The World Bank

Agriculture and Rural Development Discussion Paper

Costs of Compliance with SPS Standards:

Thailand Case Studies of Shrimp, Fresh Asparagus, and Frozen Green Soybeans

Sompop Manarungsan
Jocelyn O. Naewbanij, and
Tanapat Rerngjakrabhet

with assistance from:
Rapeeporn Suthatham
Nucharin Ketnil
Krisana Pongsricharoensook

ARD
AGRICULTURE AND RURAL DEVELOPMENT

First printing or web posting: 2005

1818 H Street, NW
Washington, DC 20433
Telephone 202-473-1000
Internet www.worldbank.org
E-mail ard@worldbank.org

Agriculture and Rural Development Discussion Papers is an informal series produced by the Agriculture and Rural Development Department of the World Bank. These papers raise concepts and issues for discussion in the broader development community and describe ongoing research and/or implementation experiences from the Bank.

The findings, interpretations, and conclusions expressed herein are those of the author(s) and do not necessarily reflect the views of the Board of Executive Directors of the World Bank, the governments they represent, or the organizations of contributing authors.

The World Bank does not guarantee the accuracy of the data included in this work.

Contents

Foreword

Food and agricultural trade is the vital link in the mutual dependency of the global trade system and developing countries. Developing countries derive a substantial portion of their income from food and agricultural trade. The emergence of food safety and agricultural health issues and the related tightening of market requirements form challenges to further gains from trade due to the lack of technical and financial capacities of many developing economies.

As part of a joint program between the World Bank's Agriculture and Rural Development Department (ARD) and International Trade Department (PRMTR), a survey on the Cost of Compliance of exporting developing countries was undertaken. The survey was focused on the supply chains of high-value food products (horticulture, fish, meat, spices, and nuts). The study quantified the costs incurred by both the public and private sectors; identified the coping strategies employed by the various stakeholders in the supply chains; determined the constraints that hinder compliance; examined the structural changes in the supply chain resulting from compliance with the safety standards; and evaluated the impact of these standards on small-scale enterprises and producers. The survey included Ethiopia (animal products), India (fish and spices), Jamaica (nontraditional agricultural exports), Kenya (fish and horticulture), Latin America Southern Cone (animal products), Morocco (fruits and vegetables), Nicaragua (shrimp), Senegal (fish and groundnuts), and Thailand (shrimp and horticulture).

This working paper is one of a series of such case studies that examined the strategies and costs of compliance of the various stakeholders in developing countries with international agro-food standards. This paper was prepared by Sompop Manarungsan (Chulalongkorn University, Bangkok, Thailand), Jocelyn O. Naewbanij and Tanapat Rerngjakrabhet (National Food Institute, Bangkok, Thailand) with assistance from Rapeeporn Suthatham, Nucharin Ketnil, and Krisana Pongsricharoensook (National Food Institute, Bangkok, Thailand) with guidance from Kees van der Meer (ARD).

A complementary perspective is provided by the companion series of buyer surveys involving representative importers, brokers, retailers, and distributors in the European Union, Japan, and the United States. This series, in turn, discusses the buyers' perception of the strengths and weaknesses of their suppliers and describes the assistance and/or interventions offered by the buyers to their developing country suppliers.

The findings and conclusions derived from these country studies are discussed in a synthesis report that seeks to identify possible points of intervention by the World Bank and other donor agencies and to determine the types of technical assistance that would be most efficient and appropriate. It is hoped that the experiences of these exporter and importer countries will provide useful insights to practitioners in the field, and to national and international policymakers in both the public and private sectors.

Kevin Cleaver
Director, Agriculture and Rural Development Department

Uri Dadush
Director, International Trade Department

Acronyms

ADB	Asian Development Bank
AOZ	Amino Oxazolidinone
BAPHIQ	Bureau of Animal and Plant Health Inspection and Quarantine (Thailand)
BRC	British Retailers Consortium
BSMI	Bureau of Standards, Metrology and Inspection (Thailand)
CFR	Code of Federal Regulations (US)
COC	Code of Conduct
CP	Charoen Pokphand
CPG	Compliance Policy Guides
DEFRA	Department of Environment, Food and Rural Affairs (UK)
DEP	Department of Export Promotion (Thailand)
DLD	Department of Livestock Development (Thailand)
DMS	Department of Medical Sciences (Thailand)
DOA	Department of Agriculture (Thailand)
DOAE	Department of Agricultural Extension (Thailand)
DOF	Department of Fisheries (Thailand)
ELISA	Enzyme-Linked Immunosorbent Assay
EMS	Environmental Management Systems
EU	European Union
EUREPGAP	European Union Retailer Produce Working Group, Good Agricultural Practice
FAO	Food and Agriculture Organization of the United Nations
FAS	Foreign Agricultural Service (US)
FDA	Food and Drug Administration (US)
GAP	Good Agricultural Practice
GDP	gross domestic product
GMP	Good Manufacturing Practice
GNP	gross national product
GSP	Generalized System of Preferences
HACCP	Hazard Analysis and Critical Control Points
IQF	Individually Quick Frozen
ISO	International Organization for Standardization
JETRO	Japan External Trade Organization
LC-MS-MS	liquid chromatography with tandem mass spectrometry
MHLW	Ministry of Health, Labor and Welfare (Japan)
MRL	Maximum Residue Level
NESDP	National Economic and Social Development Plan
NFI	National Food Institute (Thailand)
NSO	National Statistical Office (Thailand)
PCR	polymerase chain reaction
ppm	parts per million
PQMS	Plant Quality Management System
SPS	Sanitary and Phyto-Sanitary
TFFA	Thai Frozen Food Association
THB	Thai Baht
TISI	Thailand Industrial Standard Institute
UK	United Kingdom
USDA	United States Department of Agriculture
WB	World Bank

WTO	World Trade Organization

Summary

This study surveys the sanitary, phytosanitary, and other market requirements of the major markets for Thai shrimp, fresh asparagus, and frozen green soybean exports and the compliance of the Thai exporters.

Market Development Dynamics

Shrimp, asparagus, and green soybeans (edamame) were introduced and developed in Thailand as export products with assistance from foreign investors. A Taiwanese investor brought in the technology of shrimp farming while Japanese investors introduced asparagus and green soybean farming in the country. Widespread adoption of shrimp farming by Thai farmers and continued research and development progress made by both private and government sectors expanded and diversified the industry. As a result, Thailand is the world's largest shrimp exporter. Production of asparagus and green soybean has had less growth. Exporting fresh asparagus needs careful planning and coordination and close supervision of the contract farming group to fulfill orders and ensure compliance with market and sanitary requirements. Although asparagus was initially grown to supply the need of the Japanese market, Thai asparagus now supplies many other countries as well. With green soybean, the major limitation for expansion was the limited farm area suitable for its growth.

The lucrative business of exporting attracted many entrepreneurs to invest in production for exports. However, variations among food producers—in investment, technologies, employee capability and capacity, quality management system, operational budget allocations, and differences in their capability and capacity to meet sanitary and quality requirements—resulted in product differentiation and market segmentation. Producers with bigger capital investments generally have better facilities and employees to meet different market segment requirements. These factories tend to supply the higher-end market while smaller factories with less capital investment to implement good quality management system are supplying local markets and countries with less stringent sanitary requirements.

Consumers with high purchasing power demand that supermarkets provide them with products that have safety and quality assurance certification and labels containing the necessary information to enable them to make informed choices. To conform with the demand, supermarkets are offering specialized and premium-priced products such as organic products, pesticide-free vegetables, ready-to cook or serve products, products from animals reared and treated according to animal welfare provisions, products with environment-friendly packaging, and other value-added features. To meet all the market-driven requirements, retailers, and processors developed private standards and imposed them on their suppliers. Public standards are set as the minimum requirement for food safety. Most private standards are set higher than the public standards since the former put not only safety but also quality into consideration. Quality includes the physical attributes of the products, such as freshness, and other sensory qualities, and packaging, which enhances marketability. To ensure that suppliers implement a quality management system that meets their requirements, retailers and processors make visit audits on a regular basis. Exporters of shrimp, fresh asparagus, and frozen green soybeans that supply to the high-end market segment bear the costs necessary in putting in place and maintaining the required quality system.

To cope and conform with the demands of the market, changes are taking place on the suppliers' side. Suppliers with big capital investment are moving toward integrated supply chain management: networking vertically to include all aspects, from primary production to marketing. Through vertical

integration, the management has full control of the quality and costing of the entire system operation. For small-scale exporters to compete in the market, they resort to coordinated supply chain management, as exemplified by contract farming, to ensure product quality that is in compliance with both public and private standards.

To ensure food safety throughout the entire food chain, a traceability system, with record-keeping is now employed by suppliers, particularly those supplying high-end markets. The system is used primarily to market foods with subtle quality attributes, facilitate the tracking of products with problems, and improve supply chain management.

Although product coding long has been used in industrial production and merchandising to facilitate the recalling of defective products, the new system extends to include primary production. Keeping a traceability record can assist buyers in establishing a list of reliable suppliers. Conversely, for the suppliers, it can be a tool to identify the point in the food chain at which a food safety problem has occurred or is likely to occur, thus providing guidance to operators/processors on points on which to focus control and monitoring. Traceability systems are now a requirement imposed by the high-end supermarket retailers on their suppliers.

The willingness of some market segments to pay more for certified quality- or safety-assured products has turned food safety into a marketing tactic to differentiate quality product from mass products. This tactic is particularly popular among multinational retailers operating in many parts of the world.

