



RURAL INFRASTRUCTURE AND  
AGRO-INDUSTRIES DIVISION

*Country case studies*

*Asia*



AGRIBUSINESS  
PUBLIC-PRIVATE  
PARTNERSHIPS

**A country  
report of  
Thailand**







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**Daleen Diane Richmond**

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# Preface

It is recognized that high levels of investment are required to unleash the potential of agriculture for sustainable development and poverty reduction in developing countries. However, in recent decades, many countries have decreased their relative budget allocations to the agricultural sector while, at the same time, the expected increase of private sector investments and the associated efficiency improvements have not been forthcoming. The high risk (actual and perceived) of doing business in agriculture often deters private sector participation in agrifood sector investments. Against this backdrop, public-private partnerships (PPPs) are being promoted as an important institutional mechanism for gaining access to additional financial resources, sharing risks and addressing other constraints in pursuit of sustainable and inclusive agricultural development.

While various forms of collaboration between the public and private sector have existed for some time, there is limited systematic information available about the current experiences and best practices for using PPPs to initiate agricultural programmes. In addition, despite a surge of interest in PPPs in the agricultural sector in recent years, there remains significant variation in the type of partnerships involved and poor documentation of the real potential for PPPs to deliver on commonly stated objectives associated with rural employment and income generation, food security and increased agricultural competitiveness.

In 2010, FAO initiated a series of appraisals of PPPs implemented in 15 countries in Africa, Asia and Latin America. The primary objective was to draw lessons to provide guidance for member countries on how to partner effectively with the private sector in order to mobilize support for agribusiness development. On this basis, a specific subset of PPPs was selected that conformed to two key criteria: (i) each PPP must involve an agribusiness enterprise; and (ii) a formalized relationship between specific public and private partners must be in place. There should also be an expectation of positive societal impacts as a result of the partnership.

Seventy individual case studies have been profiled and details provided on the circumstances that led to their formation, management and performance to date. The partnerships analysed cover different topics and intervention areas and involve different types of arrangements and actors. Particular attention was given to the identification of specific roles and functions for each of the partners, including roles in governance, implementation and monitoring. Key results of the study include identification of the factors that influence success or failure in the development and implementation of PPPs, and best practices for creating an enabling environment for increased investment in agriculture through the PPP mechanism.

FAO is publishing the series of case studies of agribusiness PPPs as a contribution towards enriching knowledge and sharing information on this type of mechanism for informed decision-making on investment promotion for engendering agrifood sector development.

## Executive summary

FAO and other key stakeholders see a need to generate practical guidelines for officers of ministries of agriculture in Thailand and other FAO member countries to partner effectively with the private sector in supporting agribusiness development. To meet this need, FAO chose to learn from the field through interaction with stakeholders in ongoing and fairly advanced PPPs in Thailand.

In-depth case studies were carried out for five recent agribusiness PPPs in Thailand in order to draw lessons on challenges and specific issues that need to be considered in the development and implementation of agribusiness PPPs in the country. Focusing primarily on support of research and development (R&D), the PPPs featured a variety of applications within agribusiness, namely:

- development of disease-resistant hybrid okra seed;
- design of fans to increase health and efficiency in poultry feeding houses;
- design of a test kit to identify disease in sugar cane;
- construction of biogas energy systems in poultry slaughterhouses; and
- implementation of hybrid corn yield trials.

The overall effectiveness of the PPP arrangements was excellent. Three of the five selected cases achieved project targets with positive results. Primarily because of unexpected economic circumstances, a timeline extension was required in the biogas case. As such, its final effectiveness will be judged after its completion at a later date. Moreover, the case involving fans came up against challenges associated with commercializing the product and meeting adoption goals among poultry farmers.

Several innovative products were commercialized as a result of the PPPs; namely, disease-resistant okra hybrids, inexpensive air control fans, test kits for sugar-cane diseases and high-performance corn hybrids. In addition to generating more domestic and export revenues for Thailand, these technological improvements and developments have benefited farmers, rural communities, and the public and private sector partners involved in the PPPs.

Results indicated that the likelihood of positive outcomes from the PPPs could be increased by public sector consideration of several issues. Based on the case studies, some key issues to be considered in developing agribusiness PPPs in Thailand are: project screening; public sector project management; risk management and distribution; regulatory framework and policy focus; flexibility; and project evaluation and monitoring.

Five main lessons were learned from the agribusiness PPPs appraised in the report. These were that:

- PPP focus on shared interests and successful partnerships require a sincere belief that the shared initiative is mutually beneficial;
- successful PPPs require clear identification of roles and responsibilities;
- timeliness increases the likelihood of success;
- PPP stakeholders should know their markets and set realistic targets; and
- PPP projects can be negatively affected by circumstances beyond the control of either party.

The five Thailand-based agribusiness PPPs studied were successful mainly because the projects were directly beneficial for the private sector and indirectly beneficial for the public sector. The more the private partner stood to benefit, the greater the likelihood that the private partner would fulfil its commitment to make the project succeed.

Agricultural supply chain development was identified as a way that benefits for enterprises and rural development could be further enhanced. As a leading producer and exporter of agricultural products, Thailand is correct to focus on supply chain development and management. Supply chain development in Thailand's agribusiness sector would not only benefit the private sector (producers, processors, exporters and others), but would also create spin-offs that stimulate development of the social, economic and environmental well-being of rural individuals and enterprises. Public support of PPPs in supply chain development would aid private sector investment by sharing risks, providing strategic input and helping to minimize bottlenecks.

Favourable policy focus and financial sustainability of PPP projects are key factors that increase the likelihood of replication. The importance of a favourable policy focus is demonstrated by the focus on R&D in Thailand's agribusiness sector. The case featuring the development of a test kit to identify disease in sugar cane is a prime example of a project that enabled replication through financial sustainability. In this case, the public sector partner retained intellectual property rights to the test kits and received revenue from test kit sales.

Based on the success of the five agribusiness PPPs studied, there appears to be good potential for PPPs as a mechanism for accelerating agribusiness investment and development. PPPs that invest in new, high-technology infrastructure may have the best potential to accelerate agribusiness investment and development.

# Introduction

FAO and other key stakeholders see a need to generate practical guidelines for officers of ministries of agriculture in Thailand and other FAO member countries to partner effectively with the private sector in supporting agribusiness development. To meet this need, FAO chose to learn from the field through interaction with stakeholders in ongoing and fairly advanced PPPs. An in-depth study of the current climate for agribusiness PPPs in Thailand was carried out in order to fulfil the following.

- Appraise the national development context, trends and policies influencing the relevance of and need for agribusiness PPPs in Thailand.
- Characterize and appraise five specific agribusiness PPPs.
- Draw lessons on challenges and specific issues that need to be considered in the development and implementation of agribusiness PPPs.
- Prepare a country report on agribusiness PPPs.

In accordance with FAO selection guidelines, the study focuses on PPPs that involve collaborative relationships between public and private sector partners for the purpose of increasing investment, improving profitability, or reducing risk for the private sector agribusiness partner. In each case, the public sector partner also aimed to create positive societal impacts such as increased farmer incomes. Each partnership has been in operation for at least two years. Projects with a total investment of more than USD100 000 were preferred, but it was not possible for all cases to meet this criterion because of the limited number of qualifying agribusiness PPPs in Thailand.

## RATIONALE FOR COUNTRY SELECTION

Rapid growth over the last two decades has transformed Thailand into a middle-income nation with one of the most developed agribusiness industries in Asia. It is one of just five net exporters of food worldwide, and is the world's top exporter of rice, rubber, canned and frozen seafood, canned tuna, canned pineapples and cassava/tapioca. It is also the world's second largest exporter of sugar. Total agricultural exports in 2010 were approximately USD17.1 billion at current market prices. While these successes are certainly impressive, they have also created new challenges for Thailand's agribusiness sector.

Increased incomes and living standards for Thai farmers have also increased the costs of producing food and agriculture products. Growing competition from neighbouring countries – Viet Nam, Cambodia, the Lao People's Democratic Republic and Myanmar – has made it difficult for Thailand to offer low prices on the global marketplace. Its agribusiness sector has been forced to shift towards science, technology, and higher-value food and agriculture products in order to stay competitive. According to the Asian Development Bank (ADB), agriculture accounted for 12.4 percent of Thailand's total economic output in 2010. Lest such a vital part of the Thai economy slip into decline, the government has stepped in to help the agriculture sector advance on a foundation of science and technology rather than on cheap labour and expanded land development.

Several recent agribusiness PPPs have served as a means for the government to help private sector firms with science and technology development. The PPPs have supported the agribusiness sector both by sharing in large financial outlays and by managing or providing expertise for R&D projects.

## STRUCTURE OF THE REPORT

The study is divided into four parts. The first part provides background information on the current climate for agribusiness PPPs in Thailand, including the country's development context and a sectoral overview of recent trends. The second provides detailed information on the five agribusiness PPPs appraised in the study. This includes a short summary, a characterization of the PPP arrangements, a description of the various processes by which the PPPs developed, details on the managerial and operational responsibilities of each party, and performance and development outcomes. The third part contains a final appraisal of conclusions that could guide Thailand and other FAO member countries as to how to partner effectively with the private sector in order to support agribusiness development. The last part contains a bibliography and details of key contacts in Thailand.

# Acknowledgements

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# Acronyms

ADB	Asian Development Bank
BIOTEC	National Center for Genetic Engineering and Biotechnology
BOI	Board of Investment
EPPO	Energy Policy and Planning Office
ERDI	Energy Research and Development Institute, Nakornping, Chiang Mai University
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
GNI	Gross national income
IC	Immuno-chromatographic
ISTRS	Institute for Scientific and Technological Research and Services
iTAP	Industrial Technology Assistance Program
MAb	Monoclonal antibody
MOAC	Ministry of Agriculture and Cooperatives
MOST	Ministry of Science and Technology
MOU	Memorandum of understanding
NCSRC	National Corn and Sorghum Research Center
NESDB	National Economic and Social Development Board
NESDP	National Economic and Social Development Plan
NSTDA	National Science and Technology Development Agency
PPPs	Public-private partnerships
R&D	Research and development
SMEs	Small and medium enterprises
STI	National Science Technology and Innovation Policy Office
THB	Thai baht
USD	United States dollar
YVV	Yellow vein virus

## Chapter 1

# Background and overview

### 1.1 COUNTRY DEVELOPMENT CONTEXT

With a population of 67 million, Thailand is a middle-income country with a gross national income (GNI) per capita of USD3 760, according to data from ADB. The Thai Government's approach to supporting economic growth has been based on increasing the country's competitiveness on the global marketplace. It emphasizes investment in infrastructure, strengthening the domestic capital market and improving the environment for private sector investment.

Thailand's well-developed infrastructure, free-market foundations, generally pro-investment policies and solid export sector helped the country to achieve average annual real gross domestic product (GDP) growth of 4.8 percent from 2000 to 2008 after recovering from the Asian financial crisis. Exports — mostly of machinery and electronic components, agriculture commodities and jewellery — drive the economy, accounting for more than half of GDP. Thailand's exports were severely cut during the financial crisis of 2008 to 2009. Most sectors experienced double-digit

drops. As a result, the economy contracted by 2.3 percent in 2009. However, a rebound in exports fuelled growth of 7.8 percent in 2010, the highest annual rate since 1995 (see Figures 1 and 2).

According to ADB, Thailand's largest industries in 2010 were manufacturing, trade and agriculture, which accounted for 35.6 percent, 13.1 percent and 12.4 percent of GDP, respectively. Grouping total 2010 GDP into the umbrella categories of industry, services and agriculture, these accounted for 44.7, 42.9 and 12.4 percent, respectively. For more details, see Table 1.

In 2010, the top destinations for Thai exports were China, Japan and the United States of America, with USD21.5 billion, USD20.4 billion and USD20.2 billion, respectively. The top importers to Thailand in 2010 were Japan, China and the United States of America, with USD38.3 billion, USD24.5 billion and USD10.9 billion, respectively. Malaysian imports were close behind at USD10.8 billion. Other key trading partners in 2010 included Hong Kong, Singapore and the United Arab Emirates (see Figure 2).

FIGURE 1  
Annual real GDP growth over time

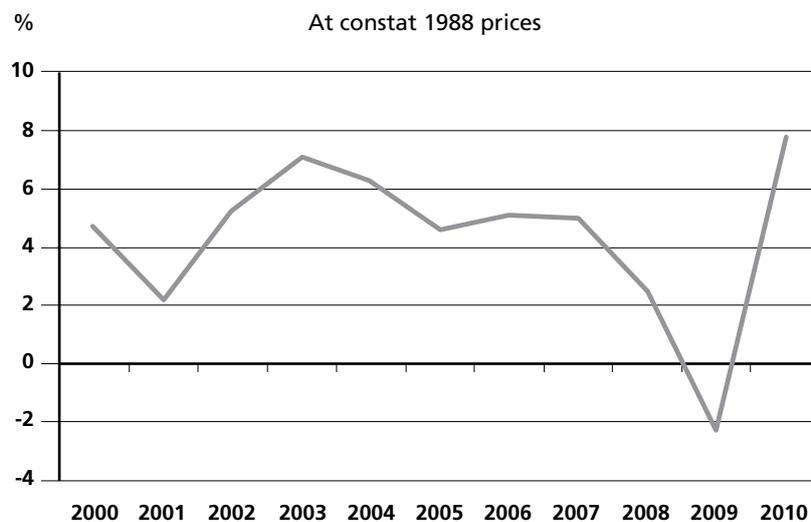


TABLE 1  
GDP by industrial origin (in billions of USD\* at current market prices)

	2006	2007	2008	2009	2010
Agriculture	28.2	30.3	35.0	34.6	41.8
Mining	8.6	9.3	10.5	10.2	11.5
Manufacturing	91.6	101.3	105.5	102.9	120.0
Electricity, gas and water	8.0	8.3	8.7	9.3	9.9
Construction	7.8	8.3	8.6	8.2	9.0
Trade	37.2	40.2	42.9	42.4	44.1
Transport and communication	19.0	20.9	21.5	21.6	22.9
Finance	16.5	17.5	19.0	19.5	21.3
Public administration	11.7	12.5	13.3	13.9	14.7
Others	33.0	35.7	37.5	38.9	41.5
<b>GDP</b>	<b>261.5</b>	<b>284.2</b>	<b>302.6</b>	<b>301.4</b>	<b>336.8</b>

\* Assumes constant THB:USD exchange rate of 30:1

Source: Asian Development Bank, 2011.

