 2008, the total production from marine fishery was approximately 1.6 million tons, while the total production from coastal aquaculture was approximately 0.8 million tons. The combined value of these two sources of production was about 97 billion baht.

Thailand's Biodiversity Strength

The National Science and Technology Development Agency (NSTDA) understands the importance of Thailand's biodiversity and has continually funded research in this field since 1996, expanding the body of knowledge in this area. These efforts have resulted in almost 800 publications in international academic journals, the development of dedicated research infrastructure and resources, and the training of over

600 research scientists, benefiting both public and private sectors. Furthermore, over 650 new species of organisms have since been discovered. This is almost equivalent to discovering one new species every week – an indication of the rich biodiversity in Thailand. These discoveries create new business and economic opportunities. For instance, a new species of Thai Fairy Shrimp that was first discovered in Thailand in 1998 has been developed commercially for sale and export overseas.

The National Center for Genetic Engineering and Biotechnology (BIOTEC) has set up dedicated infrastructure, and developed specialised capabilities and technologies that have enabled more efficient and better utilization of biological resources. For instance, the BIOTEC Culture Collection (BCC) houses the largest collection of microbes in Thailand – comprising over 40,000 cultures collected between 1996 and 2010. These are made available to researchers and industry partners conducting R&D projects. For more downstream projects, BIOTEC has set up its Fermentation Core Facilities to support production process development up to pilot scale.

Over the years, research units within BIOTEC have also developed strong capabilities across specific domains. For example, the Bioresources Technology Unit focuses on microbial research and has expertise in areas like microbial survey, microbial sampling, microbe classification and purification, as well as biological assays and fermentation. Its researchers also work with the industry to identify novel microbial enzymes suitable for industrial processes or to develop biological activity tests on novel compounds suitable for drug development. BIOTEC scientists have also developed new technologies that aid in the utilisation of Thailand's biodiversity. For instance, they have established highly effective metagenomic technology platforms to extract DNA from environmental samples collected from various types of ecosystems like hot springs, swamps and even termite guts and buffalo stomachs.

Thailand's Policy on Biodiversity

Thailand is a party to the Convention on Biological Diversity – the international convention that aims to conserve biodiversity, ensure its sustainable utilisation, as well as ensure fair and equitable sharing of benefits arising from genetic resources. Following the principles laid down in the convention, Thailand enacted two pieces of legislation, namely the Plant Varieties Protection Act, B.E. 2542 and the Protection and Promotion of Traditional Thai Medicinal Intelligence Act, B.E. 2542. Thailand, thereafter, ratified this important convention on 31 October 2003.

At the organisational level, institutes such as BIOTEC have also put relevant policies in place to ensure proper and effective management of biological resources. At BIOTEC, there are clear policies and rules that BIOTEC personnel must adhere and there are processes and tools to ensure the proper procedures are followed. For example, the two main legal documents that BIOTEC uses to control the movement of important biological resources – the Material Acquisition Agreement (MAA) and Material Transfer Agreement (MTA), have become the standard for many research institutes in Thailand.



Guiding Business Development

To ensure sustainable utilisation of Thailand's bioresources, NSTDA supports research, builds up networks and engages relevant players at all levels, starting at the local community level. It provides guidance aimed at conserving forested areas and water sources as well as promote good management practices among businesses and companies that are making use of bioresources. It has encouraged the formation of SMEs involved in the culture and development of native seeds, animals and microbes, such as Thai Fairy Shrimp farms which produce eggs and frozen Fairy Shrimp for export, and earthworm farms which produce bio-fertilizers. NSTDA has also collaborated with larger businesses in the private sector, through joint research and technology development. Such collaborative projects are diverse and range from the production of unsaturated fatty acids for food supplement manufacturing to the production of enzymes for use in animal food manufacturing.

To promote networking and exchanges with top scientists elsewhere, NSTDA actively collaborates in research with other world leading research institutes. This fosters transfer of skills and know-how among the research community. And lastly, NSTDA's consistent investment in infrastructure encourages greater cooperation between public research institutions and the private sector. One recent example is its investment in the construction of a microbial fermentation plant for the production of animal feed together with private companies, with the aim of strengthening the industry's overall capabilities.

The above measures taken as a whole will help Thailand make significant advancements in promoting biodiversity, to enhance its economic development in a sustainable manner.

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