Product Overview

Shrimp

Thailand remains the world's leading shrimp exporter with approximately 25 percent world market share. Shrimp brought in an average annual revenue of US$2.32 billion in 1998–2001. In 2002 shrimp exports fell to only US$1.72 billion as a result of the increasing price competition among suppliers and the zero tolerance of banned antibiotic residues imposed by the EU.

Thailand's primary shrimp markets are Japan and the United States. The export market accounts for 75 percent of the total shrimp production; only 25 percent is consumed locally. Shrimp exports constitute 54 percent of prepared and preserved products, and 43.4 percent of chilled and frozen products.

Shrimp production is 75 percent–80 percent cultured and 20 percent–25 percent captured. There are approximately 75,000 people employed in the 65,000 hectares (ha) of shrimp farms in Thailand. In 2000 approximately 80 percent of them were farming less than 1.5 ha, 18 percent farming 1.5 to 2.5 ha, and only 2 percent farming more than 10 ha. Shrimp farms in Thailand are 85 percent intensive and 15 percent semi-intensive or extensive and are concentrated in three major areas: South (55 percent of the farms), East (35 percent), and Central (10 percent).

Most processed shrimp are distributed via supermarket chains (exporter-importer-distributor-supermarket chain). Supermarkets set quality and sanitary standards with which Thai suppliers must comply. Although most compliance with standard problems encountered by Thai shrimp exports in the country's major markets can be considered minor, the EU's enforcement of zero tolerance for banned chloramphenicol and nitrofuran chemicals in shrimp that destroyed Thai shrimp shipments in 2001 and 2002 stirred actions and changes in both private and government sectors to prevent occurrence of similar problems in the future.

Costs of sanitary compliance with shrimp stakeholders. The impact of tightening the sanitary measures on chemical drug residues in shrimp has resulted in three major developments at the farm level: the recognition and popularization of probiotic farming, the farming of disease-resistant *vannamei* shrimp, and the emergence of more laboratories providing diagnostic test services.

To minimize the use of chemicals and reduce the chance of leaving residues in shrimp harvests, farmers are using a more disease-resistant shrimp variety (*P. vannamei*), which does not require as many chemical drugs as the Black Tiger variety. Farmers also are switching to probiotic farming, which makes use of the microbiological formulation that can both clean up the ponds of feed wastes and serve as nutrients to farmed shrimp.

The use of alternative chemicals increased costs by 5.7 percent from the conventional chemical-supplemented shrimp farming method, but by shifting to probiotic farming, farmers decreased their production costs by 33 percent. Using probiotic farming and also switching from Black Tiger to white *vannamei* shrimp reduced production costs further by approximately 39 percent. However, bigger Black Tiger shrimp sizes command a higher price than the price of the smaller but higher-yielding *vannamei* shrimp. So, regardless of which shrimp farmers raised, income may not be quite different except that *vannamei's* greater resistance to disease lessens farmers' harvest uncertainties.

The costs to the exporters/shrimp processors of compliance with the zero tolerance ban was approximately US$328/ton of shrimp. This figure is based on estimated laboratory analysis expenses of US$1,804,525, given 5,510 tons of shrimp exports to the EU. Roughly, the cost of compliance is approximately 1.6 percent of the total shrimp export value to EU of US$111 million.

The cost to the government sector to test and monitor chloramphenicol and nitrofurans amounts to US$4,301,790 (the cost of the analytical equipment). As a consequence of the chloramphenicol and nitrofuran cases, many reforms have been undertaken: the enforcement of the registration of farmers and cooperatives to facilitate traceability; the requirement for 100 percent testing on all shrimp exports to the EU; and the promotion of quality management systems in the entire food chain.

As most of the problems of quality compliance could be traced back to the farms, traceability systems are now implemented by some large exporting companies. Having traceability systems is also a marketing tactic, especially in the high-end markets, to qualify the products as safe.

Asparagus

For the past 5 years, exports of Thai asparagus has expanded in both volume and value with an average growth of approximately 60 percent and 40 percent, respectively. The volume of exported fresh asparagus in 2002 totaled 8,013 tons, with a value of US$12.2 million–an increase of 7.9 percent in volume and 23.9 percent in value over that of 2001. This growth is a result of the rising consumption, especially in Japan, which is a major world asparagus importing country, as well as the expansion to new markets such as the EU, India, and the United Arab Emirates.

Present production has increased by approximately threefold from 2,300 tons annually in 1998 to 8,500 tons for the last five years, and planted areas have increased from 600 ha to 2,200 ha. In 2002 there were approximately 5,850 farmers engaged in asparagus production in Thailand.

Japan is the destination of 40 percent–50 percent of Thailand's total asparagus exports. For the past 5 years, export growth rate has increased to 19 percent in volume and 28 percent in value. Value growth

exceeding volume growth suggests that Japanese demand has risen. Thailand, with 16 percent market share, competes with Australia (30 percent) and the Philippines (20 percent) in the Japanese market.

Taiwan is Thailand's second largest market for asparagus in terms of value. In terms of volume, it is the largest. Thailand is the leading supplier of asparagus to Taiwan holding a 91 percent share followed by Australia with 4.4 percent, and the US with 4.1 percent share. The UK is still a small market for Thai fresh asparagus accounting for only 288 tons in 2002. In 2001 Thailand provided approximately 5 percent of the UK's total asparagus import volume (4,900 tons).

Costs of sanitary compliance to asparagus stakeholders. The tightening of the pesticide and other chemical residues standard requirements in Japan and other markets has pressured exporters to impose more stringent controls on their contract farmers on the use of pesticides. By shifting toward organic or reduced chemical usage in farming, farmers increased their initial production costs by 165 percent and lowered their yield by 20 percent. However, their produce commanded a price that is 29 percent higher than the price of its conventional pesticide-treated counterpart.

For the exporters, the bulk of the increase in the costs of compliance is due to the cost of the private laboratory analysis. Roughly, the cost of compliance with exporters is 100 percent higher than the compliance cost prior to the tightening of the pesticide requirement. Laboratory analysis accounts for 63 percent, and the implementation of quality systems 37 percent of this cost.

For the government, the additional costs are the expenses for the additional laboratory equipment and training staff to provide additional laboratory services to the private sector. Other costs to the government are for research and development, such as developing standards and guidance for Good Agricultural Practices, pesticide test kits, high-yielding and pest-resistant varieties, and technology to prepare and preserve natural pesticides. No financial estimates on this research and development

Frozen green soybean

Approximately 98 percent of the green soybean (edamame) production is exported to Japan. Japan consumes approximately 170,000 tons of green soybean annually, that is, approximately 1.5kg/capita annual consumption, while its domestic production supplies only 60 percent of its demand. China, Taiwan, and Thailand with market shares (volume) of 50 percent, 34 percent, and 13 percent, respectively, were Japan's leading suppliers of frozen green soybean in 2002.

Thailand's green soybeans are mostly grown in the north of the country, particularly in Chiangmai, Chiangrai, and Lampang, by some 8,250 farmers. Its yearly average production is approximately 10,000 tons. With only 3,000 ha of farm land available with a maximum production of no more than 14,000 ton/year, expansion of production does not seem feasible. Export expansion is further limited with only three processing companies exporting frozen green soybeans. Increase of production and market share will require research on how to increase yield and to produce varieties suitable for other environmental conditions.

The competitive advantage of China over Thailand is its lower price offer, but with the present food safety problems in China and the rapid expansion and development of supermarkets chains in Japan, it is likely that potential suppliers with commendable records of safety and traceability of products will be preferred.

Costs of sanitary compliance with green soybean stakeholders. For frozen green soybean, the cost of pesticide compliance with farmers increased their production costs by approximately 10 percent from

US$1,114 to US$1,200 per ha/year. The increase in costs was primarily due to use of better-quality but costlier chemicals and organic fertilizers for mixing with chemical fertilizers, which have been found to induce better quality pods and yield.

To comply with Japan's strict pesticide standards, frozen soybean exporters invested in compliance in five major areas in their production:

- *Technology.* Exporters increased investment in technology and test equipment. Equipment increased by 25 percent in quantity or 33 percent in value.

- *Human resources.* Exporters increased their staff by 35 percent with quality control and testing staff increasing by more than 200 percent, and farm advisors by 15 percent of the previous number.

- *Training.* Staff were sent for training at government laboratories to learn the techniques and standard analytical methods of measuring pesticide residues. The contract farmers were sent for training in agricultural production and product quality maintenance.

- *Quality control and testing*. The costs of testing per month increased from US$820 to US$11,598. The number of samples tested daily increased 8-fold while field sampling was changed from random to 100 percent sampling. Additional random checks are conducted at the arrival of raw material, after washing, during processing, and before shipment of frozen products.

- *Quality system implementation*. To meet international standards and build consumers' confidence in their products, all Thai companies interviewed are GMP, HACCP (Hazard Analysis and Critical Control Point), and ISO 9000 certified.

Developments Affecting Food Safety Compliance

Two major developments are affecting the compliance of the Thai food exporters. One is the consumers' increasing food safety awareness that forces both regulatory bodies and food supermarkets and retailers to impose more stringent food safety requirements. For example, the government is now requiring enlisting farmers to promote traceability. Imposing stringent sanitary requirements has had both positive and negative impacts on Thai exporters. The positive impact is that sanitary standards are pushing the private sector to improve and adopt a quality management system that can provide its products with a competitive edge. As a consequence, exporting companies select their own raw material suppliers and assist them in implementing quality systems to be in compliance with their market's requirements. More exporters are avoiding open markets as their raw material sources because traceability systems are hard to implement and product quality hard to control in such a setting. The negative impact is that the cost of implementing quality systems often is not reflected in the market price unless the product is customized for the high-end market segment.