Tourism is one of the most important industries in Thailand. Although the tourism sector was negatively affected by anti-government protests in May 2010, it made a quick recovery and finished the year with almost 16 million international arrivals, exceeding earlier expectations. Total tourism revenues in 2010 were approximately USD18 billion (Oxford Business Group, 2011). The resiliency

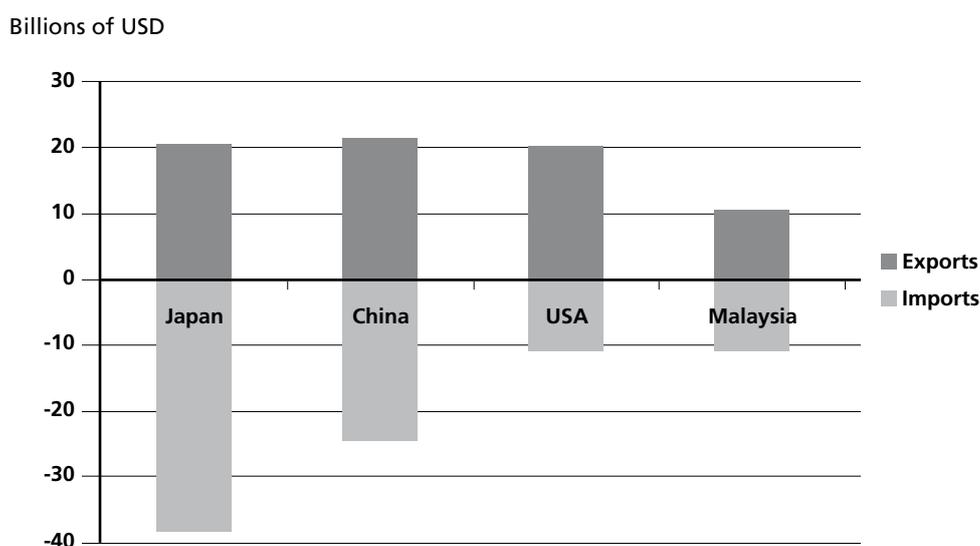
of Thailand's tourism sector in 2010 reassured both market participants and investors.

## 1.2 SECTORAL OVERVIEW AND TRENDS

### 1.2.1 Overview

The agricultural sector in Thailand, one of the world's leading food producers and exporters, has a major role to play in economic development.

FIGURE 2  
Trade with key partners in 2010



Source: Asian Development Bank, 2011.

However, it faces challenges from increasingly competitive neighbouring markets.

According to figures from ADB, the agriculture sector accounted for 12.4 percent of Thailand's total output in 2010, up from 11.6 percent and 11.5 percent in 2008 and 2009, respectively. At current market prices, output from the agriculture sector was approximately USD41.8 billion, an increase of 21 percent from the 2009 level of USD34.6 billion.

Rice is the country's most important agricultural crop, with a total production value of more than USD11.5 billion in 2010, according to figures from the Bank of Thailand. Rubber was second in terms of production value, accounting for USD10.4 billion. Sugar cane accounted for USD2.2 billion, while production of cassava, palm kernel and corn was valued at USD1.5 billion, USD1.2 billion and USD1.2 billion, respectively (see Figure 3). In most cases, total production of these crops was down slightly in 2010 compared with 2009, but prices were up significantly.

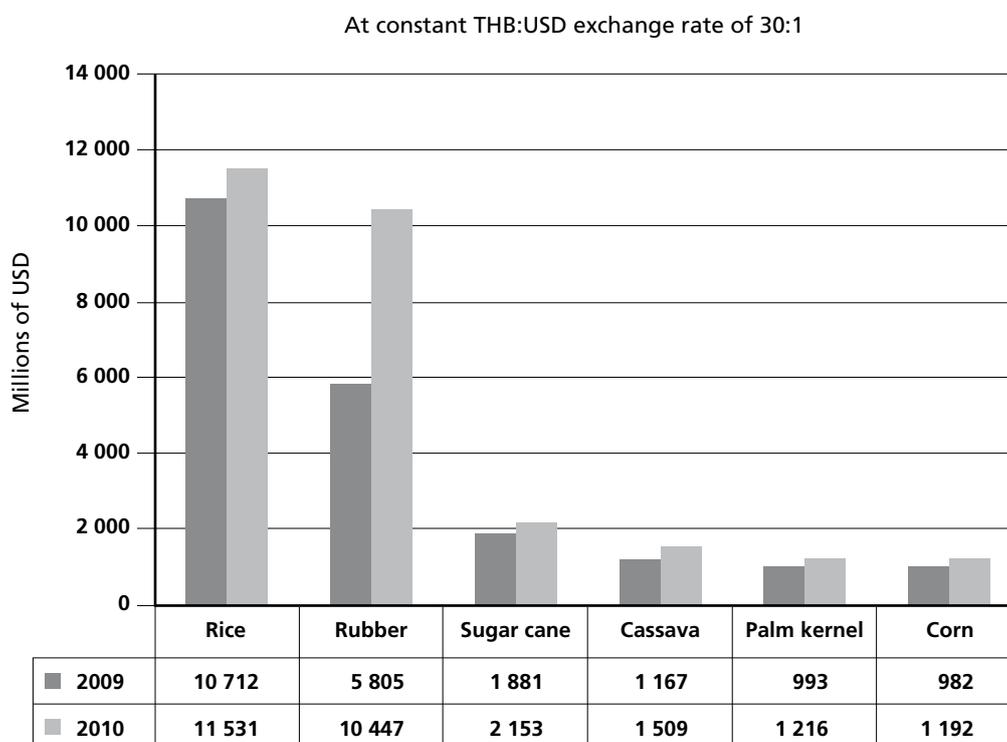
A large portion of Thailand's agriculture and food output is exported, with total exports in 2010 of approximately USD27.5 billion (THB:USD

exchange rate of 30:1), according to the Office of Agricultural Economics. Thailand is one of only five net food exporters in the world, and is the world's number one exporter of rice, rubber, canned and frozen seafood, canned tuna, canned pineapples and cassava/tapioca. Additionally, it is the second largest exporter of sugar.

### 1.2.2 Shifting sectoral strategy

Speedy growth over the last two decades has turned the Thai agribusiness sector into one of the most developed in Asia, but new challenges have emerged for Thai agribusiness as a result of its recent development. Increased production costs along with growing competition from neighbouring countries, especially Viet Nam, Cambodia, the Lao People's Republic and Myanmar, have made it difficult for Thailand to offer low prices in the global marketplace. As a result, the sector has expanded its efforts away from simply pursuing more production to promoting mechanization, R&D and higher-value food and agriculture products in order to move up the value chain and stay competitive. Substantial growth in agricultural

FIGURE 3  
Value of crop production



mechanization has occurred over the past decade as tractors and harvesters have replaced human and animal power.

R&D is currently being undertaken to address the problems of low yields and disease risk often encountered by small Thai producers. The Oxford Business Group (2011) outlines a long list of recent agribusiness R&D efforts in its 2011 annual Thailand research report.

*National research centres focus R&D efforts on seeds, rice, cassava, algae, post-harvest processing, greenhouse farms, longer shelf-life packaging and quality assurance. Higher-quality corn, cucumber, chilli and tomato seeds have been developed and are set to be exported under a Thai brand name. New types of virus-resistant prawn feed and tiger prawn broodstock have also been created. Functional food research has also been progressing, with discoveries in nutraceutical foods, probiotics, herbal medicine and pharmacogenomics.*

Other recent agricultural R&D efforts include the development of less expensive and more energy-efficient infrastructure for poultry farmers, and the development of test kits to identify harmful plant diseases. A successful project to map and patent the genetic code for *Hom Mali* (jasmine) rice has also been completed. With this basis, new rice varieties have been developed that are more resistant to drought, salinity and pests.

Foreign investment in R&D has been hindered by legislative and regulatory delays. More effective legislation and regulations are required for foreign investors to benefit from incentives offered by the Board of Investment (BOI) for R&D.

### **1.3 POLICY STATEMENTS, STRATEGIC DOCUMENTS AND COMMITMENTS RELATED TO AGRIBUSINESS DEVELOPMENT AND ENGAGEMENT WITH THE PRIVATE SECTOR**

#### **1.3.1 National Economic and Social Development Plan**

The current system of agriculture policy in Thailand is rooted in the first National Economic and Social Development Plan (NESDP), which ran from 1961 to 1966. The 10th NESDP, which set a range of targets for the agriculture sector, covered the period from 2007 to 2011. A draft 11th NESDP encompassing developmental plans and goals for 2012 to 2016 has also been produced. Each NESDP

is generated by the National Economic and Social Development Board (NESDB).

The latest draft of the 11th NESDP addresses the agriculture sector on several levels. For example, it aims to make agriculture the “main source of income and food security” for the country, as one of six dimensions of resilience to be created in the economy. Another dimension of resilience listed in the draft plan is “development based on knowledge and technological advancement”, which has clear ramifications for agriculture in the near term. Furthermore, one of seven key targets in the draft plan is to increase the relative shares of the agriculture and services sectors in overall economic output.

The draft NESDP also outlines six developmental strategies for 2012 to 2016.

- Promoting a just society.
- Developing human resources to promote lifelong learning.
- Balancing food and energy security.
- Creating a knowledge-based economy.
- Strengthening economic and security cooperation in the Southeast Asian Region.
- Managing natural resources and the environment towards sustainability.

Under each of the developmental strategies are several key measures to guide the course of action. There is one reference to PPPs among these measures. Specifically, certain measures presented for balancing food and energy security are to:

- enhance agricultural productivity and value chains;
- promote job and income security for farmers; and
- improve agricultural management to ensure balance between food and energy production.

To create a more knowledge-based economy, some measures are to:

- develop agro-industry by increasing the productivity and value of agricultural products for long-term competitiveness;
- develop science and technology, research, and innovation as driving forces to help the Thai economy grow sustainably; and
- develop infrastructure and logistics systems by seeking private sector participation based on PPPs.

#### **1.3.2 Government agencies supporting agricultural development**

Government agencies support R&D in the Thai agribusiness sector through the provision of fund-

ing, expertise and other services. Two of the most important agencies providing these services are the National Science and Technology Development Agency (NSTDA) and the National Centre for Genetic Engineering and Biotechnology (BIOTEC).

NSTDA is an agency set up under the Ministry of Science and Technology (MOST) to promote technology investment through PPPs for all sectors, including several in the agriculture sector. The agency executes policies set by the National Science Technology and Innovation Policy Office (STI). NSTDA has four missions – R&D, technology transfer, human resources development, and science and technology infrastructure development. It also supports research in universities. Growing rapidly, the agency applied for 178 patents in 2010 and generated over USD30 million in co-investment from the private sector, according to industry sources. NSTDA's annual budget in 2010 was approximately USD156 million.

BIOTEC is one of four technology centres under the auspices of NSTDA. It is a leading research institute in Thailand and the Association of Southeast Asian Nations (ASEAN) region, with over 30 laboratories and 150 principal scientists conducting basic and applied research covering a wide spectrum, from agricultural science to biomedical and environmental science. BIOTEC's income comes from government funding, revenues from providing services, and non-government entities, such as international funding agencies and private foundations. In addition to funding and conducting research for the agriculture sector and other related sectors, BIOTEC places strong emphasis on promoting the industrial applications of biotechnology by both local and global companies.

### 1.3.3 MOAC's agricultural development policy

The policy framework of the Ministry of Agriculture and Cooperatives (MOAC) falls under the Public Administration Plan, Directive Principles of Fundamental State Policies under the Constitution of the Kingdom of Thailand, B.E. 2550 (2007), and the framework established by the Minister of Agriculture and Cooperatives. MOAC's current written policy includes, among other items, three overall strategies to "restructure the economy of the agricultural sector". These strategies are: developing farmers and agricultural institutes; developing production; and developing fundamental factors and missions.

MOAC's first strategy for restructuring the agriculture sector includes language related to promoting and strengthening farmers and agricultural

institutes by enhancing efficiency, and assisting with production and marketing of agriculture products. The second strategy deals with creating production efficiencies for key cash crops and increasing agricultural profits. The MOAC policy framework for developing production also mentions the importance of promoting value-added processed foods and creating a reliable food safety inspection system. The third strategy deals primarily with managing water resources by developing irrigation technology.

According to MOAC, steps have been taken to ensure the success of its policies, such as thorough reviews of operating results and the current agricultural economic situation.

## 1.4 SCOPE AND NATURE OF PUBLIC-PRIVATE COOPERATION IN THE AGRICULTURAL SECTOR

Because of a necessary shift in policy focus and strategy, most recent PPPs in Thailand's agribusiness sector have been centred on R&D. These partnerships often involve government agencies aiming to carry out policy mandates, such as increasing agricultural efficiency and fostering a knowledge-based economy, by helping to mitigate private firms' risks related to R&D. Public sector partners help reduce risks faced by private sector firms through various means, including financial contributions of up to 100 percent in certain cases, provision of scientific research services and provision of managerial expertise. The human resources and knowledge capital of public universities are often leveraged by the public sector in research-based PPPs. As a result of the focus on relatively advanced projects, large enterprises have benefited more than smaller firms from recent public support in the agribusiness sector.

## 1.5 BRIEF OVERVIEW OF THE COUNTRY CASES

This report comprises five case studies of PPPs in Thailand's agribusiness sector. Each of the five cases is based, in one form or another, on public support for private sector R&D efforts in agribusiness. Three of the cases, referred to as yield trials, Uni-seeds and Mitr Phol, feature companies operating in the crops subsector, with corn, okra and sugar cane represented, respectively. The other two cases, biogas and B.Inter, feature companies operating in the poultry subsector. NSTDA was the public partner for the B.Inter case, which involved poultry production infrastructure. BIOTEC, as an agency under NSTDA, was the public partner for the

Uniseeds and Mitr Phol cases, which involved crop biotechnology in okra and sugar cane, respectively. Research institutes administered by two public universities, Chiang Mai University and Kasetsart University, served as partners in the biogas and yield trials cases, which dealt with poultry slaughterhouse infrastructure and hybrid corn seed testing, respectively. Experts from King Mongkut's University of Technology also assisted NSTDA in the B.Inter case. Table 2 gives an overview of the five country cases. Generally, each case is referred to in the report by the name of the private sector partner involved.

Levels of investment range from USD10 000 (plus professional time) for the yield trials case to USD114 000 for the Uniseeds case. In the yield trials case, the public sector partner, the National Corn and Sorghum Research Center (NCSRC)/Kasetsart, provided only technical and managerial services, which were free of charge. In the other four cases, the public sector partner provided support to the private sector partner through a combination of financial contributions and technical services.

In the Uniseeds project, BIOTEC was approached by Uniseeds, a producer and marketer of frozen okra, for help in developing an improved

okra hybrid with resistance to the damaging yellow vein virus (YVV). The R&D cooperation between Uniseeds and BIOTEC lasted from 2004 to 2007. Six resistant varieties were developed, two of which have been commercialized. The availability of okra varieties that are less susceptible to YVV outbreaks has helped Uniseeds to secure a more dependable okra supply in addition to increasing incomes and decreasing risks for Thai okra farmers.

The B.Inter project began in 2005 when NSTDA offered services and funding subsidies to small and medium enterprises (SMEs) in the poultry industry, aiming to aid the adoption of technologies to improve productivity and save energy. B. International & Technology Co. Ltd (B.Inter) asked NSTDA for financial and technical assistance to design and install air control fans in its poultry feeding houses. The project was completed in 2009. The fans, which are manufactured in Thailand, have now been commercialized. As a result of the B.Inter project, agribusiness investment and poultry farmers' incomes have increased thanks to domestic availability of more affordable air control fans. Investment in air-controlled feeding houses has also resulted in higher poultry growth rates and lower disease risks compared with open-air systems.