The second development is the changes in the market distribution. As more exporters are supplying supermarkets, suppliers need to be competitive by complying not only with the supermarkets' more stringent food safety requirements but also with the quality and sensory attributes of the product. To ensure product quality, quality management systems and traceability must be in place in the entire food chain. To control and manage quality and operational costs, exporters are moving toward integrated or coordinated supply chains.

With the globalization of supermarkets and the shortening of the market distribution chain, supermarkets are able to provide consumers safe and quality products at more affordable prices. A proactive strategy can be rewarding (box 1).

Box 1. Rewarding proactive strategy

A Thai packing house that collected horticultural products from small-scale producers and delivered packed products for export to an exporter received strong signals in the late 1990s from buyers in the UK that it had to upgrade to the new retail standards of the British Retail Consortium (BRC) and EUREPGAP. The company decided on a proactive and offensive strategy. The company acquired land to establish Good Agricultural Practices (GAP). It upgraded all its facilities, introduced HACCP and ISO 9001 with external certification, and was BRC accredited in 2003. Its farm is EUREPGAP accredited. It has heavily invested in training its staff. The company shortened the supply chain by exporting directly and leaving out the exporter. The company has long-term daily delivery schedules with buyers, which enabled the company to negotiate low air-freight rates.

In 2003 the company produced approximately 35 percent of the value of its shipping on its own farms, but that share is declining. It buys the rest from small-scale farmers through a system of contract arrangements with brokers for farmers' groups and their individual members. The brokers provide technology and ensure compliance with delivery requirements. For vegetables, Good Agricultural Practices are prescribed; and growers receive training, seeds, pesticides, and other inputs**.** The inputs are repaid in kind. Use of inputs and production is registered daily. The farmers' groups have first responsibility to control compliance with GAP requirements. The number of the company's contract farmers was approximately 900 at the end of 2003 and has been increasing. This company's sales grew from US$3.3 million in 1999 to US$8.5 million in 2003 and to an estimated US$11.5 million in 2004.

Source: Information collected by Sompop Manarungsan and Kees van der Meer, May 2004.

1. Introduction

Following the meeting of September 22, 1985 of the G-5 countries (world economic leaders consisting of France, Germany, Japan, UK, and US), also known as the Plaza Accord, these 5 countries agreed to free float their own currencies and to pursue national policies conducive to economic development to sustain global economic growth and higher employment.

As a consequence of the free floating of currencies, the Japanese yen appreciated in value while the US dollar, which has been overvalued for the past years, depreciated to its market value. With the appreciation of the yen, the Japanese government encouraged industrial production expansion through relocation. Thailand, on the other hand, has a national policy to pursue an export-led development. With the Thai Baht pegged to the US dollar, which depreciated in value, investing in Thailand became quite attractive to Japanese investors. Japan viewed expanding its production base in its neighboring countries, including Thailand, particularly in agricultural production, as an ideal solution to meet Japan's increasing demand for and diminishing supply of food, owing to its increasing population and decreasing land area for agricultural production. Likewise, in pursuing the enhancement of sustainable economic growth and the promotion of higher employment globally, the USA and the other G-5 (European) countries also invested in other countries, bringing their capital and technology to developing countries and helping them with the distribution and marketing of their finished products.

The food sector is an important economic sector in Thailand. It contributes 14.4 percent in export revenue, provides employment to some 20 million people in both agricultural and industrial food sectors, and absorbs approximately 80 percent of the country's raw agricultural food production. Thailand is a net food exporter, and frozen shrimp has been its largest food export (in value) for more than a decade.

Thailand's rapid agricultural and industrial development is a result of the government's 5-year National Economic and Social Development programs, which were launched in 1961. The aim of these programs was to promote industrial development and exports. Thailand adopted a competitive, export-oriented economy that resulted in decades of unprecedented economic performance and business optimism. The consistent average GDP growth of 8.2 percent in 1985–94 encouraged and instilled great confidence in business sectors to engage in enormous property market speculation and construction projects, which subsequently resulted in the accumulation of nonperforming loans. These nonperforming loans led to economic setback and forced the government to devaluate the Baht in July 1997. The crisis had caused most economic sectors to register negative growth rates (with the exception of agriculture, which achieved a positive rate of 2.8 percent in 1998) that further devalued the Baht. The foods affected by the Baht devaluation were mostly those that need import materials in their production since they need to pay more Bahts to buy dollars. For frozen and prepared shrimp or fresh and frozen vegetable exports, these events did not have any impact.

To enhance economic revival, the government introduced a restructuring plan to boost the development of the country's raw materials and the other industrial sectors. The aim was to reinvigorate the country's exporting capacity while reducing unemployment created by the closing of other economic business sectors, developing small and medium-scale enterprises, enhancing better quality and standards of production, developing relevant applied research, and enhancing greater cash liquidity in the business sector.

As part of the government's aim to maintain its competitiveness and position as one of the world's key food-exporting countries, it launched the "Kitchen of the World" program, which aims to widely promote Thai food products and Thai cuisine internationally by creating an image for Thailand as the country of quality and safe food. As part of the program, the Ministry of Public Health designated

2004 as the "Year of Food Safety," implying that stricter measures would be implemented on inspection and certification of both food exports and imports. Measures also are being prepared to ensure traceability and food safety throughout the entire food chain. Relevant agencies are collaborating to put an effective framework in place and to expedite the implementation of food safety policies.

Selected Products

For the selection of products for this survey, two major criteria were considered: (1) the product must be in conformity with the products selected by the other teams; and (2) it must be a product exported in large volume or value. The three products selected for this study were shrimp, fresh asparagus, and frozen green soybean. Shrimp, which is exported mostly in the frozen or prepared/preserved form, is the largest (in value) export food product of Thailand. Fresh asparagus and frozen green soybean were selected, even though their export volume is relatively small compared with the other food exports of Thailand, because they are largely exported to Japan, one of the countries surveyed in this project.

Methodology

The study was conducted using questionnaires and interviews. The questionnaire (in Thai), which was similar to that used by the other teams on this project, was sent to pertinent exporting companies. Answers were analyzed, and the information was included in this paper. Potential participants for in-depth interviews were identified, and researchers communicated by writing and by telephone or by e-mail for permission and scheduling of appointment for interviews. The topics and issues to be covered in the interview were sent in advance.

The in-depth interviews made were as follows:

For shrimp:

2 association of processors/exporters
3 exporting company owners/managing director
1 private service laboratory analyst
2 hatchery owners
4 village shrimp farmers
2 Department of Fisheries (DOF) staff
1 private company researcher

For fresh asparagus:

2 village head farmers
3 exporters
1 broker
1 DOA staff

For frozen green soybean:

3 village head farmers
3 exporters
1 broker
1 Department of Agriculture (DOA) and Department of Agricultural Extension (DOAE) officer

2. Shrimp

Shrimp Farming Production Development

Black Tiger Prawn was first introduced in 1974 by the Department of Fisheries Regional Office in Pukhet to local farmers. However, this shrimp did not become popular until 1983, when a Taiwanese entrepreneur came to Thailand to survey the possibility of establishing a shrimp food factory and an aquaculture breeding training center. As part of the training center, a model aquaculture pond was built, which was seen as the major force in popularizing aquaculture farming in the country.

In 1983 shrimp farms were occupying some 35,200 ha but increased to 40,000 ha in 1985. Production from mostly extensive and semi-extensive farms in 1982 was only 170 tons; in 2000 shrimp aquaculture production was 300,000 tons from around 80,000 ha. Shrimp landing, on the other hand, was 178,500 tons in 1982; and in 1990, it was down to 107,400 tons, indicating that the maximum sustainable catch had already been exceeded. The 1996 catch was 134,483 tons, of which 76 percent was from the Gulf of Thailand and the rest from Indian Ocean (TFFA 2001).

To increase local food subsistence in rural areas, the government included "Shrimp Culture Development" in its 5th (1982–86) National Economic and Social Development Plan (NESDP). By the 6th NESDP (1987–91), the government received a US$33.1 million loan from the Asian Development Bank (ADB) to promote aquaculture as a viable export industry. The ADB also provided technical assistance grants for project preparation and implementation.

Black Tiger shrimp had not gained international acceptance until 1987, when its demand jumped dramatically and increased the country's production tremendously. Production was up to 10,544 tons from a land area of 51,200 ha as a consequence of the growing demand in Japan and other markets.

The high demand for shrimp and the prospect of high profit have been the main driving forces for farmers to engage in shrimp farming. The shrimp farming boom in Thailand also boosted the growth of hatcheries. However, in 1995–97, shrimp production decreased as a result of a series of natural calamities including typhoons, which destroyed hatcheries and shrimp farms, followed by a shrimp epidemic. The problems of the shrimp exporters were compounded by the shrimp exports' graduation from the EU's Generalized System of Preferences (GSP) implemented in 1996, which basically increased the tariff, thereby affecting Thai shrimp products' competitiveness in the EU market. On top of that, local environmental activists were protesting aquaculture shrimp farming and accusing it of destroying mangroves and their natural habitat.

Shrimp farming was developed in the coastal area to provide a near-natural environment to shrimp. Thais have been raising shrimp and fish by enclosing them with hand-made dikes in mud flats. By building simple gates, they were able to let seawater flow in and out of their ponds naturally. This type of farming is known as *extensive* farming. Later, *semi-intensive* farms were developed and built near the coast of the central region. These farms later moved to mangroves. After the strong protest from local activists, *intensive* shrimp farming was introduced. In intensive farming, more shrimp were produced per unit area, but instead of feeding on natural seafood, they fed on formulated feeds. Intensive farming ponds are easy to clean after harvest.

Two agribusiness groups dominate the shrimp aquaculture. One is Charoen Pokphand (CP) Aquaculture Business Group; the other is Aquastar Ltd., which has foreign investment. CP established four processing companies in Thailand, then expanded its operation to Australia, China, India, Indonesia, Mexico, and Vietnam in the 1990s. Moving toward vertical integration and high

efficiencies, CP utilized products from its feed mills and market shrimp products through its expanding food market network. CP utilized contract farming by linking farmers with company operations in a manner that minimizes overhead costs while consistently producing an export-quality product (DEP 2001). Fresh water shrimp farms were developed. To control the spread of disease that had affected seminatural and natural settings during the past 4–5 years, the shrimp farms moved to the lower central region. In 2000–01 CP introduced a more disease-resistant and less salt-sensitive shrimp strain, *P. vannamei*. At present, the smaller *vannamei* shrimp (50–60/kg) earns an almost equal share of export volume as the bigger Black Tiger shrimp strain (30–40/kg).

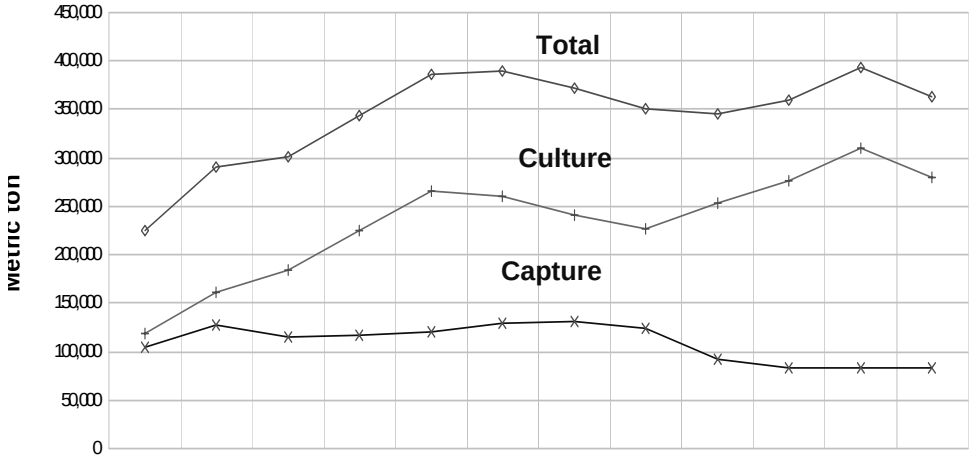
Aquastar started by setting up a demonstration farm and working with and providing extension services to its individual landholders. It integrated social and economic development and environmental principles in its shrimp farming operations. Rapid expansion led to an agreement with Bectel Engineering to make a large-scale expansion of its standard pond design, with Aquastar providing larvae, feed, and marketing. Later BP Nutrition acquired Aquastar. Under the new ownership, the company gained wider international marketing resources and introduced monitoring procedures to increase aquaculture water quality (DEP 2001).

Important Markets and Their Sanitary and Other Market Requirements

World shrimp production in 2000 was over 4 million metric tons (MT), with 26 percent from aquaculture and 74 percent capture and the Giant Tiger prawn getting the largest share. In contrast, approximately 75 percent–80 percent of the shrimp production in Thailand are cultured, and only 20-25 percent are captured (figure 1).

The People's Republic of China is the world's largest shrimp producer, but almost all of its production is for domestic consumption. India, the second largest producer, had an average production of 383,000 MT for the past 10 years, while Thailand, the third, averaged 354,000 MT per year.

Figure 1. Thailand's total shrimp production, 1990–2001



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Capture	104,847	127,811	115,681	117,579	120,166	129,713	131,381	123163	92,649	84,054	82,902	82,396
Culture	119,510	162,051	184,884	225,515	265,524	260,713	240,339	227,560	252,731	275,544	309,863	280,000
Total	224,357	289,862	300,565	343,094	385,690	390,426	371,720	350,723	345,380	359,598	392,765	362,396

Source: FAOSTAT 2003.

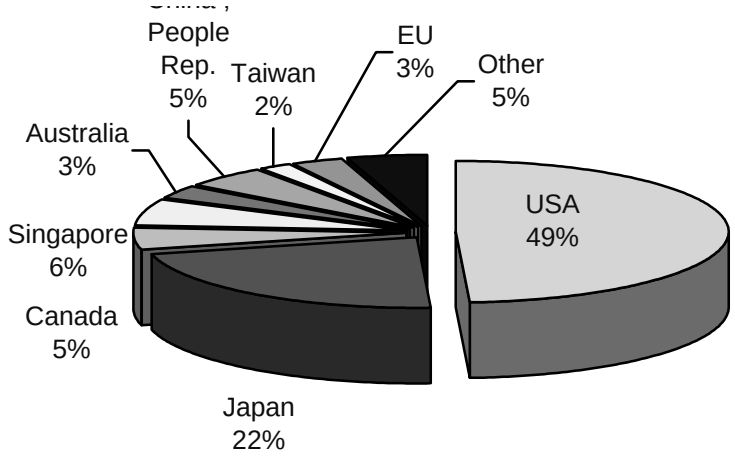
In 2000 approximately 76,390 people were engaged in farming the 65,000 ha of shrimp farms in Thailand. In that year, approximately 80 percent of these workers were farming less than 1.5 ha; 18 percent were farming 1.5 to 2.5 ha; and only 2 percent were farming more than 10 ha. Shrimp farms in Thailand are 85 percent intensive and 15 percent semi-intensive or extensive, and are concentrated in three major areas, South (55 percent of the farms), East (35 percent), and Central (10 percent) (NSO and DOF 2000).

Thailand has been the world's leading exporter of shrimp for several years and held a world market share of 25 percent in 2001 (FAO 2001). Shrimp exports are 54 percent prepared and preserved products and 43.4 percent chilled and frozen products. High income and strong market demand around the world have driven the fast growth of the industry.

The shrimp industry is Thailand's biggest revenue earner in the fishery category holding a 40 percent export share or 25 percent of the country's total food exports. Shrimp brought in an average revenue of US$2.32 billion a year in 1998–2001.

Thailand's primary shrimp markets include Japan and the USA, while its secondary markets include Singapore, Canada, China, Australia, the EU, and Taiwan, in that order (figure 2). Thai shrimp exports account for 75 percent of its total shrimp production. Approximately only 25 percent are consumed locally.

Figure 2. Thailand shrimp market destinations, average value, 1998-2002



Source: Department of Customs, Thailand Ministry of Finance.

In 2002 the increased price competition among suppliers and the problem of zero tolerance on banned antibiotic residues imposed by the EU caused Thai shrimp exports to fall. That year, Thailand exported 215,143 tons of shrimp worth US$1.72 billion, the volume down by 15.8 percent from 255,568 tons and the value down by 19 percent from US$2.2 billion in 2001 (table 1). Exports of Thai shrimp (in terms of value) fell sharply to Canada, China, Japan, Singapore, and the US, but especially to the EU—65 percent by value or 57 percent by volume from 2001. The lower international demand for Thai shrimp in 2002, especially in the US and Japan, greatly increased shrimp supplies locally.

Thailand's export of frozen shrimp in 2002 worth US$798 million decreased in terms of both quantity (29 percent) and value (35 percent) from 2001. The change was partly related to a slow Japanese economy and to consumers' switch to smaller shrimp sizes of lower price. Shrimp farmers faced a tough time in 2002 as not only did shrimp prices fall but also costs of feed increased, significantly pushing up costs of production up. As a result, many shrimp farmers diversified into other fishery products or gave up their shrimp farming businesses.

To withstand competition, Thai producers need to continuously diversify into products for niche or high-end markets while continuing to build the country's reputation as the producer of quality and safe foods. Until 1995, approximately 75 percent of shrimp exports were in the form of frozen shrimp, mostly Black Tiger and freshwater prawn. At present, the frozen shrimp share is down to 43 percent, while prepared/processed shrimp constitute 54 percent of the country's total shrimp exports.

Table 1. Thailand shrimp exports by types of products, 1993–2002

Year	*Chilled/frozen*		*Prepared/preserved*		*Other processed*		*Total*	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1993	148,603	1,490	42,651	370	3,322	31	194,576	1,890
1994	186,768	1,948	50,666	528	2,945	27	240,380	2,504
1995	178,842	2,012	58,755	642	3,181	39	240,777	2,693
1996	161,387	1,709	67,248	737	2,084	23	230,718	2,468
1997	137,020	1,498	73,493	893	1,905	13	212,417	2,404
1998	155,967	1,402	84,643	890	7,741	11	248,351	2,303
1999	138,050	1,283	101,389	1,033	1,113	9	240,551	2,326
2000	144,259	1,496	104,376	1,174	1,018	9	249,653	2,679
2001	144,495	1,227	110,086	978	987	9	255,568	2,214
2002	102,689	798	112,060	915	394	2	215,143	1,715

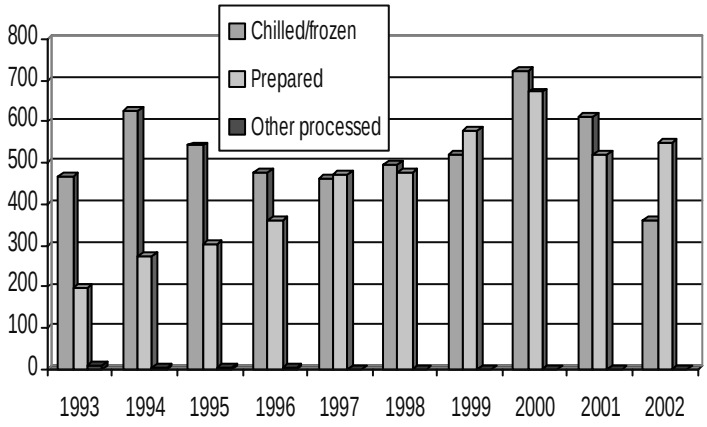
Source: Department of Customs, Thailand Ministry of Finance.
Volume: MT Value in US$ million*
* Reference Exchange Rate (Bank of Thailand):
1993 25.37 THB/US 1996 25.39 THB/US 1999 37.66 THB/US 2002 43.11.
1994 25.20 THB/US 1997 31.48 THB/US 2000 40.27 THB/US
1995 24.97 THB/US 1998 41.59 THB/US 2001 44.56 THB/US.