TABLE 2  
Overview of country cases

Case	Short name	Private partner	Public partner	Nature of public support	Nature of private support
Creating a disease-resistant okra seed variety	Uniseeds	Uniseeds Co. Ltd	BIOTEC	Funding of 15 percent, laboratory services	Funding of 85 percent, staff time for yield trials
Design and installation of air control fans in poultry feeding houses	B.Inter	B. International & Technology Co. Ltd, a subsidiary of the Betagro Group	NSTDA	Reimbursement of 100 percent of expert fees and 50 percent of R&D costs, technical expertise	50 percent of R&D costs, commercialization, participation
Biotechnology for the detection of white leaf disease in sugar cane	Mitr Phol	Mitr Phol Sugarcane Research Center, a subsidiary of the Mitr Phol Sugar Group	BIOTEC	Full funding for research, loan for 20 percent of project costs, laboratory services	100 percent of project costs in second phase
Promoting biogas technology in integrated slaughterhouses	Biogas	Five integrated poultry slaughterhouses	ERDI, Chiang Mai University	Funding of 30 percent, technical expertise	Funding of 70 percent, operational management and participation
Multilocation hybrid corn yield trials	Yield trials	Multiple hybrid corn seed breeders (eight in 2010)	NCSRC, Kasetsart University	Trial coordination and management, technical evaluations	Staff time, materials, operational management and participation, fees

Source: author's compilation, 2011.

The Mitr Phol project, a cooperative venture between the Mitr Phol Sugarcane Research Center, BIOTEC and an anonymous third-party contractor from 2005 to 2008, involved the creation and commercialization of a simple test kit to identify white leaf disease in sugar-cane crops. With technical and financial support from BIOTEC, the collaboration developed an antibody able to detect white leaf disease and a test kit utilizing the antibody. With this new technology, Mitr Phol and other sugar-cane farmers are now able to screen cane stalks free of white leaf disease before planting, which not only reduces losses, but also minimizes the spread of disease to healthy plants. As a result, the risks of investing in sugar-cane farming have been reduced, enabling the sugar-cane industry to expand production. Mitr Phol owns the test kit technology and BIOTEC receives a royalty fee from test kit sales.

The Biogas project was initiated by the Energy Research and Development Institute (ERDI) of Chiang Mai University to promote biogas technology in poultry slaughterhouses. The project, which began in 2008 and is scheduled to end in 2013, aims to utilize wastewater for the production of biogas energy at five large poultry slaugh-

terhouses throughout Thailand. To date, poultry operators Betagro Land Co. Ltd, GFPT Nichirei (Thailand) Co. Ltd, F&F and Bangkok Produce Co. Ltd have committed to the project as private sector partners. A fifth partner will join later. By helping slaughterhouses install systems to utilize wastewater for energy production, the project will increase agribusiness investment in addition to reducing greenhouse emissions and improving community health.

The hybrid corn yield trials project is an annual project that has been carried out by NCSRC, Kasetsart University, every year for the past 24 years. Each year, private sector breeders from throughout Thailand and the world are invited to participate in multilocation corn yield trials. The trials allow breeders to test new hybrids in multiple geographic locations at low cost as a result of collaborative management and technical support. Thanks to this PPP and management and resource contributions by NCSRC and private sector plant breeders, investments in Thailand's corn seed sector have increased, better hybrids are being developed, and farmers in Thailand and across Asia have access to hybrids that are better adapted to their geographic areas.



## Chapter 2

# Characterization of PPPs

### 2.1 CASE 1. CREATING A DISEASE-RESISTANT OKRA SEED VARIETY

Thailand started exporting fresh, frozen and processed okra in 1987/88. At that time, okra seeds were imported from Japan, which was also the major importer of fresh okra from Thailand. However, contracting Thai okra for export abroad was especially difficult based on three key factors: quality, yield and disease risk. The varieties of okra traditionally grown in Thailand did not meet the quality standards such as colour, shape, size and aroma required for major export markets such as Japan. Although the Japanese varieties produced high-quality pods, importing the seed was expensive and yields were low. These varieties were also highly susceptible to YVV.

A serious outbreak of YVV occurred in Thailand in 1992, which completely destroyed crops in the outbreak area. After this, the Thai industry switched to okra seeds imported from India. Indian okra seeds had better resistance to YVV, but the pod quality of these varieties was not suitable for Japanese consumers. A second YVV outbreak occurred in Thailand in 2000, resulting in a 30–40 percent reduction in production, which meant that the okra had to be sold on the local market at a very low price because of its poorer quality.

Uniseeds Co. Ltd, an exporter of frozen okra, began breeding okra seed in Thailand in 1997, in response to the first YVV outbreak and the Japanese aversion to Indian okra. After years of breeding, Uniseeds had developed high yielding hybrids for Thai growing conditions that achieved the strict quality standards for export to Japan. However, these new hybrids were still highly susceptible to YVV outbreaks compared with the Indian varieties.

In 2004, Uniseeds approached BIOTEC for help in developing an improved okra hybrid with resistance to YVV. It was critical for the new variety to have the high pod quality standards required for export, especially to Japan. BIOTEC entered into an R&D cooperative with Uniseeds that lasted continuously until April 2007. With BIOTEC's financial and technical support, six different YVV-resistant hybrids were developed.

These hybrids had yields as high as 2 500 kg per rai (15 625 kg per ha), compared with a national average yield of about 1 600 kg per rai (10 000 kg per ha) at that time. Two of the six hybrids were suitable for commercialization.

#### 2.1.1 Characterization of PPP arrangements

The purpose of the project was to develop a variety of okra seed that was:

- suitable for the Japanese export market;
- optimized for growth in Thailand; and
- resistant to YVV outbreaks.

To begin the partnership, Uniseeds and BIOTEC each submitted proposals to their respective management teams for project approval and funding. After approval, a formal contract was signed by both parties. The contract outlined terms for relevant issues, such as responsibilities, financial contributions, potential outcomes, management, project period and intellectual property rights.

Uniseeds and BIOTEC both made technical and financial contributions to the three-year partnership, although most of the financial commitment was shouldered by Uniseeds. Under the agreement, Uniseeds carried out its own R&D on okra hybridization and sent hybrid samples to BIOTEC researchers for laboratory examination. The researchers used okra hybrids from Uniseeds to develop a biotechnology-based examination method for YVV. The best method was selected based on efficiency and simplicity of application. BIOTEC then used the method to identify the best hybrids with YVV resistance. The total R&D budget for the project was THB3 426 360 (USD114 212). BIOTEC contributed THB500 000 (USD16 667), with the remaining THB2 926 360 (USD97 545) contributed by Uniseeds.

Uniseeds and okra farmers were the most obvious direct beneficiaries of the partnership arrangements. As an exporter of more than THB140 million (USD4.7 million) per year in frozen okra, the most important need for Uniseeds was to obtain a suitable and dependable supply stream. The introduction of high-quality, high yielding, disease-resistant seed varieties developed through

the partnership gave Uniseeds added assurance that suitable supply would be available to fulfil large export contracts and maintain customer relationships, even during YVV outbreaks. Additionally, Uniseeds was able to introduce branded hybrid seed to generate additional income.

Naturally, the same key factors that benefited Uniseeds – high quality, high yield and disease resistance – also benefited okra farmers. While corporate income for Uniseeds was increased through superior supply and the ability to enter into lucrative contracts, farmers' incomes were increased through higher yield and fewer losses to YVV outbreaks. The new seeds featured an average yield of approximately 2 500 kg per rai (15 625 kg per ha), 56 percent more than the 1 600 kg per rai (10 000 kg per ha) average for standard varieties at the time. With YVV resistance, the new seeds reduced the risk of farming okra with no added time or labour. As a result, farmers were more likely to choose to grow okra.

Although BIOTEC did not have a revenue share from seed sales (in contrast to some other PPPs), it received other important benefits. The success of the project meant that, in this instance, BIOTEC achieved its mission to support private sector innovation. In 2010, the Thai Government allocated only about 0.5 percent of GDP to support, which was low compared with its peers. In light of Thailand's limited R&D spending, BIOTEC's repeated success in its mission would increase the likelihood that future government budget appropriations would be set aside for the agency, allowing it to continue supporting Thailand's technological development in agribusiness and other sectors. Furthermore, researchers at BIOTEC saw the project as a good opportunity to gain experience with okra and thus increase the agency's overall level of expertise.

### 2.1.2 Development of PPP arrangements

According to data from the Thailand Customs Department, as a result of a severe YVV outbreak, the country's okra exports were reduced by 22 percent in 2000 compared with 1999. Another outbreak in 1992 was even more damaging. As an exporter of more than THB140 million (USD4.7 million) per year in frozen okra, Uniseeds was severely impacted. The company was aware that, if the partnership with BIOTEC were to succeed, future supply shortages such as those suffered during the outbreaks should be minimized or eliminated. This would help Uniseeds normalize revenue, enter into larger export contracts and

reduce the risk of defaulting on an obligation, even during YVV outbreaks. Additionally, Uniseeds was able to introduce branded hybrid seed to generate additional income.

Uniseeds chose to approach BIOTEC for help with the project because BIOTEC was well known in Thailand for its R&D expertise in biotechnology. Furthermore, through word-of-mouth communication among the relatively small biotechnology community in Thailand, private sector firms such as Uniseeds were aware of BIOTEC's policy mandate to assist private enterprises with R&D efforts in biotechnology, both technically and financially.

According to stakeholders, BIOTEC identified the Uniseeds project as a good partnership opportunity for four main reasons.

- Okra is an important export vegetable for Thailand.
- Potential exists to reduce expensive seed imports.
- Potential exists to reduce farming losses and increase farmers' incomes.
- Uniseeds, the private sector partner, was already involved in the whole okra export supply chain.

According to data from the Thailand Customs Department, the value of Thailand's okra exports was about THB511 million (USD17 million) when the partnership with Uniseeds was first arranged in 2004. A successful partnership with Uniseeds would positively impact the whole okra supply chain, including farmers, vegetable exporters and the national economy.

BIOTEC also saw clear potential for the industry to reduce reliance on expensive seed imports and increase farmers' incomes. Seeding rates for okra in Thailand were approximately 1 kg per rai (6.25 kg per ha). The first strains of imported Japanese okra seed were priced as high as THB3 000–5 000 (USD100–167) per kg, compared with just THB 50–80 (USD1.67–2.67) per kg for local seeds. Reducing reliance on imported seeds had the potential to increase farmers' incomes.

Moreover, farmers' incomes would be increased through higher yields and reduced losses to YVV outbreaks. In 1999, the total cost of okra production in Thailand was approximately THB25 285 per rai (USD5 268 per ha), according to the Department of Agriculture. In the same year, the average yield for local okra was about 1 000 kg per rai (6 250 kg per ha). The outbreaks of 1992 and 2000 had resulted in losses at or near 100 percent in

affected areas because affected okra pods were not of an adequate quality for export. Any production affected by the virus was sold on the domestic market at a significantly lower price (approximately THB3–4 [USD0.10–0.13] per kg compared with THB10–20 [USD0.33–0.67] per kg for exports). The new hybrids were also expected to be better adapted to Thailand's environment and yields were expected to increase as a result. Based on these and other factors, it was clear to BIOTEC, as it was to Uniseeds, that market potential existed for a local seed variety that would reduce reliance on expensive imported varieties, resist YVV outbreaks, grow well in Thailand and produce pods suitable for export markets such as Japan.

BIOTEC was further reassured by the fact that Uniseeds already had experience in hybridization, okra seed commercialization, farming and okra exports. Since the company was already in the market, it was well positioned to identify and capitalize on the market opportunity. As such, potential for commercialization would be high if the project were to succeed, increasing the likelihood that all potential stakeholders would benefit. Unlike some other PPP arrangements, BIOTEC did not put any conditions on its support for Uniseeds in this case.

As negotiations progressed leading up to the agreement, Uniseeds and BIOTEC each submitted proposals to their respective management teams for project approval and funding. In all, the deal was negotiated through meetings, e-mails and conference calls over the course of a few months. After approval, a formal contract was signed by both parties. The contract outlined terms for relevant issues such as responsibilities, financial contributions, potential outcomes, management, project period and intellectual property rights.

The role of each partner was determined based on its expertise. For example, since Uniseeds already had experience with R&D on okra hybrids, one of its responsibilities would be managing field trials. BIOTEC researchers were specialists in biotechnology, so they would be responsible for laboratory examinations. The levels, nature and timing of partner contributions were based on the respective responsibilities.

It was relatively easy for Uniseeds to form a useful estimate of R&D activities and expenses since the company had already been breeding okra for several years before the partnership. In accordance with policy, BIOTEC's maximum financial contribution for any project was THB500 000 (USD16 667), so both parties knew what BIO-

TEC's financial contribution would be from the start. Any R&D expenses above that level would be contributed by Uniseeds.

### 2.1.3 Management and operations

A kick-off meeting was held soon after terms were agreed between the two parties where roles and responsibilities of each partner were discussed in more detail.

The project had two phases. The first consisted of field trials and laboratory work to determine the best method to identify YVV in okra samples. Uniseeds carried out the field trials on okra hybridization and sent hybrid samples to BIOTEC researchers for laboratory work. The best method was selected based on efficiency and simplicity of application. Once the most efficient and simple method of identifying the virus had been selected, the second phase of the project was initiated. In this phase, Uniseeds carried out more field trials and sent the new hybrid samples to BIOTEC for more laboratory work. This time, the selected virus identification method was employed in the process to develop hybrids with YVV resistance. Previous Uniseeds hybrids were used as the basis because of their high yield and pod quality.

Monitoring of project progress was conducted continually through regular field visits. Progress reports were completed and submitted at update meetings every six months. Additional meetings were held on an as-needed basis. No outsourcing or subcontracting was required.

The only significant technical problem was BIOTEC's initially unsuccessful attempt to distil YVV from okra samples in order to produce the antibody. Okra generally contains high amounts of mucilage, making it difficult to distil. Researchers were forced to use a different molecular biology technique to solve the problem.

Potential problems with cooperation or project management were minimized because both parties were highly motivated to succeed. To Uniseeds, the benefits of a more stable okra supply and increased exports vastly overshadowed any expenses incurred in the project. BIOTEC also saw great value in the project, as detailed in section 2.1.2, and its ability as an agency to obtain future government appropriations depended on success. Since both parties shared a common goal and there were plainly outlined responsibilities based on clear differences in expertise, there was minimal space for cooperation problems between the parties.

### 2.1.4 Performance and development outcomes

Overall, the project was a success. Six different YVV-resistant okra hybrids were developed, two of which were suitable for commercialization. The total R&D budget for the project was THB3 426 360 (approximately USD114 212). BIO-TEC contributed THB500 000 (USD16 667) with the remaining THB2 926 360 (USD97 545) contributed by Uniseeds. The YVV-resistant hybrids developed through the partnership featured yields as high as 2 500 kg per rai (15 625 kg per ha), compared with a national average yield of about 1 600 kg per rai (10 000 kg per ha). Pod quality was suitable for export to Japan and other markets.

With a yield of 15 625 kg per ha and an average price of USD0.5 per kg, farmers would generate

a gross revenue of USD7 813 per ha by growing the Uniseeds hybrid. With a yield of 10 000 kg per ha and an average price of USD0.12 per kg – the average domestic market price provided by industry sources – gross revenue would be just USD1 200 per ha. Using the 1999 okra production cost figure of USD5 268 per ha, this represents the difference in a USD2 545 profit and a USD4 068 loss. Reduced chemical use resulting from YVV resistance further increased net income and had an additional environmental benefit.