Shrimp is a relatively expensive source of protein, but its taste is widely sought by consumers around the world, creating a strong demand for shrimp. As shrimp sales are largely dependent on the international market, demand is expected to remain high, provided that the buying power of consumers in Thailand's major markets remains strong. Through its continuing efforts to improve the technology of shrimp farming and processing and to provide clients with greater quality satisfaction and safety assurance, Thailand aims to maintain its world position in shrimp trade.

United States Market

The US accounts for approximately 50 percent of Thailand's shrimp exports. In 2002 the US imported 430,000 tons of shrimp products worth US$3.4 billion (appendix 1). Thailand's major shrimp exports to US were in the form of fresh frozen, but starting in 1997, the prepared form equaled the fresh frozen form and is now the predominant export product (figure 3). The change is due partly to the fact that US importers of Thai shrimp are largely hotels and restaurants, which prefer conveniently prepared shrimp products to save time, money, and effort.

Figure 3. Value of shrimp exports to the US, 1993–2002 *(US$ million)*



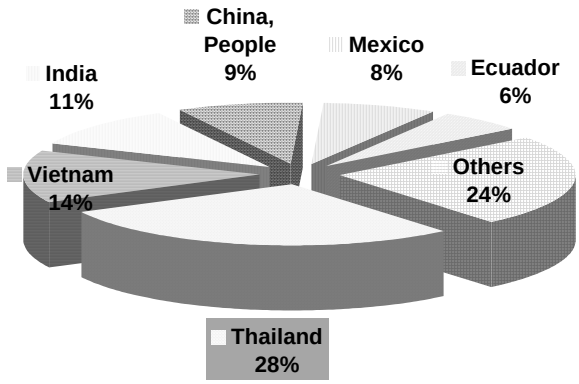
Source: Department of Customs, Thailand Ministry of Finance.

The US is both an exporter and an importer of shrimp. It has a policy to limit its capture fishing area, but its domestic demand for shrimp increases annually. The US is a large country. Thus, the cost of transporting shrimp catch from one part to the another can be high. The labor wage is also high. For these reasons, for the US, importing processed shrimp is cheaper than transporting and processing its own catch. The US market prefers tough and sweet meat such as Gulf White and Acudorcan. The US regards them as high-value, high-priced shrimp, while Chinese white and Black Tiger are considered to be of lower grade. However, because Black Tiger shrimp is cheaper and the eating quality (tougher meat) is similar to their preferred species, it gained American consumers' wide acceptance. US consumers consider Pink and Brown shrimp from South America to be of medium grade.

The major types of shrimp consumed in the US are the warm water shrimp (80 percent of consumption) and the cold water shrimp (20 percent). Approximately 18 percent of cold water shrimp are supplied by local production and the rest are imported. Approximately 80 percent of the total warm water shrimp consumed are distributed through hotels/restaurants, and the rest are channeled through other distribution centers.

Because of the relatively high wage rate in Thailand compared with its Asian competitors, Thai shrimp costs more. The price difference puts Thai shrimp exports in stiff competition with shrimp from countries with lower labor wage advantage like Vietnam, India, Indonesia and others. However, despite the competition, Thailand still remains the leading shrimp supplier of US with 28 percent market share (figure 4).

Figure 4. Thai shrimp market share in the US, 2002



Source: National Marine Fishery Services, US.

*US food safety requirements for shrimp imports***.** The US is very strict about documents, disciplines, and quality of products. Products that fail to meet its sanitary requirements are rejected or destroyed. Thai exporters are obliged to comply with the following sanitary requirements:

1. Exporting factories are required HACCP certification. Exporters are obliged to follow the rules of the Consumers Seafood Safety Act permitting the US Department of Agriculture's Food and Drug Administration (FDA) to test the quality of products imported into US and to inspect suppliers' plants in the exporter's country. The US government further requires that seafood pass both laboratory test and physical and sensory evaluations conducted by US food inspectors.

2. FDA inspectors carry out random sampling of imports. Importers with previous nonconformity record are classified into Automatic Detention list, with their next 5 consecutive shipments subject to testing. If test results turned satisfactory, then the importer's name will be moved to the random sampling list.

3. Shrimp products must conform to the following FDA regulations:

- Food Drug and Cosmetic Act
- Fair Packaging and Cosmetic Act
- Nutrition Labeling and Education Act
- Current Good Manufacturing Practice regulation
- Color Additives regulation
- Food Additives regulation
- Food Labeling regulation
- Low Acid Canned Food regulation

4. The US has not changed the acceptance level for most of the chemical residues, but it has banned the use of sulfamerazine and chloramphenicol in marine products (table 2).

Table 2. U.S. standards for selected chemicals

Chemical	*Tolerance level*	*Reference*
Oxytetracycline	2.0 ppm in flesh	21 CFR 556.500
Sulfadimethoxine/Ormetoprim	0.1 ppm in flesh, combination,for both drugs	21 CFR 556.640
Methyl mercury	1.0 ppm	CPGSec.540.600
Polychlorinated Biphenyls	2.0 ppm	21 CFR 109.30

Source: US Food and Drug Administration.

US rejection list of Thai shrimp exports in 2002. Between 1998–2002, the USFDA rejected shipments of Thai shrimp for the following reasons: "Filthy," "*Salmonella*," and "no process" (table 3).

Table 3. USFDA refusal report of shrimp imports from Thailand

Year	*Type*	*Reason*
Sep 2002	Frz. Ez Peel shrimp 41/50	Filthy
Oct 2002	Shrimp cooked	Filthy, salmonella
Nov 2002	Canned tiny shrimp Frozen shrimp	Filthy Salmonella
Dec 2002	Minced prawns in spices Shrimp	Filthy, no process Filthy
Jan 2003	Canned tiny shrimp Frozen prepared shrimp	Filthy Vetdrugrs
Mar 2003	Frozen black tiger shrimp Frozen hlso shrimp Frz raw h/l s/on black tiger shrimp Frz raw h/l s/on black tiger shrimp 6/8, 8/12, and 13/15 Frz raw h/l s/on black tiger and pink shrimp Frz h/l s/on black tiger shrimp size 26/30 Iqf raw s/on ez-peel pink shrimp size 26/30 Frz raw h/l s/on black tiger shrimp size 51/60 Frz raw h/l s/on pink shrimp size 61/70 Frz raw h/l s/on black tiger & pink sh	Vetdrugrs Salmonella Filthy Filthy Filthy Filthy Filthy Filthy Filthy Filthy
April 2003	Shrimp in brine in aluminum pouches	Filthy
May 2003	Frozen raw peeled deveined t-on shrimp (31/40) Frz raw hdls s/on shrimp sz. 71/90, 91/110	Salmonella Salmonella
July 2003	Minced prawn in spices	Filthy

Source: www.fda.gov.
Note:
No Process = Manufacturer has not filed information on its scheduled process as required by 21 CFR 108.25(c)(2) or 108.35(c)(2).
Vetdrugs = Food contains new animal drug, or conversion product thereof, that is unsafe (within the meaning of current regulation).
Salmonella = Food contains Salmonella, a poisonous substance that may render injury to health.

These incidents may be explained by the wide variations in quality management among exporting companies and suggest that Thailand needs to work more on safety and quality implementation and management. An in-house and hands-on training might help improve quality management in factories.

Japanese Market

Although Japan ranks only as the third largest shrimp importer in the world, next to the US and EU, the Japanese market is one of the most sought shrimp aquaculture-importing countries in the world. The reasons are the huge demand for shrimp in that country and the fact that most competing Asian shrimp exporters are situated close to Japan. Annually, its demand totals approximately 300,000 tons. Japan imports approximately 90 percent of its demand while less than 10 percent is supplied by its local production. Approximately 88 percent of its imported shrimp are frozen. Thailand supplies approximately 40,000–50,000 tons annually (table 4).

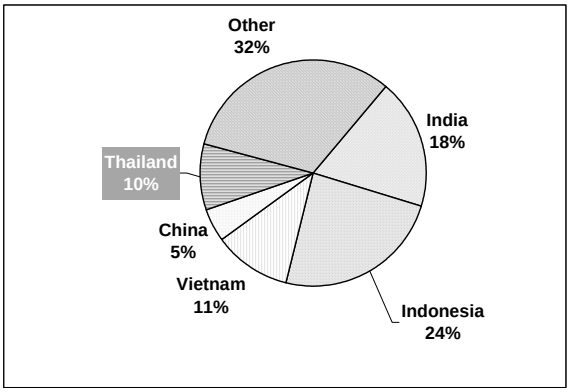
Table 4. Thai shrimp market share in Japan

	1998	*1999*	*2000*	*2001*	*2002*
Thai export (t)	45,905	40,699	45,054	49,976	49,350
Total shrimp imports (t)	248,351	240,551	249,653	255,568	215,144
% share	18.5	16.9	18.1	19.6	22.9

Source: Department of Customs, Thailand Ministry of Finance.

Japanese consumers value quality, price, hygiene, sanitation and standards, and prefer freshness and the natural taste of shrimp. They are loyal customers, making it difficult for new entrants to break into the market. However, with the economic slowdown in 1996, Japanese importers looked to trade with lower-priced frozen shrimp suppliers. Because of the higher labor wage in Thailand, its frozen shrimp is priced higher than its competitors. The switch away from Thai imports in 1996 made by the Japanese resulted in an 18 percent fall in the Thai frozen prawn exports to Japan. Thailand's market share fell to an average of 10 percent in 1998–2002 (figure 5). Thailand, which used to rank second (1995) as supplier of frozen shrimp to Japan, has fallen to the fifth position (2002) behind India, Vietnam, and even China.

Figure 5. Thai frozen shrimp market share in Japan, 1998–2002

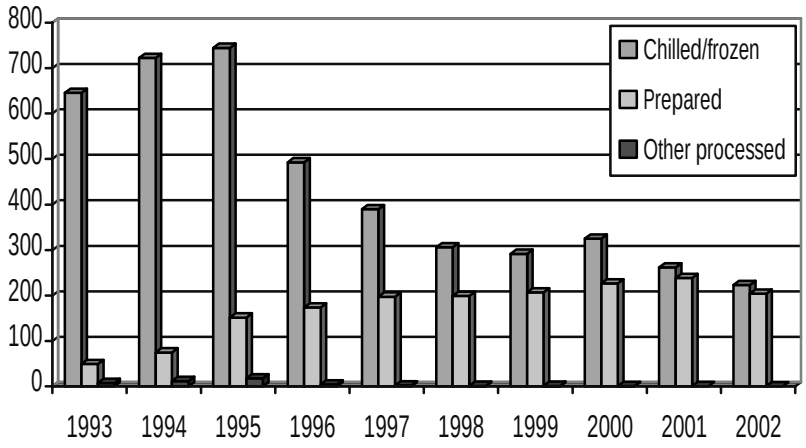


Source: JETRO 2002b.

Note: Average import value (1998–2002) = $2,454.88 million.

In the past decade, with the continuing drop in shrimp price and stiff competition in the frozen shrimp category, Thai processors diversified to value-added production. These products include breaded tempura and sushi boiled shrimp, which are now widely distributed on most supermarket shelves. Thai processors not only catered to consumers' changing preferences but also took the opportunity to exploit Thai labors' skills and experience in processing to gain a competitive advantage. Shifting to prepared/preserved shrimp products ahead of its rivals provided Thailand a lead over its competitors (see figure 6 for the ratio of Thai prepared to frozen shrimp exports).

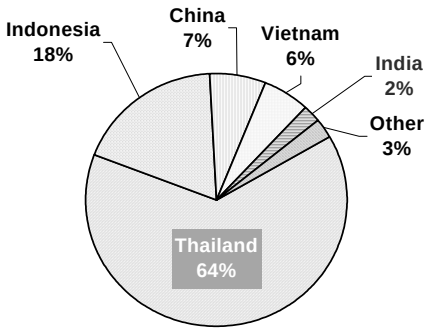
Figure 6. Value of shrimp exports to Japan, 1993-2002 *(US$ million)*



Source: Department of Customs, Thailand Ministry of Finance.

Thailand maintained its leading position with a 64 percent (1998–2002 average) market share in the prepared/preserved shrimp category in Japan (figure 7). To maintain its position, Thailand is working hard to improve its nationwide food safety implementation program, to build its reputation of safe and quality food, and to support its government campaign to make Thailand the "kitchen of the world."

Figure 7. Thai prepared/preserved market share in Japan, 1998–2002



Source: Department of Customs, Japan.
Note: Average import value (1998–2002) = US$345 million.

After the economic crisis, shrimp consumer behavior changed. Japanese shrimp consumption decreased from 3 kg/capita to 2.25 kg/capita. Households became more sensitive to price. Although consumers tended to consume more during holidays, their preference shifted from large to medium-sized shrimp, which is popularly served in sushi bars.

Market distribution channels. Distribution channels for imported fishery products may be classified in two types. The first is wholesale market-based distribution, in which distribution starts from importers to wholesale markets in Tokyo and other major cities. The second type operates outside the wholesale market-based distribution, that is, from importers to wholesale distributors operating outside the wholesale market system, and then to mass merchandisers, retailers, and food service establishments. Imported fishery products are more often distributed through the latter channel (Jetro 2002).

Food safety requirements for shrimp imports in Japan. The importation of shrimp, prawns, and lobsters into Japan is subject to the provisions of the Quarantine Law and the Food Sanitation Law.

*Quarantine Law***.** Imports of shrimp from countries with known outbreaks of cholera within their territories is required to undergo inspection for cholera bacteria. If cholera bacteria are detected, the cargo may not be imported into Japan and must be decontaminated or disposed of in some other manner. Based on Japan's Ministry of Health, Labor and Welfare (MHLW) report inspection, Thailand is regarded as a clean and unpolluted area.

Food Sanitation Law. Under the provisions of the Food Sanitation Law, an Import Notification form is required for shrimp being imported for the purpose of sale. To expedite the procedural process, Japan has established a prior notification system and a planned reporting import system. Under prior notification, documentation may be submitted up to 7 days prior to the scheduled arrival at the port of entry. Regarding the planned reporting import system, if the importer provides the Quarantine Station with a 1- or 3-year import plan, provided it passes examination, the importer will be exempted from filing import notifications for the subsequent imports within the plan's specified time frame.

Prior to importing, the importer may take samples of imports to official laboratories designated by the MHLW in Japan or in exporting countries. The test results may be substituted for the corresponding inspection at the port of entry, which expedites the quarantine clearance process.

Shrimp is inspected for the presence of bleaching agents since most are allergens and require labeling. The commercial value of these seafood products decreases as their shell blackens. Food preservatives such as nitric acid, sodium sulfite, and sodium hyposulfite are used to prevent the shell from blackening. Cultivated shrimp and lobsters are also inspected for the presence of residual antibiotics and antibacterial chemicals. Because additives are strictly controlled in Japan, inspection is conducted on random samples to find out whether the preservative used is listed in Japan's additive positive list and whether the level conforms with the established allowable level (JETRO 1997). The Food Sanitation Law recommends raw material labeling for food products that contain allergens. Processed food products containing shrimp are advised to bear labeling to the effect that they contain shrimp.

The law stipulates the maximum quantity of antibiotics and food additives per unit that can remain in fish and shellfish. Under the Food Sanitation Law of 2003, the Maximum Residue Levels (MRLs) for marine animal drugs were set for 21 categories, which include 2 antibiotics used in shrimp culture namely, Chlortetracycline/Oxytetracycline/Tetracycline with an MRL of 0.2 ppm, and Spiramycin with MRL of 0.2 ppm. MRLs for other residues and some food contamination are maintained at the levels shown in table 5.

Table 5. Japan's Maximum Residue Levels for marine animal drugs

Type	*Maximum allowable levels (ppm*)
PCBs in fishes and shell fishes in ocean and open sea	0.5
PCBs in fishes and shell fishes in inland sea and bay	3.0
Total level of mercury	0.4
Methyl mercury (as mercury)	0.3
Paralytic shellfish toxicants (PSP)	4.0
Diarrhoeal shellfish toxicants (DSP)	0.05
Sulfite group	<100.0

Source: JETRO 1997.

The difference in MRL for mercury requirement between Japan (0.3 ppm) and US (1ppm) is possibly related to Japan's higher per capita consumption of shrimp and other fishery products, which are recognized potential sources of methyl mercury. In other words, using the same tolerance would put Japanese consumers at a greater risk than Americans from methyl mercury exposure.

Japan's rejection list of Thai shrimp exports in 2000–02. Despite the fact that all Thai shrimp-exporting factories are HACCP-certified, instances of noncompliance with microbiological and chemical MRLs were still noted (table 6). However, considering that Thailand is supplying some 20 percent of the total shrimp imports of Japan (table 3), 5 violations is not bad. China, with a far lower share, had nine violations within the same period.

Table 6. Thai shrimp product violations of Japan's Food Sanitation Law, 2000–02

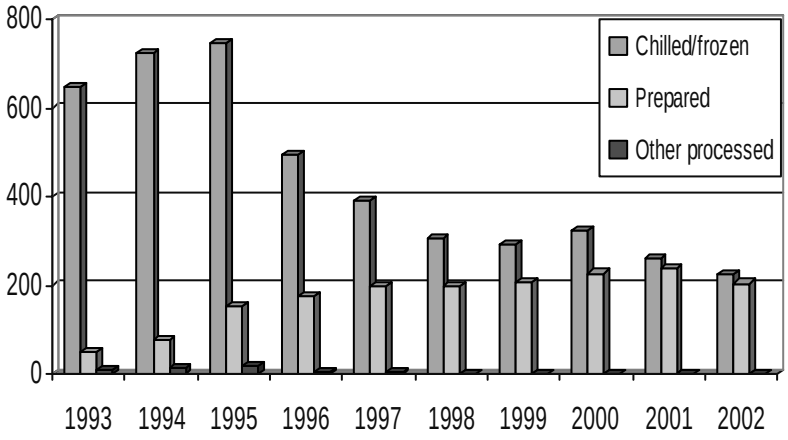
Product /date	*Violation*	*Standard*
Frozen shrimp with breadcrumbs, Aug 2000	Bacterial count 3.9 x 10^6/g	3 x 10^6/g
Frozen shrimp with breadcrumbs, Jan 2001	Bacterial count 3.5 x 10^6/g	3 x 10^6/g
Frozen cultured shrimp, peeled, Feb 2001	Oxolinic acid 0.06ppm	Not allowed for use with shrimp cultures
Frozen cultured shrimp, Jun 2001	Oxolinic acid	Not allowed for use with shrimp cultures
Frozen shrimp (boiled and peeled), Aug 2002	Bacillus positive	Negative

Source: Department of Food Safety, Ministry of Health, Labor and Welfare.