The availability of high yielding okra varieties that were less susceptible to YVV outbreaks helped Uniseeds to secure a more dependable okra supply, in addition to increasing incomes for okra farmers. Risks associated with investing in okra farming were reduced through YVV resistance. Uniseeds

TABLE 3  
Profit for Thai okra farmers under various scenarios

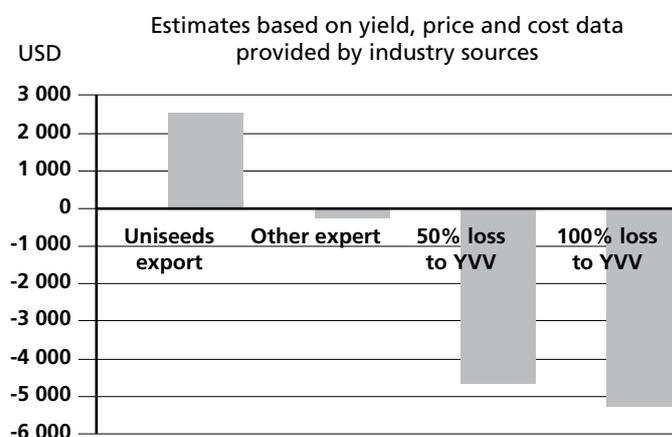
	Uniseeds for export No YVV	Other seeds for export No YVV	Other seeds 50 percent loss to YVV*	Other seeds 100 percent loss to YVV
Yield per ha (kg)	15 625	10 000	5 000	0
USD per kg	0.50	0.50	0.12	0.00
Revenue per ha	USD7 813	USD5 000	USD600	USD0
Cost per ha**	USD5 268	USD5 268	USD5 268	USD5 268
Profit (loss) per ha	USD2 545	(USD268)	(USD4 668)	(USD5 268)

\* Price assumes all surviving pods are sold on the domestic market.

\*\* Based on 1999 data.

Source: author's compilation, 2011.

FIGURE 4  
Estimated profit (loss) per ha for Thai okra farmers



Source: author's compilation, 2011.

was able to normalize revenue, enter into larger export contracts and reduce the risk of defaulting on contracts, even during YVV outbreaks. Additionally, it was able to introduce branded hybrid seed to generate additional income. As a result of its clear benefits over alternatives in Thailand, the commercialized Uniseeds okra hybrid, named UNIH109, was extremely marketable. At the time, imported hybrid seeds were sold for about THB2 000–5 000 (USD67–167) per kg. The Uniseeds hybrids were sold for only THB 100–200 (USD3–6) per kg.

In addition to providing a benefit for the Uniseeds project, the virus examination technique developed by BIOTEC could be applied to other hybrid seeds. It is realistic to assume that other seed producers will use BIOTEC's virus examination technique to produce their own disease-resistant hybrids.

## 2.2 CASE 2. DESIGN AND INSTALLATION OF AIR CONTROL FANS IN POULTRY FEEDING HOUSES

In the mid-2000s, many small- and medium-scale poultry farmers in Thailand were sacrificing poultry growth potential by using open-air feeding houses rather than air-controlled systems. The use of the latter reduces stress on poultry and increases poultry growth rates.

Thailand's Department of Livestock Development and international market pressures also began to encourage poultry producers using closed evaporation systems to address concerns about bird flu outbreaks possibly being associated with these systems. As a result, demand increased rapidly for air control fans, which reduce the risk of disease outbreaks in closed poultry feeding houses. At the time, more than 2 000 air control fans were being imported to Thailand from Japan each year, according to interviewees. However, the imported fans were expensive and not well suited to the Thai environment.

Meanwhile, NSTDA had offered services and funding subsidies to SMEs in the poultry industry to aid in the adoption of technologies to improve productivity and save energy. The poultry industry was targeted because it generated export revenue for Thailand. The NSTDA subsidiary that would work directly in the area of new technology adoption in the poultry industry was called the Industrial Technology Assistance Program (iTAP).

In 2005, the poultry producer Betagro Group capitalized on the opportunity to commission

iTAP for the design of new air control fans for its poultry feeding houses. Betagro's machinery subsidiary, B.Inter, worked directly with iTAP on the project. B.Inter trades and manufactures various livestock production equipment for both the local and export markets.

With iTAP's funding and cooperation, experts from King Mongkut's University of Technology helped B.Inter develop PowerTECH fans. The University experts participated as service providers to iTAP. The design was completed in April 2009. The locally made, 50-inch (127-cm) fans were cheaper than imported models and also relieved chicken stress because they made less noise. As a result, they were associated with improved growth yield. As intended by B.Inter and iTAP, the PowerTECH fans had commercialization potential.

The total budget for the project was THB2.16 million (USD72 000); iTAP contributed THB920 000 (USD30 667), with the rest coming from the private partner B.Inter (USD41 333).

A standard feeding house (12 x 120 x 2.2 m) generally requires ten fans. The PowerTECH fans cost approximately THB12 500 (USD417) each, 50 percent less than a comparable imported model priced at THB25 000 (USD833). As a result, a typical poultry feeding house would save approximately THB125 000 (USD4 167) in upfront investment by purchasing PowerTECH fans instead of comparable imported models. Additional savings were expected through lower energy usage relative to the imported models.

Today, B.Inter sells the PowerTECH fans on the domestic market in addition to exporting them to India, Bangladesh and other nations. B.Inter collects all revenue from sales and there is no revenue sharing. Domestic demand for air control fans has been strong and B.Inter has targeted sales volume of 5 000 units per year. The air control fans have also been adapted for use in other applications, such as outdoor markets and orchid farms. The Betagro Group uses the PowerTECH air control fans in all of its own feeding houses.

### 2.2.1 Characterization of PPP arrangements

At the time of the project, Thailand was already a major poultry producer and exporter. However, technology development in the sector was limited. Accordingly, iTAP focused on the development of production efficiency through the use of technology, offering services and funding subsidies to SMEs in the poultry industry because it generated export revenue for Thailand. By providing a ben-

## BOX 1

**Roles and functions of each partner in the B.Inter project****iTAP role 1: industrial technology advisor**

- Management of the overall project
- Recruiting technical experts according to private sector requirements
- Intervening when problems occur or a project does not operate as planned
- Assisting in initial technical problem analysis
- Negotiating consulting contracts
- Monitoring and performance evaluation
- Providing technical information on production processes and machinery

**iTAP role 2: expert advisor**

- Diagnosing technical problems
- Creating project proposal and operating project according to proposal
- Providing expertise in operations and technology development according to the private sector partner's requirement
- Reporting on project operations and creating summary report at the end of the project

**B.Inter role: development facilitator**

- Providing information on problems and technological requirements
- Supporting experts with research and development
- Paying all expenses upfront
- Providing production process information and staff

Source: author's compilation, 2011.

efit to the Thai poultry industry, iTAP would also be providing a benefit to the Thai economy. Both iTAP and NSTDA stood to benefit by achieving the goal of supporting SMEs in the poultry industry. Success would increase the likelihood that future governmental budget appropriations be allocated to NSTDA.

From the iTAP and NSTDA perspective, the purpose of the B.Inter partnership was to increase Thailand's capability to achieve a sustainable competitive advantage in agricultural production, especially through SMEs. Increased growth efficiency, reduced bird flu risk and lower costs of

poultry production resulting from the use of low-cost air control fans would increase the industry's competitive capability in the global marketplace.

From B.Inter's perspective, the PowerTECH fans would help the company realize cost savings and better performance. Access to the technical expertise and funding provided by iTAP was especially beneficial to the company. B.Inter also saw an opportunity for commercial sales of air control fans that offered better performance at a lower price compared with imported models.

Before the project began, a memorandum of understanding (MOU) was created and signed by B.Inter and iTAP, based on previous discussions during the project proposal phase. The MOU outlined roles and responsibilities of each partner. No formal contract was used.

As the project got under way, iTAP served a dual role as industrial technology advisor and expert advisor. The agency's primary function in both of these roles was to manage the overall project. In its role as development facilitator, B.Inter supported R&D efforts, clearly identified its requirements and paid all expenses upfront. The respective roles and functions of iTAP and B.Inter are detailed in Box 1.

iTAP funded 100 percent of expert fees and 50 percent of research, development and technology expenses up to THB500 000 (USD16 667). In the end, iTAP's total financial support for the project was THB920 000 (USD30 667). B.Inter paid all these expenses upfront, with reimbursement from iTAP occurring upon satisfactory completion of the project. The payment structure was meant to ensure project completion. After reimbursements, B.Inter's final financial outlay was THB1.24 million (USD41 333). Additionally, taxation laws allowed B.Inter to claim 200 percent tax exemptions for all expenses related to research and technology development.

In all, the project lasted three years and eight months, from September 2005 to April 2009. In other cases, such as support for rice milling and rubber drying operations, iTAP tried to limit project duration to between one and 12 months, and most PPPs lasted for just three to six months. There were two reasons for iTAP's attempts to shorten the project time frame as much as possible. First, a shorter time frame helped iTAP stay in touch with fast-moving technological advances. Second, it limited the period of negative cash flow for the private sector partner, in this case B.Inter. Since this project could not be completed within the one to 12-month time frame, it was extended

as necessary for up to two years. After that, a new phase was implemented separately.

### 2.2.2 Development of PPP arrangements

B.Inter submitted an application for project funding in 2005 when it saw an advertisement highlighting NSTDA's offer of services and funding subsidies to SMEs in the poultry industry. The company wished to produce the fans in Thailand. Less expensive, locally made fans would lower input costs and also reduce exposure to costly exchange rate fluctuations.

In accordance with regular procedures, iTAP and a project expert analysed a standard list of ten questions in order to identify and assess the project's market opportunities and prospects prior to accepting B.Inter's application (see Box 2).

iTAP was attracted to the B.Inter project because it saw an opportunity to help Thai poultry farmers and the national economy through technological development. This fitted in well with iTAP's stated purpose. Specifically, iTAP foresaw the following positive effects related to the project:

- affordable, more efficient farm equipment made available for small- and medium-scale poultry farmers;
- reduced energy consumption (compared with imported models);
- increased chicken growth rate and, thus, farm incomes and core revenue; and
- new and increased employment along the supply chain from manufacturing, distribution and installation.

A formal project proposal was developed by both parties after iTAP agreed to B.Inter's initial application for funding. Most of the negotiations between the parties took place during the project proposal development phase, which lasted less than two months in total. The proposal covered objectives and targets, schedule, scope, working process, roles of each partner and budget. A feasibility study was also performed in-house by iTAP during the proposal period to estimate expected costs, revenues and returns on investment. After senior management from both parties authorized the terms outlined in the project proposal, an MOU was created and signed.

### 2.2.3 Management and operations

iTAP managed the overall project and provided consultation regarding contracts, terms of payment, non-disclosure agreements, problem-solving and other matters. Member of iTAP's

management team visited the site regularly for management and monitoring. Monitoring checklists and regular communications with all parties were extensively implemented.

B.Inter supported iTAP's R&D efforts and made its staff available for input on the production process. B.Inter also had to identify its requirements clearly and provide constant input to ensure the fans achieved the desired effects of improved air circulation and reduced energy usage.

In addition to engineering, the project required in-depth expertise in animal husbandry. This expertise was obtained through consulting contracts with experts, including those from B.Inter's parent company, the Betagro Group. Candidates for subcontracting were extensively screened by iTAP because potential conflicts of interest were a major concern. Contractors could not be employees of or have any beneficial interest in the project. The private partner (B.Inter) was responsible for day-to-day management of third-party contractors.

As operations got under way, there was some friction between the professionals of iTAP and B.Inter and the third-party experts. Understandably, the third-party experts had time limitations

#### BOX 2

#### Questions analysed to assess market opportunities and prospects of the B.Inter project

1. Will this aid company competitiveness?
2. Is it a value-added product?
3. Is there any extension to research and development?
4. Will this aid in development and training of R&D personnel?
5. Will this solve any problems for the private sector?
6. Is this research and development output practical and useful?
7. Might this R&D help the industrial sector?
8. Is this a good opportunity to establish a cooperative system between the private and public sectors?
9. Is there market demand for the product?
10. Does the private sector partner have knowledge of the market or product?

Source: author's compilation, 2011.

because they generally had other responsibilities outside the project, such as university research or coursework. This meant intermittent work and difficulty in communication, which was often frustrating to full-time employees of the project. Furthermore, research trials sometimes required several iterations before favourable outcomes were achieved. At times, professionals may not have understood the unpredictable nature of R&D time frames. iTAP arranged for regular management meetings with the team to alleviate this problem.

As in any R&D project, there were several significant implementation risks. First, there was the risk that the fan design would not work in an actual production situation. Although extensive laboratory testing was employed, final conclusions on effectiveness could not be drawn until installation and on-site testing were completed. There was also the risk that development costs might run over B.Inter's budget. iTAP's shared funding reduced this risk. Other risks were related to the use of third-party expert contractors. In order to reduce the risk of experts walking away from the project, iTAP suggested that B.Inter pay them by instalments, based on progress. Non-disclosure agreements were signed to reduce the risk that consultants would provide information to competitors. iTAP also performed extensive screening and created agreements with consultants to address potential conflicts. Consistent monitoring of all aspects of the project reduced the risk of information leaks.

Upon implementation, the project also encountered complications related to the air control system and obtaining the appropriate raw materials for a fan prototype. Fast-changing technology in the industry also meant the initial design had to be modified prior to commercialization in order to accommodate the latest technological advances.

#### 2.2.4 Performance and development outcomes

Although not without problems, the partnership was successful. In total, the project spanned three years and eight months. The total budget for the project was THB2.16 million (USD72 000). iTAP reimbursed THB920 000 (USD30 667), with the rest being the full responsibility of B.Inter. The key products designed and created were PowerTECH air control fans and controlling systems for use in poultry feeding houses and other applications. The fans were 50 inches (127 cm)

in diameter and featured three propellers instead of the conventional six. Other key features of the fans were less noise and energy use compared with alternative models. The primary innovations were the number and shape of the fan blades. Reducing the number of blades from six to three provided better air flow. The fan blade shape was designed with consideration to steel sheet size in order to minimize waste from production. iTAP did not participate in the processes of commercialization or manufacturing since B.Inter already had extensive expertise in these areas.

In test trials, PowerTECH fans required 23 percent less energy than competing products. According to stakeholders, a typical feeding house's energy bill would be reduced by roughly THB20 000 (USD667) per year through the use of PowerTECH fans rather than imported models. Upfront investment would also be significantly less, as the initial cost of PowerTECH fans (THB12 500, or about USD417 each) was 50 percent less than imported alternatives. Cost differentials from imported models are shown in Figure 5.