European Union Market

The EU was the fourth largest market for Thai shrimp in 1995, but Thailand lost its competitiveness in that market when it was dropped from the EU list of countries under the EU's Generalized System of Preferences (GSP) in 1996. As a result, the tariff for Thailand frozen shrimp jumped from 4.5 percent to 14.5 percent, and the rate for the prepared/preserved shrimp, from 6 percent to 20 percent. Consequently, Thailand's shrimp export to EU fell by 52 percent—from US$251 million in 1996 to US$120 million in 2000. In 2002 following the veterinary drug (vetdrug) residue problem, Thai shrimp exports to the EU took a nosedive to US$37 million (figure 8).

Figure 8. Thailand's shrimp exports to the EU, 1993–2002



Source: Department of Customs, Thailand Ministry of Finance.

At present, Thailand has only a 3.5 percent market share, worth US$65 million, for frozen shrimp in the EU. Leading frozen shrimp exporters to the EU include Argentina with 17 percent share; Bangladesh, 8 percent; India, 6 percent; Indonesia, 6 percent; Madagascar, 5 percent; and Ecuador, 5 percent. For the prepared/preserved shrimp category, Thailand has a 9.5 percent share worth US$46 million, behind Iceland, Norway, and Greenland with 25 percent, 20 percent, and 12 percent shares, respectively.

EU food standards and problems encountered by Thai shrimp exporters. The EU market emphasizes price more than the other markets. The EU emphasizes importing low-priced products; yet, its monitoring process is more rigid than any other market's, putting more emphasis on composition and residue. Exporters/processors are required to register and acquire HACCP certification from Thailand's Competent Authority, the Department of Fishery (DOF), and to pass the EU quality control check.

The European Union has made many corrections and improvements in its food laws. The continuous technical improvement in testing and the zero tolerance policy on banned chloramphenicol and nitrofurans residues (antimicrobials to treat shrimp diseases, which have been found to cause aplastic anemia and cancer in humans) has posed great problems for Thai shrimp exports in 2001–02.

Even if the EU is no longer a major market for Thai shrimp, the international news coverage of the EU's ban of Thailand's shrimp products prompted overwhelming response from both private and government sectors. For fear that the problem might adversely impact the image that Thailand had been trying to build as a world supplier of safe and quality foods, immediate actions to resolve the problem were taken. Fears that trade disruptions could prolong indefinitely and that problems would spill over to other markets prompted Thailand's fast response.

The other EU sanitary problems that have been encountered by Thai shrimp exporters for the past 5 years (1998-2003) are presented in table 7.

Table 7. Thai shrimp export violations of EU Food Sanitation Law, 1998-2003

Year	*Destination*	*Type*	*Reason*
Aug 1998	Denmark	Peeled raw shrimp	Vibrium
Feb 1999	Sweden	Canned shrimp & crab meat	Sulfur dioxide (EU = 50 ppm)
Apr1999	France	Frozen shrimp	Fecal coliforms
			Vibrio parahaemolyticus
Dec 1999	France	Frozen shrimp	*Vibrio parahaemolyticus*
			Vibrio Cholerea
			Thermotolerant coliforms
Dec 2000	France	Frozen shrimp	Coliform bacteria/*Clostridium sulfito*
	Norway	Black Tiger shrimp in pastry	*Vibrio parahaemolyticus* and *Vibrio Cholerea*
Feb 2001	Spain	Frozen giant tiger prawn	*Vibrio Cholerea*
Jun 2003	UK	Frozen Black Tiger shrimp	Nitrofuran (metabolite), Furazolidone (AOZ, or Amino Oxazolidinone)

Source: Newspapers.

Sanitary and Quality Problems and Costs of Compliance

With the advancing trade liberalization, more and more regulatory changes are taking place that are changing the way trade is practiced. With consumers' growing health awareness as a result of the increasing media coverage of the various food scares and scandals happening around the world, safety standards are now playing an important role in market access and product marketability. Buyers are demanding food safety throughout the entire supply chain. This study determines how the sanitary and phytosanitary (SPS) requirements are affecting all stakeholders in the food chain and their overall capacity to export.

Three major tests are carried out on shrimp to ensure its quality and safety:

1. *Physical and sensory evaluation.* This test uses tasters' sensory skills to determine how each product and marine animal type will be perceived by consumers. Consistency and reliability of tasters are the most crucial factors in this test. To be consistent, training is necessary. Defining and measuring of quality criteria are keys in sensory evaluation.
2. *Microbiological standards.* Countries have different microbiological standards, especially hygiene indicators.
3. *Chemical standards.* Countries have different chemical standards so exporters need to know the standards of the importing country to which they intend to export their goods and to comply with its requirements.

Developments That Led to the Tightening of Shrimp Quality Control

With their growing health awareness, consumers, particularly in the EU, are demanding not only better quality and safer food but also information about the food so that they can make informed choices. These demands became even greater when a number of food scares such as mad cow disease and the dioxin scandal attracted international media coverage. The public lost confidence not only in the agencies responsible to protect consumers but also in their countries' own food supplies. To restore consumer confidence, many of the new regulations are highly precautionary.

Because of the regulatory changes in the EU and introduction of more sophisticated testing equipment, lower levels of residues could be found than before. Since Thailand was unable to detect the presence of the banned drug, chloramphenicol, due to the lack of the appropriate equipment, shipments that should have failed approval passed Thai authorities' clearance. The results were the highly publicized chloramphenicol and nitrofuran issues (box 2).

Box 2. Thai experiences with banned drugs in food exports

In November 2001, a member of the Greenpeace environmental group reported in the international media that some canned shrimp products from Thailand had tested positive for chloramphenicol (a banned antibiotic thought to cause leukemia in 1 out of 20,000 exposed human beings). The report was based on the analysis of samples pulled randomly from the supermarket shelves in Austria. Soon after the news, recalls of products from the retail distribution channels caused much chaos among wholesalers, processors, and importers, who had not been guided by government authorities on how to deal with such a situation.

On March 14, 2002, the Thai Competent Authority for animal products, the Department of Livestock Development of the Ministry of Agriculture and Cooperatives, was informed by the EU authorities that traces of "nitrofurans" (banned carcinogenic antimicrobial drugs) were found in chilled/frozen chicken and shrimp and prawn imports from Thailand. The EU's zero tolerance rule for banned chemicals requries that any product found contaminated with banned antibiotics be destroyed. The EU's destruction of the Thai chicken and prawns caused monetary losses as well as affected clients' confidence and the image of the producers.

Source: Excerpted from newspaper clippings by J.O. Nawbanij.

Rapid global reporting of the fate of the Thai shrimp shipment to the EU prompted immediate and overwhelming response from both Thai government and private sectors. They rushed to correct the problem for fear that the news would impact other Thai markets and damage the reputation that Thailand had been trying to build as a quality product supplier.

Some of the concerns were that:

- The issue might influence other major importing countries to follow the EU's actions.
- Thailand, being an exporting country, believed that the faster the problem was solved, the less impact or disruption it would have on its food exports.
- Thailand wanted to prove that it was capable of meeting even EU's stringent food standards. In addition, a number of Thai exporters believed that the EU's zero tolerance regulation was unfairly applied to Asian exporters. The exporters based their claim on the analytical results reported by Thailand and China indicating that positive chloramphenicol results had been obtained on a number of products

imported from the EU. Those findings were interpreted to mean that the EU applied a double standard to imports and local products.

Thailand has many food safety regulatory measures in place, but, unfortunately, enforcement is rather weak. External pressures play an important role in tightening shrimp quality control in Thailand. For example, in 1996, the Japanese government declared that it would insist on higher quality standards for shrimp imports. Immediately, the Thai private sector responded to correct the problem.

To resolve the shrimp drug residue problems, the following remedial actions have been taken by the Thai private and public sectors:

1. Many Thai shrimp factories have started to get their raw material from trustworthy farms instead of buying from wholesaler central markets, for which it was more difficult to establish source or origin.
2. The Thai government has banned the importation and use of chloramphenicol and nitrofuran in animal feed and has agreed to tighten imports of chloramphenicol. Importers are now required to declare the purpose of chloramphenicol's import, and any person found guilty of drug misuse is now subject to severe punishment.[1]
3. The Department of Fisheries (DOF) formed a special committee to carry out periodic inspections in shrimp-producing provinces to prevent the use of chloramphenicol and other banned chemicals.[2] The Department of Fisheries, Ministry of Agriculture and Cooperatives, and other concerned agencies are closely monitoring the production of animal feed as well as shrimp raising, processing, and exports.
4. DOF representatives are inspecting shrimp before they are sold to markets to ensure that shrimp are free from contaminants.
5. With the further imposition of 100 percent checking on Thailand's shrimp exports by the EU, a team of high-ranking Thai government officials flew to Brussels to discuss with the EU authorities their planned comprehensive measures to prevent future problems.
6. Extension work was intensified to educate farmers on the use of chemicals and the grave consequences of using banned chemicals.
7. DOF has pushed the adoption of the Code of Conduct guidelines by shrimp farmers to ensure product safety from farm to table.
8. DOF permitted the import of the more disease-resistant white shrimp for commercial breeding and farming in Thailand in June 2002.
9. DOF issued a new regulation requiring farmers to fill out a "shrimp-catching form," which includes catch date, total shrimp weight, name of farmer, and ID card number. Central markets at Mahachai and Pakpanang also require suppliers and buyers to complete this document to ensure traceability.
10. DOF purchased equipment to test antibiotic residues based on EU standards.