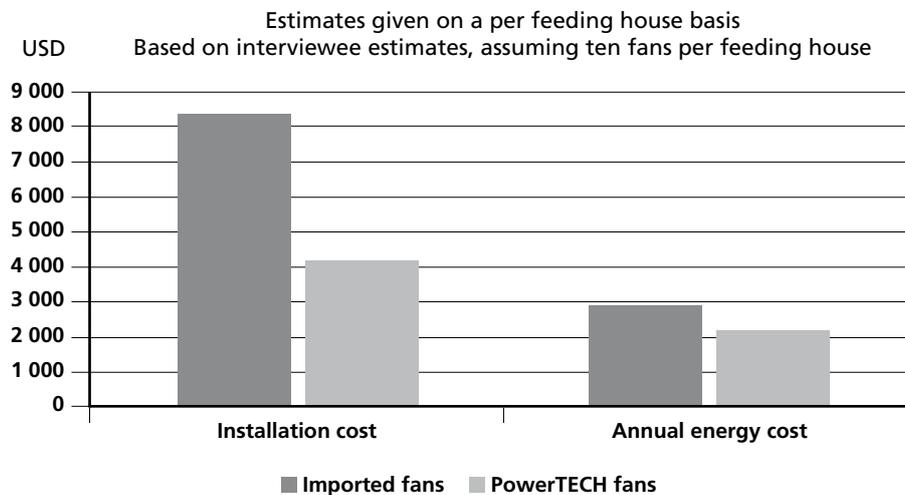
Benefits to Thailand's agribusiness development associated with the PowerTECH fan technology included:

- higher poultry revenues through increased bird growth rates and reduced disease risks;
- lower poultry production costs for fans and energy use compared with imported models;
- increased likelihood of adoption because of lower upfront investment compared with imported models;
- increased domestic employment along the supply chain as a result of new and improved design and manufacturing processes;
- lower imports, with more value remaining in Thailand; and
- an example for other Thai companies to leverage domestic technology.

In addition to the benefits listed above, B.Inter's export revenue increased by about 10 percent because it was able to export the PowerTECH fans.

Medium-term prospects for adoption appear cautiously positive as a result of overall cost savings compared with alternatives. Key informants believe continued R&D efforts and the creation of new products and services will be important for the products to achieve their potential. However, one reason the iTAP chose to participate in the project was because of its potential extension to small- and medium-sized poultry operations. Unfortunately, extension of the technology to a wider market has

FIGURE 5  
Cost savings with PowerTECH fans versus imported models



Source: author's compilation, 2011.

not been easy. Although the fans are 50 percent cheaper than the imported models available previously, outfitting a standard feeding house (12 x 120 x 2.2 m) with PowerTECH fans still requires upfront investment of approximately THB125 000 (USD4 167). This is a large investment for most small- and medium-sized Thai poultry farmers. As such, adoption has been disappointing, with most small poultry operations still using open house systems, which limits growth rates and causes higher disease and death rates compared with air-controlled systems.

B.Inter has tried to expand market penetration by implementing the air control fans and control systems in its parent company's (Betagro) contract farms. The company has offered credit for the installation of fans and control systems to contract farmers, who are able to pay later when they obtain benefits from the systems. B.Inter has also invested in a new fan production line for export markets, which has stimulated employment.

iTAP has continued to provide consulting services to improve the existing products. R&D has been undertaken to apply similar technologies to other livestock farms in Thailand. The technology has also been implemented in other applications such as in the Ying-Charoen Wet Market (a traditional market in Bangkok) and in orchid farms.

### 2.3 CASE 3. BIOTECHNOLOGY FOR THE DETECTION OF WHITE LEAF DISEASE IN SUGAR CANE

White leaf disease is a serious condition caused by phytoplasma in sugar cane. The disease is transmitted to the plant by the leafhopper *Matsumuratettix hiroglyphicus* (Matsumura). Weeds that grow in and around sugar-cane farms are suspected carriers since they can be infected with phytoplasma and often show symptoms similar to sugar-cane white leaf disease.

To help combat this dangerous disease in Thailand's sugar-cane industry, BIOTEC cooperated with the Mitr Phol Sugarcane Research Center, a subsidiary of the private sector sugar producer and miller, the Mitr Phol Sugar Group, and a confidential third-party contractor to develop a rapid immunochromatographic (IC) assay for the detection of white leaf phytoplasma in sugar cane. The detection method needed to be accurate, quick and simple to use, economical and non-perishable. If successful, the project would have great benefits for the sugar-cane industry since it could help prevent disease, better farmers' incomes and improve the raw material supply chain for sugar mills.

The project was divided into two phases. The first phase, from September 2005 to December 2006, included R&D for an antibody able to detect white leaf disease. The second phase, from February 2007 to February 2008, consisted of developing a white leaf disease test kit. Researchers from

BIOTEC took the lead in the first phase and the third-party contractor carried out most design work in the second phase.

The total budget for both phases was approximately THB3 million (USD100 000). BIOTEC provided all funding in the first phase and advanced 20 percent of project expenses for the second.

The white leaf disease test kits developed in the project proved to be innovative and valuable worldwide. They enabled farmers to screen for cane stalks free of white leaf disease before planting. This not only reduced losses, but also minimized spread of the disease to healthy plants. The kits were 90 percent accurate, fast and easy to use, and could be stored for at least 12 months without risk of spoilage.

The kits were commercialized domestically and internationally. They were sold for only THB500 (USD17) for a pack of ten, much less than alternatives. Mitr Phol and BIOTEC received revenue and royalty fees from sales.

Mitr Phol continues to promote the rapid IC test kit with sugar-cane growers for the detection of white leaf phytoplasma. BIOTEC continues to provide technical recommendations to Mitr Phol regarding R&D in the sugar-cane industry. Additionally, the third party involved in the development is currently cooperating with Kasetsart University to produce sugar-cane tissue that is free of white leaf disease.

### **2.3.1 Characterization of PPP arrangements**

The purpose of the arrangements was to produce monoclonal antibodies (MAbs) and develop rapid IC assay equipment to detect white leaf phytoplasma (the cause of white leaf disease) in sugar cane efficiently. Mitr Phol and BIOTEC shared the same goal in the project: to reduce disease losses and increase incomes in sugar-cane production. By screening for phytoplasma-free cane stalks before planting, farmers could reduce losses in their own crops and also minimize the spread of disease to healthy plants in other areas.

Favourable NSTDA policy enabled the project to develop. BIOTEC's focus on promoting the industrial applications of biotechnology to both Thai and foreign companies would not have been possible without this help. One reason the Mitr Phol project was attractive to legislative officials was its potential to reduce government spending for crop insurance payments resulting from losses to white leaf disease.

Mitr Phol, other sugar-cane farmers, BIOTEC and the third-party contractor were all beneficiar-

ies of the arrangements. As a sugar-cane producer and miller, Mitr Phol benefited directly through reduced losses to white leaf disease and a more dependable supply for its mills. Mitr Phol also profited from sales of the white leaf disease test kits. Individual sugar-cane farmers benefited once the technology had been made available on the market. The easy-to-use test kits could be used on-site and required no laboratory support. They were also inexpensive compared with other methods.

BIOTEC benefited by achieving its mission to support private sector innovation. Repeated success in its mission would increase the likelihood that future governmental budget appropriations would be set aside for BIOTEC, allowing the agency to continue to support Thailand's technological development in agribusiness and other sectors. As the owner of specific technology able to detect phytoplasma, BIOTEC also received royalty payments from test kit sales. This enabled it to be less reliant on governmental budget appropriations to provide its services. The third-party contractor was chosen as the manufacturer and distributor of the test kits.

Funding for the project was divided into two phases. BIOTEC provided all funding for the first phase out of its normal budget, which consisted of R&D of an antibody able to detect white leaf disease. For the second phase, which consisted of developing a white leaf disease test kit primarily by the third-party contractor, BIOTEC advanced 20 percent of project expenses. After completion of the project, Mitr Phol refunded this 20 percent. Financial support for R&D was also offered to the third party by BIOTEC. The third party contributed to the project as an outside consultant and not as a co-investor.

In addition to financial support, BIOTEC had a primary operations role in developing a monoclonal antibody able to detect white leaf disease. R&D of the antibody lasted from September 2005 to December 2006. Since the antibody was required in order for the third-party contractor to develop the test kits, success in this phase was a prerequisite for implementation of kit development. BIOTEC also had the responsibility of monitoring Mitr Phol and the third-party contractor.

The third-party contractor developed the test kits in the second phase. The contractor had previous experience developing similar test kits for human and animal applications. Later, it assumed the role of manufacturer and distributor of the test kits.

Mitr Phol's role consisted primarily of supporting BIOTEC and the third-party contractor in R&D

efforts. For example, Mitr Phol provided samples of sugar cane with white leaf disease to BIOTEC and performed field testing for the test kits.

Project arrangements were formalized through an MOU between BIOTEC and the private sector partners, as well as a licensing agreement between BIOTEC and the third-party contractor. The licensing agreement gave the contractor rights to manufacture and distribute the test kits, but the intellectual property related to the antibody remained with BIOTEC.

### 2.3.2 Development of PPP arrangements

The idea for the project came from an especially damaging outbreak of white leaf disease in Thailand's Lampang province in 2003. After the outbreak, the Mitr Phol Sugar Group and the Thai Government began to recognize the impact of the disease on farmers, sugar mill suppliers and government crop insurance payments. Mitr Phol sought a method to reduce damage from the disease and improve yields in order to stabilize raw material supplies for its sugar mills. Mitr Phol then engaged BIOTEC to determine whether biotechnology could be used to detect white leaf disease in sugar cane.

The project was attractive to BIOTEC because sugar cane is an important agricultural product of Thailand with a large economic impact. White leaf disease and other pests presented serious problems to crop production by reducing both the quantity and quality of sugar cane. The ability to detect and identify plant pathogens would be essential to epidemiological and disease management studies. An accurate detection system was also required for selective breeding programmes for pathogen-resistant plants and certification of disease-free seeds for import and export. Despite commercial availability, antibodies and diagnostic test kits for plant pathogens were expensive. Therefore, BIOTEC saw the need for a rapid, specific, accurate and cost-effective diagnosis system. The project was also attractive to other government officials because tax revenues were used for crop insurance payments due to losses from white leaf disease.

These factors, combined with the fact that no such system existed at the time, led Mitr Phol, BIOTEC and the third-party contractor to believe that the test kits would have a market outside Mitr Phol's own uses. Yield loss reduction, return on investment and the value of a dependable source of raw materials were also considered when assessing the market opportunity.

Leading up to the project, representatives from all three parties discussed objectives, targets and

scope of responsibilities for several weeks before Mitr Phol submitted a formal project proposal to BIOTEC. All partners' roles and responsibilities were identified clearly during this stage. The respective strengths of each party were carefully considered. These were determined to be:

- BIOTEC: expertise in biotechnology and the ability to develop a monoclonal antibody;
- Mitr Phol: ability to support field trials, provide samples of phytoplasma and share expertise with all parties; and
- third-party contractor: experience producing similar test kits for human and animal applications.

BIOTEC sent the project proposal from Mitr Phol to its board for approval of principle, strategy and funding. Final project approval came approximately three months after submission.

Revenues and return on investment were estimated, based on milling supply improvements and test kit sales for Mitr Phol, and on royalty payments for BIOTEC. Further financial benefits for Mitr Phol were expected from reduced losses in sugar-cane production related to white leaf disease. R&D expenses incurred by the private sector parties to the project also qualified for a special 200 percent R&D tax deduction allowed by the Thai Revenue Department.

### 2.3.3 Management and operations

The technical nature of the project meant management and control of its various aspects were somewhat set apart. Financial contributions aside, Mitr Phol commissioned BIOTEC to develop the white leaf disease antibody because it did not have the technical ability to do so in-house. Later, Mitr Phol and BIOTEC hired the third-party contractor to develop the rapid test kits since neither possessed the expertise required to do so. The fact that each step of the process required a specific technical skill that only one of the three parties possessed lent clarity to management roles and responsibilities, but also required high levels of trust among the parties.

The first phase lasted from September 2005 to December 2006 and the second from February 2007 to February 2008. Since the antibody was required in order for the third-party contractor to develop the test kits, success in the first phase was a prerequisite for implementation of the second phase. The planned time frame for the first phase was one year, but a three-month extension was required.

The main risk for the project was that BIOTEC would fail to produce monoclonal antibodies capable of identifying phytoplasma within the required budget and time frame. This was a significant risk, as researchers were not able to control the outcome of laboratory trials. However, this risk was mitigated by Mitr Phol and the third-party contractor because BIOTEC assumed 100 percent of the financial risk in the first phase. Some technical problems arose during implementation, but none resulted from managerial issues.

All parties usually met every three months, with additional meetings requested if problems occurred in the meantime. Each party was required to submit a report on its function and activity every six months. A final report was required when the project was completed.

As the public sector partner and majority funder, BIOTEC had the end responsibility to monitor the progress of Mitr Phol and the third-party contractor. In accordance with its policy, BIOTEC monitored and assessed the impact of the project with an eye to social and economic development. The white leaf disease test kits were evaluated with field trials and compared with other methods such as DNA probes, PCR and nested PCR. Checklist forms were also used to monitor progress in each phase.

### 2.3.4 Performance and development outcomes

Effective white leaf disease test kits were successfully created using three new prototypes of

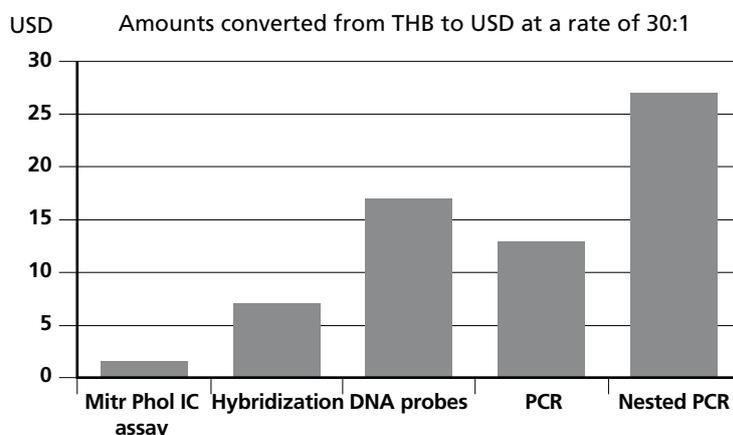
monoclonal antibodies. The kits were 90 percent accurate, easy and fast to use, and could be stored for at least 12 months without risk of spoilage.

Kit sales were successful in domestic and international markets, with exports to Brazil, the Lao People's Democratic Republic and India. Total sales were THB1.15 million (USD38 333) in 2010. The first branded manufacturing contract with the third party had a five-year term. This contract is likely to be renewed with a new expiry date of 2028, pending 20-year intellectual property right registration. In addition, the third party has also cooperated with Kasetsart University to produce sugar-cane tissue free of white leaf disease.

Sugar-cane farming and sugar milling have benefited from the availability of a dependable and inexpensive method to identify the presence of harmful white leaf disease. Although specific data on adoption are not available, it is expected that increasingly widespread implementation of testing measures will result in reduced crop losses from white leaf disease and, therefore, higher incomes for farmers and millers. Furthermore, the test kits developed in the project were sold for only THB500 (USD17) per pack of ten at the time of surveying. During the same period, pricing per test for the alternative methods of hybridization, DNA probes, PCR and nested PCR was THB200 (USD7), THB500 (USD17), THB400 (USD13) and THB800 (USD27), respectively (see Figure 6).

Monoclonal antibodies have become increasingly important diagnostic tools in medicine, agriculture and various other types of basic research. To

FIGURE 6  
Unit cost of white leaf disease testing methods



address the high demand for antibodies, BIOTEC has made it a goal to specialize in monoclonal antibody production and immunological assay development for diagnostic purposes. As such, future research focused on monoclonal antibody production and immunoassay development for detection of plant pathogens is expected to be implemented in Thailand's agribusiness industry.

## 2.4 CASE 4. PROMOTING BIOGAS TECHNOLOGY IN INTEGRATED SLAUGHTERHOUSES

In 2006, there were about 30 integrated poultry slaughterhouses in Thailand with a total processing capacity of approximately three million birds per day. When discarded improperly, wastewater from these factories created pollution. However, according to industry sources, the wastewater from Thai slaughterhouses also has the potential to produce about 39.6 million m<sup>3</sup> of biogas per year when recaptured in a biogas energy production system.

Recognizing this potential, ERDI initiated a project to utilize wastewater for the production of biogas energy and promote the technology in integrated poultry slaughterhouses. The planned project period is four years and six months, from September 2008 to March 2013, and this is still ongoing.

ERDI is administered by Chiang Mai University, a public university in northern Thailand. ERDI supports the research and academic pursuits of Chiang Mai University and aims to become an innovative centre of R&D on biogas energy technology. For this project, ERDI plans to provide funding for five integrated poultry slaughterhouses to design, construct and operate biogas energy production systems to utilize the wastewater from their poultry processing operations. ERDI aims to produce about 30 000 m<sup>3</sup> of biogas per day from wastewater, which is the estimated biogas output from processing 500 000 to 750 000 birds per day (five factories each with an average processing capacity of 100 000 to 150 000 birds per day).

Private sector slaughterhouse operators Beta-gro Land, GFPT Nichirei (Thailand), F&F and Bangkok Produce have already committed to the project. These four operations have a total processing capacity of about 700 000 birds per day and produce about 26 000 m<sup>3</sup> of wastewater daily. A fifth processor is considering the project, but so far has not drawn up a contract so its identity has not been disclosed. This potential partner is being considered to fill the gap vacated by another private processor that withdrew from

the project even after undergoing a full vetting process and signing an MOU.

Funding from ERDI is THB6 million (USD200 000) for each of the five factories with processing capacity of at least 150 000 birds per day. For this project, ERDI utilizes funding from the Energy Conservation Fund of the Energy Policy and Planning Office (EPPO), a key agency in the formulation and administration of energy policy and planning in Thailand. The private slaughterhouse operators are responsible for the remainder of total project expenses, which is estimated to be approximately THB14 million (USD420 000) for each system.

### 2.4.1 Characterization of PPP arrangements

The purpose of the arrangements is fivefold and is to:

- treat and control wastewater pollution from poultry slaughterhouses to reduce pollution;
- conserve and recycle more water from wastewater treatment systems;
- promote the adoption of biogas energy technology in integrated poultry slaughterhouses;
- reduce emissions of methane gas that harm the atmosphere; and
- educate the public and private sectors about the benefits of biogas technology.

The beneficiaries of the arrangements are the private sector slaughterhouses, the general public and ERDI. The private sector slaughterhouses will benefit primarily through reduced energy expenses and shared investment in infrastructure. With ERDI funding up to THB6 million (USD200 000) for each biogas system, the slaughterhouses will be able to reap the full cost savings of biogas production without paying the full cost of system installation. Positive public relations and increased sustainability will be additional benefits for the private partners.

The arrangements will benefit the general public through improved environmental conditions and community health, improved water resource conservation, and reduced LPG, crude oil and electricity consumption. Furthermore, the technology promoted in the project may have other applications, such as on swine farms.

ERDI will benefit if it successfully implements its purpose to become an innovative centre of R&D for biogas energy technology. Thailand's well-developed poultry and swine industries are prime targets for biogas production. Repeated

**BOX 3****Roles of each partner in the biogas project****ERDI roles**

- Promote biogas technology
- Recruit, motivate and screen poultry slaughterhouses to join project
- Survey factories and estimate project costs
- Develop and design standard biogas production systems
- Provide technical consulting to poultry processors regarding selection of construction companies
- Design, advise and inspect systems construction and installation
- Providing technical consulting to processors for at least one year after installation
- Generate funding
- Report to EPPO
- Monitor and evaluate project outcome

**Poultry slaughterhouse roles**

- Submit documentation to ERDI (such as land title deeds, specifications of current wastewater systems, processing capacity data and bank guarantees for ensuring its investment capacity)
- Select construction companies
- Operate system continually for at least 12 months
- Cooperate with ERDI inspections
- Report any technical problems to ERDI
- Cooperate with ERDI to promote the adoption of biogas energy systems

Source: author's compilation, 2011.

success in its purpose will increase the likelihood that ERDI will continue to be a key player in the industry's development, generating additional funding and allowing the institute to continue to support R&D in biogas energy production. ERDI also earns technical service consulting fees from the project. Furthermore, participation in these activities is a good opportunity for the Chiang Mai University faculty and its students to develop technical and practical skills in project design and management.

For this project, ERDI provides financial support for 30 percent of total project expenses up to THB6 million (USD200 000) per factory. Funding

will be reduced proportionally for each factory if processing capacity fails to reach 150 000 birds per day. Funding is divided into four payments as follows:

- 35 percent when system construction reaches 60 percent completion;
- 35 percent when system construction is completed;
- 15 percent when system installation is completed and the system is running; and
- 15 percent when the system has been running for 12 months with an alternative energy utilization rate of at least 80 percent.

In addition to funding, ERDI will manage the overall project and provide services to the private sector partners to aid in system design, start-up and operations for at least one year following installation. As the public sector partner, it has also been ERDI's role to recruit, motivate and screen potential private sector partners for the project.

The primary role of each poultry slaughterhouse in the project will be to facilitate ERDI's management and operations by cooperating with the process and providing documentation. Additionally, the private sector partners will be required to select a construction company (with support from ERDI) to build and install the system. The roles of each partner are shown in Box 3.

Agreements in the project were formalized through a general MOU, as well as various contractual agreements among the various stakeholders. The MOU clearly outlined the roles of each partner in day-to-day management of the project, most of which fell to ERDI.

**2.4.2 Development of PPP arrangements**

ERDI had the initial idea for the project and was the main driver of the arrangements. It promoted the project in integrated poultry slaughterhouses, developed and designed a standardized biogas production system, generated project funding from the Ministry of Energy and recruited participants. Government policies on energy and environmental conservation were key enabling factors. As a result of these policies, funding to support the project was allocated by the Ministry of Energy.

Before proposing the project to EPPO, ERDI conducted a feasibility study to estimate costs, revenues and returns on investment associated with the project. Wastewater volume from current poultry production, costs of wastewater management and energy usage in a model slaughterhouse were taken into consideration in the feasibility

ity study. The costs of wastewater treatment and energy usage were then compared with the value of expected power generation from a standard ERDI-designed biogas system. In addition to the financial benefits, ERDI also highlighted the social benefits for EPPO. For example, the systems were projected to help the environment and improve relationships between poultry slaughterhouses and local communities.

Upon receipt of project approval from EPPO, ERDI engaged in a recruitment campaign for private sector participation. Managers from various private poultry slaughterhouses submitted project proposals and documentation to ERDI. ERDI checked each factory's documentation and made site visits to facilities that showed potential.

ERDI conducted an extensive vetting process to select the best private sector partners. To identify and assess the market opportunities and prospects of the private slaughterhouses applying for participation, ERDI painstakingly examined production capacity, land area and landownership, investment capacity and current energy sources. It was critical that private partners applying for participation in the project were able to prove sufficient supply of wastewater (which is directly related to production capacity). To obtain this information, ERDI requested detailed project proposals from each applicant and performed extensive checks of documentation and qualifications. If a given applicant's documents were as required, ERDI staff visited the applicant's facility to evaluate the possibility of biogas system installation. Landownership was also verified. When a biogas system was deemed to be feasible for an applicant's facility, site construction and installation costs were estimated and the applicant was provided with details on available funding and total investment. Given the applicant's approval of funding and investment levels, the case was formally processed for ERDI management approval.

Finally, contracts were signed by both parties. Agreements were completed within two months after individual slaughterhouses had been selected for participation. Each poultry slaughterhouse has been required to provide a bank guarantee until the biogas system construction is completed.

### 2.4.3 Management and operations

ERDI fills the leading managerial role in all aspects of the project. The private sector partners are required to facilitate and cooperate with ERDI's managerial leadership. Additionally, the slaughterhouses are required to cooperate with ERDI in construction management and technology promo-

tion. Once biogas production is under way, each slaughterhouse must operate the biogas system continually for at least 12 months to receive the final 15 percent of funding (see Box 3 in section 2.4.1 for more details on each partner's role).

In-depth knowledge of biogas technology, including software and hardware, is required for the project. So far, ERDI has been able to provide this expertise. Slaughterhouses have hired third-party contractors to build the civil works and carry out land preparation necessary for system installation. ERDI has provided designs, specifications and technical services for the builders and excavators. When necessary, ERDI has provided technical expertise to help the private partners choose building and excavation contractors. Additionally, ERDI will assist with day-to-day management of the construction and installation processes, visiting each site on a weekly basis during the construction period. It will also monitor utilization rates and provide other services during the first year in which the systems are operational.

ERDI's managerial time contribution to each slaughterhouse has depended on several factors, including:

- size of the slaughterhouse
- state of the current wastewater treatment system
- slaughterhouse location
- timeline and expertise of the construction company
- unexpected circumstances

For example, one of the selected slaughterhouses was severely affected by economic factors after undergoing the entire vetting process and signing an MOU to join the project. As a result, the company decided to withdraw from the project because of its inability to meet investment requirements. This was an unexpected circumstance that presented a key challenge to ERDI, which was forced to recruit a new poultry slaughterhouse, a process that is still under way as of the date of this report. The replacement processor is considering the project, but has not yet drawn up a contract.

The overall project has also been delayed by slower than expected construction progress and an economic downturn that has decreased poultry demand. This has also reduced wastewater production and biogas production. The complex decision-making processes of the larger slaughterhouses have delayed progress, while the limited financial resources of the smaller companies have caused problems in light of the economic down-

turn. Equipment breakdowns and maintenance have also contributed to delays.

#### 2.4.4 Performance and development outcomes

The project is still under way as of the date of this report. Although construction and overall progress have been delayed by various factors, stakeholders still expect a successful outcome. In the end, ERDI expects to produce about 30 000 m<sup>3</sup> of biogas per operating day from wastewater, the estimated biogas output from processing operations totalling 500 000 to 750 000 birds per day. ERDI estimates that this volume of biogas energy production could achieve the following benefits for the slaughterhouses and society:

- annual LPG savings of 2.28 million kg, a value of about THB45.5 million (USD1.5 million) at a cost of THB20 (USD0.66) per kg;
- annual crude oil savings of 2.72 million litres, a value of about THB49 million (USD1.6 million) at a cost of THB18 (USD0.60) per kg;
- annual energy cost reductions for wastewater treatment of approximately THB13.5 million (USD450 000); and
- annual greenhouse gas emissions reductions of approximately 41.6 million kg.

In addition to generating cost savings and positive public relations for private slaughterhouses employing the technology, the biogas energy generation systems increase rural income and employment during the construction and installation peri-

ods. Furthermore, slaughterhouses that have joined the project may extend the biogas technology to other factories or share their expertise with other business lines that can apply biogas technology. In fact, cooperation and assistance from ERDI's future efforts to promote biogas technology are prerequisites for private participation in the project. Thailand's swine and tapioca (cassava) industries are prime targets for extension of ERDI's biogas energy generation technology.

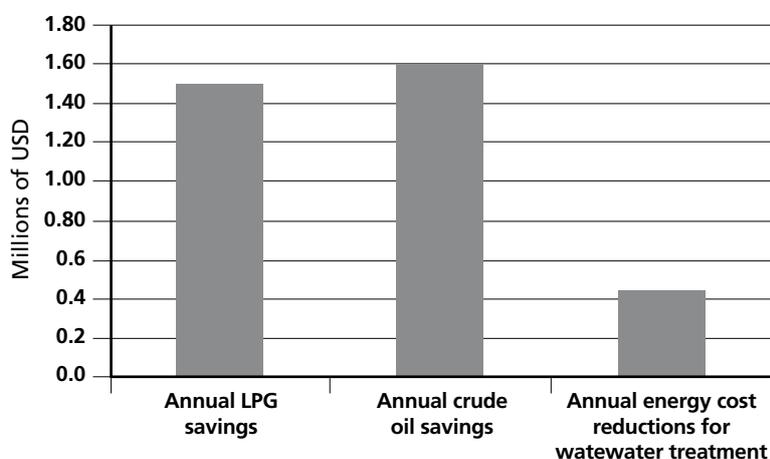
Medium-term prospects appear cautiously positive, provided funds are available for the relatively high upfront investment. The primary risk to the project's success appears to be discontinuance, especially in light of the recent economic downturn. Initial investment for the biogas system is quite high, which has been a considerable factor for poultry slaughterhouses, especially smaller ones. Discontinuance is a risk, even after systems are installed and operational. When demand for chicken meat decreases, slaughter volume decreases, causing wastewater and biogas production to decrease in turn.

In the longer term, societal and developmental benefits are expected to include improvements in community health and the environment, water resource conservation, technology transfer, and reduced LPG, crude oil and electricity consumption through the use of cheaper alternative energy.

Notably, government policy on energy conservation and wastewater management was a key enabling factor for the biogas project. As a result of these policies, funding to support the project

FIGURE 7

#### Estimated benefits of biogas energy systems in five poultry slaughterhouses



was allocated from the Ministry of Energy (via EPPPO). The government's regulatory framework affecting the project also had clear working steps and authorization processes, enabling the project to proceed efficiently. The key goal of the biogas project from the public sector's perspective appears to have been the perceived societal benefits of biogas energy production. This stands in contrast to some other PPPs in Thailand's agribusiness sector, in which the key goals are generally private sector investment and efficiency.

## 2.5 CASE 5. MULTILLOCATION HYBRID CORN YIELD TRIALS

The phenomenal growth and success of Thailand's feed and livestock industry over the past 20–30 years are due, in large part, to the country's parallel success since the 1960s in developing its hybrid corn seed industry. As a result of several Thai Government policies and programmes to stimulate the seed sector, new corn hybrids are continually being developed and introduced on the market by domestic private and public sector breeders. These new hybrids exhibit increasingly high-yield capabilities, better pest resistance, earlier maturity periods, better grain quality and other desired traits.

Every year for the last 24 years, a multilocation hybrid corn yield trial programme has been conducted by NCSRC, in cooperation with Chiang Mai University, Maejo University, other government crop research centres and private corn seed producers. The purpose of the programme between NCSRC and its various public and private sector partners is to provide a low-cost, voluntary and unbiased method to evaluate and compare corn seed hybrids available in Thailand.

NCSRC, a public-funded entity focused on R&D for corn and sorghum, serves as the public sector partner. NCSRC was initially organized in late 1966, when the Inter-Asian Corn Program came to Thailand, as a cooperative arrangement between the Thailand Ministry of Agriculture, Kasetsart University and the Rockefeller Foundation. The centre was officially founded in 1969. In 1989, NCSRC was reorganized under the Kasetsart University Research and Development Institute. A further reorganization took place in 1992, when NCSRC was transferred to the Insechandrasatiya Institute for Crop Research and Development. The centre comprises five units: Student training, Academic and technology transfer, Research services, Seed production and Multiplication. NCSRC manages a research centre located in Nakhon Ratchasima province, in northeastern Thailand,

with a total area of 2 589 rai (414 ha). The centre, also known as Suwan Farm, is today recognized internationally as one of the leading centres for tropical corn breeding, development and training.

Many corn seed companies and breeders have been private sector partners in the project. In 2010, the private sector partners were:

- Bangkok Seeds Industry
- Thai Plant Breeding R&D
- Pacific Seeds
- Seed Asia
- Syngenta Seeds
- Monsanto Thailand
- Northern Seeds
- Shriram Bioseed (Thailand)

The yield trials project has been held each May through September for the last 24 years. Every year, NCSRC provides expertise to conduct hybrid breeding and testing programmes aimed at improving the yield potential and quality of corn hybrids. Contributions from private breeders include hybrid seed, staff time, land for the trials and crop inputs. In 2010, total cash contributions from the private sector for trial fees, land rental expense and fertilizer were approximately THB300 000 (USD10 000). This figure does not include non-cash contributions from private and public sector participants, such as working hours, expert consulting services, farm management, record-keeping, data compilation and evaluation, and reporting of field data to NCSRC.

### 2.5.1 Characterization of PPP arrangements

The purpose of the programme is to support R&D of hybrid corn varieties in the public and private sectors. The collaborative programme generates positive impacts for Thailand's corn seed industry, farmers and other related businesses.

In 2010, ten organizations (the eight private companies mentioned above, Nakhon Sawan Field Crops Research Center and NCSRC) carried out the trials with a total of 26 hybrid corn varieties. Yield trials were conducted at 12 locations. Each organization was given the opportunity to submit up to two varieties for the trials. Two varieties developed by NCSRC and another four varieties with high yields in previous trials were used for yield comparison.

Hybrid corn seed breeders from the public and private sectors are direct beneficiaries of the arrangements. Through the programme, breeders have the opportunity to share expertise, working procedures, management and problem-solving

methods with other breeders. Since the trials are carried out in many different locations, breeders gain valuable understanding of how their products perform in different areas of the country with distinct climatic, soil and agronomic conditions. Furthermore, NCSRC yield trials are considered to be the most reliable in Thailand. As such, participating breeders are able to leverage positive results into marketing opportunities. However, marketing is not a stated purpose of NCSRC in the context of the programme.

The public sector benefits because the programme encourages domestic investment in hybrid corn breeding R&D, building on Thailand's aim to become a regional seed hub. Thai farmers and the overall Thai economy benefit because superior hybrids are developed with traits specifically targeted for increased performance in Thailand. This encourages higher farmers' incomes and sector output through higher yields and increased tolerance to pests and stresses, such as drought.

NCSRC coordinates the trials, provides two hybrid varieties, collects and distributes participants' varieties, evaluates performance and reports the project results to partners at the end of each year. It also provides yield trial management guidelines, which must be followed precisely in order to ensure fair results. At its own discretion, NCSRC may provide technical assistance for any problems encountered during yield trials. State universities, including Chiang Mai University and Maejo University, contribute field trial land and farm management on their plots.

In order to participate, each private breeder is required to provide the following inputs:

- 4 kg of corn seed;
- significant staff time for researchers, agronomists and workers;
- yield trial fee of THB10 000 (USD333);
- 1–2 rai (0.16–0.32 ha) of uniform farmland on which to carry out the trials;
- fertilizer expenses; and
- agronomic information for the first 60 days after planting and final yield information.

Depending on area, rental expense for farmland was THB12 000–25 000 per rai (USD2 500–5 200 per ha) in 2010, including irrigation, labour, agronomist and other services. Provision of farmland constituted a direct cash contribution for breeders who rented their land. For breeders who owned land, this constituted a contribution based on opportunity cost. Fertilizer expense, another direct project contribution from private breed-

ers, averaged about THB2 000 per rai (USD417 per ha). NCSRC collected a total of THB80 000 (USD2 667) in fees from the eight companies joining the programme in 2010. Of this amount, THB60 000 (USD2 000) went to the two participating state universities contributing land area for field trials. NCSRC retained only THB20 000 (USD667) for its own operating expenses, such as transportation and other costs incurred to carry out the project activities. For all parties involved, the most significant contribution by far was the opportunity cost of staff time for researchers, agronomists and farm workers. The financial implications for staff time, which included high earning professionals and academics, varied for each company.

At the end of each year's programme, NCSRC organizes a meeting to present results. This allows participants to discuss any issues encountered during the trials and share ideas about corn R&D.

All parties participate on a voluntary basis. NCSRC organizes the programme with cooperation from state universities, other public crop research centres and private hybrid corn seed breeders. No MOUs or contractual agreements are used. Although contributions to the programme are significant, especially for staff time, no party assumes a level of financial or operational risk for which a contract would be deemed necessary. Furthermore, both NCSRC's long history and local esteem for the programme assuage any concerns breeders may have.

Another likely factor for success is trust in the NCSRC programme coordinator, Dr Sansern Jampathong. Because Kasetsart University is the premier institution for agriculture in Thailand, many agricultural researchers from private companies and state universities in Thailand are former students of NCSRC. As such, they understand how the centre functions and have implicit trust in its coordinator.

### 2.5.2 Development of PPP arrangements

The main drivers behind the development of the project are NCSRC and hybrid corn breeders in the public and private sectors. The programme is perceived as a good opportunity for participants to discover how their products compare with hybrids from competitor companies and public institutions. Field trials in different environments are especially valuable because the cost and managerial implications of carrying them out in-house can be significant. Managers and agricultural researchers of NCSRC and private breeding operations understand that trials of this type also help

them improve R&D processes and train their staff. Additionally, private sector firms see the project as an opportunity to showcase their companies and evaluate product performance compared with others. Meanwhile, the project's goals are in line with the NCSRC focus on excellence in academics, as well as service and support for the public and private sectors.

Each year, participants simply inform NCSRC that they will join the yield comparison programme and then transfer yield trial fees to NCSRC for management and operating expenses. Participants must send their respective hybrid seed samples to NCSRC by 20 April of each year. NCSRC distributes unlabelled seed to all participants in early May. The timing of planting the trials is determined by weather conditions each year. About four months are required to produce a corn crop in most areas of Thailand. Planting periods usually start in May or June each year depending on the area.

### 2.5.3 Management and operations

NCSRC manages overall project operations. Private breeders in the project each submit two varieties of their hybrid corn and receive varieties from other breeders (via NCSRC) for yield trials. Specific trial management instructions are provided by NCSRC. Breeders must report detailed input data from field trials to NCSRC. If any problems arise during field trials, breeders are able to seek advice or technical support from NCSRC, or from other cooperators. There is a high degree of communication and support between the private sector breeders as a result of the programme.

At the end of the project, breeders receive from NCSRC a final report on hybrid performance in different locations. Information on yield, disease resistance, problems encountered and suggested problem-solving methods are included in the final report, along with other information. This information enables breeders to identify the relative strengths and weakness of their products compared with those of their competitors. It also provides guidelines for R&D policy, strategy, investment, marketing and even market trends. Yield comparisons are reported for different areas, providing breeders with valuable information that may be difficult or expensive to obtain via other means.

No outsourcing or subcontracting is undertaken. Breeders who join the programme generally possess all the necessary expertise.

The main implementation risks encountered have been dealt with through the development

of detailed trial management guidelines. In the past, some private breeders have failed to follow NCSRC instructions in their yield trials, thus causing data loss or bias. When this has occurred, it has resulted in wasted time and resources for the whole group, as all trials must be managed similarly for results to be considered valid. Representatives from NCSRC therefore regularly monitor each trial in order to ensure consistency and fairness.

Other uncontrollable problems have also occurred in past trials. For example, one private breeder was unable to complete the trials because the landowner chose not to renew a land rental contract.

For breeders, obtaining good trial results for their products is the key challenge. If their products rank highly, this creates market creditability for the breeders. Through their participation in the programme, breeders and seed producers face the risk that their products will perform poorly compared with their competitors, and thus will develop a negative reputation. Although poor results may result in poor sales, the trials also provide an excellent opportunity to learn, improve products that are in the breeder's R&D pipeline and select new products for future trials.

### 2.5.4 Performance and development outcomes

The multilocation hybrid corn yield trials sponsored by NCSRC can most definitely be called a success, based on almost 25 years of history and continuous operation. Investment in corn breeding R&D has certainly increased as a result. Many hybrids tested in the NCSRC trials have been commercialized and introduced on the market. Conversely, many hybrids tested at the trials have performed poorly, helping breeders avoid the costly mistake of launching a product that is not competitive or not yet ready for the market.

Farm yields and incomes have increased because of the availability of better performing hybrids. According to the Department of Agriculture, Thai farmers' recent corn production costs have been about THB4 000 per rai (USD833 per ha), or THB6 (USD0.20) per kg, with average yields of about 640 kg per rai (4 000 kg per ha). This is very low compared with the yields achieved in NCSRC trials, which in 2010 averaged about 1 400 kg per rai (8 750 kg per ha). Although factors such as land quality and extra managerial care certainly contribute to the difference, it is clear that new corn hybrids developed for high performance in different environments could increase farm incomes and

agriculture sector output through higher yields and increased tolerance to drought, diseases and other stresses.

Meanwhile, carrying out yield trials in different areas has helped breeders understand how their products perform countrywide, reducing the risk that customers in areas where the breeder does not operate will be displeased with seed performance. Additionally, although most breeders have their own capital resources, they have had the opportunity to share expertise, working procedures, management and problem-solving methods with other breeders. All of these help increase the performance of Thailand's seed industry. Successful breeders have also been able to leverage positive results into new marketing opportunities in Thailand and other countries.

The project has been made possible through government appropriations to Kasetsart University and NCSRC. The centre will continue in its aim to be an excellent academic institution that supports research. It does not plan to compete with the private sector. Specifically, NCSRC will continue to support the following.

- Transfer and sharing of expertise.
- Improvement of agricultural research capabilities.
- Support of hybrid corn seed R&D.
- Improvement of hybrid corn yield.

Average corn yields have steadily increased in Thailand over the last 24 years, in large measure as a result of NCSRC's annual multilocation hybrid corn research trials. According to data from the Office of Agricultural Statistics, average corn yield in Thailand increased by almost 14 percent from 587 kg per rai (3 669 kg per ha) in 2000 to 668 kg per rai (4 175 kg per ha) in 2009. Meanwhile, the country's hybrid corn breeders have raised their businesses from fledgling status to domestic and international seed production hubs for markets in Asia and other tropical corn-growing areas around the world. Thailand's domestic corn planting area of about 800 000 ha (5 million rai) requires at least 15 000 tonnes of corn seed annually. This creates a current market value of approximately THB1.9 billion (USD65 million). In addition to this domestic production, Thailand seed producers export another 15 000 to 20 000 tonnes of hybrid corn seed annually, making Thailand the world's sixth largest corn seed exporter in 2009 and the largest seed-exporting country in Asia.

Continued positive results and breeder enthusiasm will result in many more successful years for the NCSRC corn yield trial programme.

## Chapter 3

# Appraisal and conclusions

### 3.1 OVERALL EFFECTIVENESS OF PPPS

Overall effectiveness of the PPP arrangements was excellent. Three of the five selected cases achieved project targets with positive results. Mainly as a result of unexpected economic conditions, a timeline extension was required for the biogas case. As such, its final effectiveness will be judged after its completion at a later date. The B.Inter case also faced challenges associated with commercializing the fans and meeting adoption goals among poultry farmers. Timeline extensions were considered acceptable because of the nature of R&D, which often requires multiple trials for the best outcome.

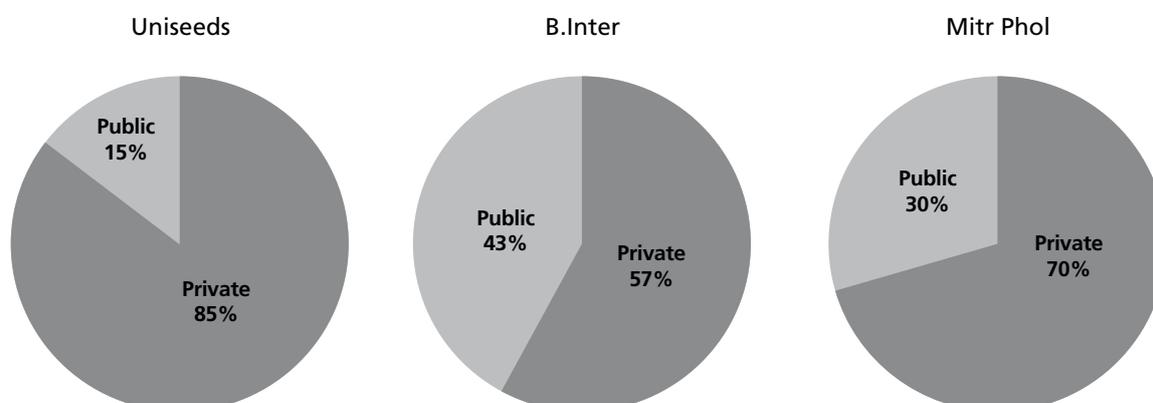
Several innovative products were commercialized as a result of the arrangements, namely: disease-resistant okra hybrids, inexpensive air control fans, test kits for white leaf disease in sugar cane, and high-performance corn hybrids. In addition to generating more domestic and export revenues for Thailand, these technological improvements and developments have benefited farmers, rural communities, and the public and private sector partners involved in the PPPs.

Based on the five cases studied, Thailand's recent agribusiness PPPs have not aligned well

with any of the classic PPP models such as build-operate-transfer; design-build-operate-maintain; build-own-operate; build-own-operate-transfer; design-build-finance-operate; rehabilitate-operate-transfer; or build-lease-transfer. Unlike infrastructure projects, which often require very large capital investments and strict public oversight, public sector involvement in Thailand's agribusiness PPPs has been relatively limited. In most cases, the public sector partner's role has been to assist the private sector to operate more economically or solve a specific problem. This has generally been accomplished through the provision of expertise and a relatively small amount of funding that constitutes only part of the total investment. Figure 8 summarizes public sector funding responsibilities in three case studies.

In three of the five cases, the private sector partners were the drivers of the arrangement, with the public sector partners simply responding to demand-driven research requests. This model had clear benefits for both parties. The relevance of the public-funded research institutions was secured and private industry competitiveness issues were reduced.

FIGURE 8  
Public-private breakdown of funding for selected projects



## 3.2 KEY ISSUES TO BE CONSIDERED IN DEVELOPING AGRIBUSINESS PPPS

While PPPs are not new in Thailand, their role in agricultural development is rarely brought to the fore. They exist because both parties, the government and the private sector, stand to benefit from well-functioning PPP arrangements. In these arrangements, the government is able to provide essential expertise and reduce the private party's risk through co-investment. In Thailand, government support for agribusiness PPPs is carried out in line with NESDP, specifically as it relates to R&D, sustainable supply chains, environmental responsibility and value-added products. Private sector partners are generally profit oriented, with innovation and cost-efficiency at the forefront of their decision-making.

However, the likelihood of positive outcomes can be increased through public sector consideration of several key issues related to developing agribusiness PPPs. Based on the case studies, some issues to be considered in developing agribusiness PPPs in Thailand are: project screening; public sector project management; risk management and distribution; regulatory framework and policy focus; flexibility; and project evaluation and monitoring. Each of these issues is detailed below.

### 3.2.1 Project screening

Successful agribusiness PPP projects are carefully screened and vetted before any partnership arrangements are negotiated. A good example is iTAP, which engages in sound project screening and problem analysis before supporting any project. iTAP receives many funding applications from private sector entities. Before the suitability of the private partner is even considered, iTAP and a project expert analyse a standard list of ten questions in order to identify and assess the market opportunities and prospects of the proposed project. If a market opportunity seems to exist, further project screening and vetting take place. If not, the application is dropped immediately. Choosing the right projects at the start greatly increases the likelihood that iTAP's PPPs will be successful. List 2 gives the ten questions used by iTAP to screen projects (section 2.2).

### 3.2.2 Public sector project management

In addition to providing technical expertise, the public sector should consider how it can add value in the managerial aspect of agriculture PPPs. For example, in the biogas case, ERDI's expertise in the management of PPP arrangements, including legal,

technical, financial and human resources issues, adds a level of value to the project that goes beyond public sector input in most of the other cases. In cases where the public sector partner is the driver, this expertise helps to recruit the best private sector participants. In Thailand, the public sector partner's network and ability to acquire third-party (outsourced) technical expertise have a direct impact on its ability to manage successful PPP projects.

### 3.2.3 Risk management and distribution

Successful PPPs in agribusiness require fair risk management and sharing strategies. In fact, risk sharing is one of the primary reasons that PPPs exist. Risk distribution is often the main concern for private sector partners in any PPP project, especially if it deals with R&D. Since R&D usually requires high upfront investment with uncertain outcomes and few marketable assets in instances of failure, private companies are often hesitant to place their own capital at risk for R&D projects. This creates a perfect opportunity for the public sector to share in the financial risk through a PPP structure.

In Thailand's agribusiness PPPs, the public partner often bears most of the financial risk during the earlier phases of project implementation. In these cases, dividing the projects and payments into different phases based on outputs helps to minimize risk for both parties before moving on to subsequent phases, as highlighted in the Mitr Phol case. In other cases, the private sector is responsible for initial cash outlays that are reimbursed by the public sector partner upon project completion.

Aside from financial risk, other risk factors may include construction, technology, environmental, operating, legal and regulatory, and political risks. Each of these can impact the development and delivery process of any PPP project and must be taken into consideration in the early stages of partnership development. Improperly managed or shared risk may have significant negative effects when the project partners depend heavily on the success of a certain project. The Uniseeds case highlighted the advantages of a structure in which both parties share a common goal and with plainly outlined responsibilities based on clear differences in expertise. This structure leaves minimal space for cooperation problems between the parties.

### 3.2.4 Regulatory framework and policy focus

Well-designed legal frameworks, regulatory standards and governance enable the public sector to promote investment by the private sector. On the

other hand, regulations that are poorly designed can slow business transactions, divert resources away from profitable investments, discourage market entry and generally discourage entrepreneurship. Proper frameworks and overview are necessary for government agencies to be efficient, stable and consistent in their delivery of each step in the PPP process. Efficiency, stability and consistency are by-products of a well-designed regulatory framework and policy focus that ultimately promotes private sector investment.

In Thailand, public sector support for R&D is especially important because, on average, the country spends less on R&D than many other countries. With growing competition from neighbouring countries, Thailand's agribusiness sector has been forced to shift towards science, technology and higher-value food and agriculture products in order to stay competitive. Thus, making more public sector support available for agribusiness R&D has been a key policy focus of NESDP.

### 3.2.5 Flexibility

Because of the often unpredictable nature of agricultural R&D, a well-designed legal and regulatory framework is needed that is flexible enough to allow for timeline extensions and similar amendments. However, extension periods should be limited and based on expert opinions from the project manager and third-party evaluators. While they are necessary in many cases, timeline extensions can be risky in high technology projects, mainly because fast-moving technological development threatens to make new products obsolete before they even get to market.

### 3.2.6 Project evaluation and monitoring

A risk evaluation or feasibility study should be implemented as part of a complete pre-project evaluation before any contract or agreement is formulated. This can help to ensure that all stakeholders are well informed before any key decisions are made. Additionally, it allows for accurate budgeting and reduced budget overruns. Ideally, a third-party consultant should be employed to carry out the feasibility study.

After project initiation, consistent monitoring with checklists and other tools ensures that all stages of project implementation are in line with planning and scheduling. This can also help to identify problems at an early stage.

Finally, a post-project evaluation should be completed by a third party in order to improve performance in future PPP projects.

## 3.3 LESSONS LEARNED ON SUCCESS FACTORS AND PITFALLS TO AVOID

Five key lessons learned from the agribusiness PPPs appraised in this report are listed below.

- PPPs focus on shared interests. Successful partnerships require a sincere belief that the shared initiative is mutually beneficial.
- Successful PPPs require clear identification of roles and responsibilities.
- Timeliness increases the likelihood of success.
- PPP stakeholders should know their markets and set realistic targets.
- PPP projects can be negatively affected by circumstances beyond the control of either party.

The five Thailand-based agribusiness PPPs studied were successful mainly because the projects were directly beneficial to the private sector and indirectly beneficial to the public sector. The more the private partner stood to benefit, the greater the likelihood that it would fulfil its commitment to make the project succeed. For example, investment in biogas systems for poultry slaughterhouses reduced the private sector's cost of power, a major operating input. It also gave the indirect benefit of improved relations with surrounding communities. The public sector benefited from reduced water treatment and cleaner air. Biogas energy generation systems were quite new in Thailand when the project began, so private businesses were hesitant to invest in the technology without partial government support. In this case, the public sector had a good management system in place with effective project approval and screening processes. Incremental reimbursement of investment costs based on progress benchmarks also encouraged completion.

Clear identification of roles and responsibilities was also helpful to encourage operational progress in the PPPs. The technical nature of the Mitr Phol project meant management and control of its various aspects were somewhat sidelined. Financial contributions aside, Mitr Phol commissioned BIOTEC to develop the white leaf disease antibody because it did not have the technical ability to do so in-house. Later, Mitr Phol and BIOTEC hired a third-party contractor to develop white leaf disease test kits because neither party possessed the required expertise. The fact that each step of the process required a specific technical skill that only one of the three parties possessed lent clarity to management roles and responsibilities. While this structure required high levels of

trust among the parties, it also encouraged steady progress towards achieving the PPP's goal.

In the successful cases, generally short time frames from the project proposal stage to implementation helped to retain enthusiasm and commitment among the partners. The use of MOUs was a common example of a mechanism to increase timeliness in the successful cases. Adopting this simple type of agreement rather than a complex legal contract cut down on costs and delays in the start-up phase.

All five successful cases also targeted realistic goals. In each case, the private sector partner was already operating in the business area targeted by the partnership arrangements before the project took place. As such, improved technology, better production processes and more reliable supply chains quickly improved the private companies' bottom lines. This also created an environment in which the private sector partners possessed in-depth knowledge of business practices relevant to the projects, increasing the likelihood of success.

While expertise in topics such as technology, engineering and animal husbandry played an important role in the PPPs, effective project management, contracts and agreements were also required in order to ensure positive results. Progress audits played an important role. When used, checklists for each step were advantageous to ensure that all processes and activities were completed at all stages of implementation. The Uniseeds and Mitr Phol projects were particularly good examples of effective project management and process auditing.

Even with effective management, it is important to note that PPP projects can be negatively affected by circumstances beyond the control of either party. The biogas project was a good example, where one of the slaughterhouses that ERDI had selected to receive support for investment in a biogas energy system was severely affected by economic factors after undergoing the entire vetting process and signing an MOU to join the project. As a result, the company decided to withdraw from the project because of its inability to meet investment requirements. This was an unexpected and uncontrollable circumstance that presented a key challenge to ERDI, which was forced to recruit a new poultry slaughterhouse late in the proceedings. Indeed, the overall project was delayed by slower than expected construction progress and an economic downturn in which decreased poultry demand led to reduced wastewater production, resulting in reduced biogas production.

Finally, most of Thailand's PPPs in agribusiness were possible because several government agencies understood the importance of building agribusiness competitiveness through value-added processes and R&D. However, with so many government agencies working on agribusiness R&D PPPs in various ways, private sector sources complained that it was difficult for them to know which agency or agencies they should approach for help with a specific problem. Efforts should be made to build understanding of each agency's focus, responsibilities and expertise, or consider consolidation of certain programmes.

### **3.4 HOW BENEFITS FOR ENTERPRISES AND RURAL DEVELOPMENT MIGHT BE FURTHER ENHANCED**

The recent focus on R&D in Thailand's agribusiness sector has been an important step for the country. However, benefits for enterprises and rural development could be further enhanced through the development of improved agricultural supply chains, with a sharper focus on making them more efficient and cost competitive versus other global suppliers. As a leading producer and exporter of agricultural products, Thailand is correct to focus on supply chain development and management. Market liberalization and increasing consumer demand offer attractive opportunities for Thailand, yet the more stringent global market standards, rising demand for safer and more nutritious food, greater focus on last-minute delivery, and increasing trade regulation are also major challenges for Thai producers. It is therefore essential that Thailand develop more efficient and globally oriented supply chains to remain competitive.

Supply chain development in both local and international markets could be enhanced through more use of PPPs. Producers in rural areas could be granted increased access to market information and knowledge of value-added activities through PPPs related to agricultural product supply chain development. The potential advantages of supply chain development are many: increased sales, improved product quality and safety, dissemination of technology and knowledge, and reduced transactions, among others.

Supply chain development in Thailand's agribusiness sector would not only benefit the private sector (producers, processors, exporters and others), but would also create spin-offs that stimulate development of the social, economic and environmental well-being of rural individuals and enterprises. Public support should play a key role

in encouraging private sector investment. PPPs in supply chain development would aid private sector investment by sharing risks, providing strategic input and helping to minimize bottlenecks. This would require information sharing, expertise in supply chain development and management, and also communication and commitment from all partners. The public sector should take steps to enhance partnership building and raise awareness of public support. Pilot projects and the development of a best practices toolkit (including topics such as good agricultural practices, efficient consumer response and information on food safety certification) should be implemented to foster supply chain development.

PPPs in agribusiness supply chain development should focus on maximizing efficiencies for the production and marketing of individual products, increasing value-added activities, strategic planning, and information sharing across all aspects of the supply chain. Supply chains are based on interdependence, trust, open communication and mutual benefit. PPPs should also focus on involving smallholders through contract farming and trade with the many informal farmer groups and associations that exist in Thailand's agriculture sector.

Finally, in order to maximize private sector impact, the public sector can improve the environment for agribusiness supply chain development by:

- organizing platforms for the public and private sectors to exchange information;
- providing market information and trade statistics to facilitate market activities;
- investing in infrastructure;
- increasing supply chain knowledge through public research institutions or programmes;
- developing and testing new technologies, tools, instruments and models to improve the performance of supply chains;
- co-financing the development of pilot projects;
- sharing experience and knowledge gained from pilot projects through publications;
- offering incentives for sustainable use of production resources;
- offering subsidies for high-risk investments (such as R&D and biogas energy systems in poultry slaughterhouses); and
- creating an environment in which smallholders and the poor can obtain income, employment and a reliable supply of agricultural products.

### 3.5 POTENTIAL AND ESSENTIAL REQUIREMENTS FOR REPLICATION

Requirements for PPP replication include the six key issues outlined in section 3.2: project screening; public sector project management; risk management and distribution; regulatory framework and policy focus; flexibility; and project evaluation and monitoring. Addressing these key issues will increase the likelihood of project success and create a sound environment for PPP replication. As these issues demonstrate, the success of PPPs is often determined by the level of care in project selection and planning before operations begin.

In addition to these six key issues, favourable policy focus and financial sustainability of PPP projects are key factors that increase the likelihood of replication. The importance of favourable policy focus is demonstrated by the focus on R&D in Thailand's agribusiness sector. The Mitr Phol case is a prime example of a project that enabled replication through financial sustainability.

Recent policy focus in Thailand's NESDP has channelled significant appropriations to government agencies that support R&D in the agribusiness sector by providing funding, expertise and other services. Two of the most important agencies providing these services are NSTDA and BIOTEC. Others include ERDI, NCSRC and researchers at various public universities. None of the five agribusiness PPPs studied would have been possible without these agencies. Future replication of successful agribusiness PPP projects in Thailand depends on their continued support.

As part of the PPP arrangements in the Mitr Phol case, BIOTEC, the public sector partner, developed new technology able to detect white leaf disease phytoplasma in sugar cane. It then retained legal ownership of the technology through intellectual property laws. When the technology was later used in commercialized test kits to detect white leaf disease, BIOTEC received royalty payments from test kit sales. This allowed it to be less reliant on governmental budget appropriations, the primary source of its funding, to provide its services in future partnership opportunities. As the Mitr Phol case illustrates, public sector agencies can increase their ability to fund future PPP projects through financial sustainability. Creatively developing secondary funding sources that do not rely on the whims of legislative bodies for appropriations can reduce risks, increase an agency's ability to set budgets in advance and allow for replication of successful projects.

### **3.6 POTENTIAL OF PPPS AS A TOOL FOR ACCELERATING AGRIBUSINESS INVESTMENT AND DEVELOPMENT**

Based on the success of the five agribusiness PPPs studied, there appears to be good potential for PPPs as a mechanism for accelerating agribusiness investment and development. PPPs that invest in new, high-technology infrastructure may have the best potential to do this. The biogas case demonstrates how PPPs can best be used as a tool to encourage private sector investment.

Biogas energy generation systems for poultry slaughterhouses require a fairly high level of initial investment. As such, poultry processors have been hesitant to move forward with such expensive technology. Indeed, many factories are not only unwilling but are unable to afford or obtain bank funding for such a high investment. However, with co-investment support via a PPP structure, investment in biogas systems has increased. Such invest-

ment is associated with multiple benefits, including reduced energy usage and wastewater treatment costs. According to interviews with several poultry processors who have adopted the technology, it would have been impossible for them to invest in the system and realize the associated benefits without support from the public sector.

As these and other successful cases demonstrate, PPPs can be an important tool for accelerating private investment and development in agribusiness. In Thailand, PPPs have supported the development of the agribusiness sector, both by sharing in the often large financial outlays and by providing technological expertise, especially in projects dealing with R&D and new technology adoption. Future replication of recent success in agribusiness PPPs will depend on careful project selection and planning, favourable policy focus and financial sustainability.

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AGRIBUSINESS  
PUBLIC-PRIVATE  
PARTNERSHIPS

A country  
report of  
Thailand



Public private partnerships (PPPs) are being promoted as an important institutional mechanism for gaining access to additional financial resources, sharing risks, and addressing other constraints in pursuit of sustainable and inclusive agricultural development. While various forms of collaboration between the public and private sector have existed for some time, there is limited systematic information available about the current experiences and best practice for using PPPs to initiate agricultural programmes.

In 2010, FAO initiated a series of appraisals of PPPs implemented in 15 countries in Africa, Asia and Latin America. The primary objective was to draw lessons that can be used to provide guidance to member countries on how to partner effectively with the private sector in order to mobilize support for agribusiness development. The outcome of FAO appraisals is presented in this series of Country case studies as a contribution to enriching knowledge and sharing information on PPPs mechanisms for informed decision making on investment promotion for engendering agrifood sector development.

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