Shrimp processing and exporting companies differ in size and quality management status. There are multinational and large national companies that have good-quality systems in place, and there are medium and small-scale factories with variable quality management systems. To convince buyers that the products supplied meet safety and quality requirements and to protect themselves from possible future problems, producers/suppliers are not only implementing the international Codex Alimentarius

[1] The Ministry of Agriculture and Cooperatives has banned the importation and use of ß-Agronist compound, chloramphenicol, Furazolidone, Avoparcin, and Nitofurazone in animal feed.

[2] There are reports that collectors may have also used banned antibiotics to control the growth of bacteria during transport. Unconfirmed personal information.

standard for hygiene and HACCP, and other private standards to meet buyers' requirements, but also are implementing DOF's code of conduct guidelines. Some large companies are implementing traceability within their quality systems both to facilitate trace-back for food safety and quality problems or complaints, and to improve their supply-side management.

Compliance Costs to Shrimp Farmers

With EU's tightening of the antibiotic drug use measures, the DOF intensified both its enforcement and extension roles to educate and create greater awareness on drug misuse and its dire consequences on the entire industry. Farmers were educated on the Code of Conduct and the use of chemical alternatives, such as herbal preparations and probiotic formulations, to prevent and check diseases. It is generally believed by specialists that most of shrimp diseases are caused by the accumulation of feed wastes, which provide a medium conducive to the growth of shrimp-disease-causing microorganisms.

Table 6 shows the fixed and variable costs that farmers incurred in farms that used antibiotics, chemical alternatives, or herbal preparations and probiotic supplements. Probiotic supplements are a microbial bioformulation designed to maintain water quality in commercial shrimp or fish farming operations. The microorganisms contained in the formulation restore water to a natural condition by metabolizing feed wastes, increasing oxygen content, and reducing most pond pollutants. The microorganisms can utilize wasted feed with high efficiency, recycling organic matter and, in turn, themselves becoming feed for the cultured shrimp.

Table 8. Production costs comparison of Black Tiger shrimp farming *(US$/ha)*

Description	*Use of antibiotics (1999)*	*Use of alternative chemicals (2002)*	*Use of probiotic supplements (2002)*
Fixed cost	**2,378**	**2,378**	**2,378**
Water mill (using used Kubota engine@$116)	435	435	435
100 floats/pond (@ $14)	1,740	1,740	1,740
100 rotor blade per pond (plastic rotor @ 60–70 Baht)	203	203	203
Variable cost	**10,732**	**10,326**	**10,761**
Larva (400,000 larva @ $0.002)	1,160	1,160	1,160
Pond construction cost (unearthing and soil foundation) $11.60/hr x 14	203	203	203
Lime and tea leaves application	377	377	377
Salt water ($43/loading. Usually 1 ha uses 12.5 loads)	580	580	580
Fuel and lubricants (for the 3 water mills/pond)	870	870	870
Shrimp feeds (at $19/bag & $16/bag for nonprobiotic and probiotic)	5,799	5,799	5,074
Zeolite (to regulate the water pH)	90	90	90
EM	271	271	271
Treatment (antibiotics, chemicals)	870	-	-
Alternative chemical ($9/kg)	-	464	-
Probiotic	-	-	1,624
Labor cost (min. wage is $3.83/day for 1 person/pond x 90days)	431	431	431
Electricity cost	72	72	72
Larva quality control (PCR test)	9	9	9
Total costs	**13,110**	**12,704**	**13,139**
Average shrimp production (kg/ha)	7,500	6,875	11,250
Average cost/kg	**1.75**	**1.85**	**1.17**

Source: Farmers' interviews by the research team, May 2003.

Note: Fixed and variable costs for using antibiotics and alternative chemicals are the same except that, instead of using antibiotics, alternative chemicals (herbal preparations) or probiotic supplements are used in other ponds. The fixed costs and most of the variable costs for the three farming practices are the same. The difference is in the "treatment" used. Conventional practice uses antibiotics (column 2); the other two practices use alternative chemicals (herbal preparations) and probiotic supplements.

A comparison of the average cost per kilogram shows that the use of alternative chemicals increased the average cost by 5.7 percent from the conventional chemical-supplemented shrimp farming method. However, by shifting to probiotic farming, farmers would decrease their average production cost by 33 percent.

Using probiotic farming and switching to white *vannamei* shrimp (table 9) reduced the substance (antibiotic/probiotic) cost per kilogram by 39 percent. The data in the table further suggest that probiotic farming of disease-resistant white *vannamei* shrimp provides farmers with other advantages, such as higher yields, higher survival rate, ease to cultivate, shorter production time, and lower feed costs. However, because bigger Black Tiger shrimp sizes command higher prices than smaller ones, the higher yield of *vannamei* may not make a big difference on the farmers' income, but *vannamei's* greater resistance to disease could lessen farmers' harvest uncertainties. Moreover, the *vannamei* shrimp also provides more meat than Black Tiger shrimp (approximately 67 percent of weight against 62 percent for Black Tiger shrimp); and grows to a more homogeneous size, which makes grading easier. Furthermore, *vannamei* shrimp can tolerate a wider range of salt content and temperature and can better endure low-oxygen surroundings. However, the disadvantages are (1) v*annamei* shrimp are smaller than Black Tiger, so the price is cheaper; (2) *vannamei* shrimp are raised in more intensive farms, which means that more larvae are required per area; and (3) *vannamei* shrimp need to compete more with the 30 supplier countries of white shrimp while Black Tiger shrimp compete with only 10 supplier countries.

Table 9. Data on probiotic shrimp farming and vannamei shrimp

	Black Tiger shrimp		*Vannamei shrimp*
	*Use antibiotic**	*Probiotic***	*Probiotic****
Pond area (ha)	0.40	0.54	0.57
Density (larva/sq m)	62	52	76
Cost of larva (US$/sq m)	0.20	0.17	0.23
Survival rate	60	63	95
Feed cost (US$/t shrimp)	23.0	24	19
Production time (days)	119	123	88
Size (no. of shrimp/kg)	48	45	65
Feed conversion ratio	1.3	1.5	1.1
Yield (kg/ha)	7,750	6,975	11,206
Cost of antibiotic/probiotic substance used (US$/kg)	0.11	0.26	0.16

Sources: * Shrimp Culture Newsletter, April 2000. (Songkhla farm data).
** Shrimp Culture Newsletter, May 2002 (average data from 9 ponds in Songkhla and Trang).
*** Shrimp Culture Newsletter, September 2002 (CP Pilot farm in Maeklong, Mahatchai, and Lamae. It is worth noting that CP is known to maintain highly productive and efficient aquaculture farms.)

In summary, the EU's tightening of the sanitary measures on drug residues in shrimp has given rise to three major developments at the Thai farm level:

1. The recognition and popularization of probiotic farming as an alternative to the use of chemicals and antibiotics in shrimp disease prevention and treatment
2. A switch to farming disease-resistant *vannamei* shrimp
3. The emergence of more laboratories providing diagnostic test services to test the health status of postlarvae using the PCR method. More farmers are now willing to pay more for postlarvae tested free of disease than untested ones. Some farmers claimed that they pay as much as US$0.001/postlarvae more for laboratory-certified disease-free postlarvae. If farmers choose to have postlarvae analyzed by private laboratories, they would pay approximately US$7/test plus the cost of the sample used for testing.

Overall, the stricter sanitary measures have not adversely affected farmers greatly since the alternatives offer cost reduction advantages. On the contrary, these stricter standards created a greater

food safety awareness among farmers, in general, that is, generated a positive impact on their farming practices.

Compliance Costs to Shrimp Processors

The EU's tightening of drug residue requirements directly affects processing factories. Since they are required to submit the necessary inspection report, they are liable to both government authority and buyers, and they will suffer losses if their products are rejected and destroyed. To ensure food safety, processors put in place quality systems such as the HACCP system. This requirement, though, has been imposed by most importing countries, such as the EU, Japan, and US. Japan requires exporting companies to be audited and certified as having a Japan-equivalent system by the exporting country's Competent Authority. DOF normally charges minimal fees to audit a factory's quality system.

To be HACCP-certified, different factories require different improvements, and, therefore, varying levels of investments. Required changes to obtain certification could involve changes or modification of factory structure and layout, and costs basically depend on the size and existing facilities of the factory. The factory might have to be audited for its waste management system, warehousing or raw material stock, lighting system, pest control, and specialists employed. Each factory has different requirement details, making it difficult to evaluate their expenditures.

The survey questionnaire asked the shrimp exporters to provide data on their costs of control. Table 10 presents the various average costs of four exporters, whose combined exports constitute 60 percent of Thailand's food exports to Japan.

Table 10. Various costs of control for shrimp exporters

Costs of control	*US$/t shrimp*
Recurrent costs:	23.95
Importers' visits	11.54
Staff training and advisory services	0.78
Monitoring suppliers (farmers)	0.27
Quality system audits	3.50
Export product inspection	6.40
Import product inspection	0.01
Sample tests within food chain	0.13
Suppliers' education/information support	1.32
Process mechanization investments[1]	24.6
Total	48.54

Source: NFI calculations based on questionnaire surveys and interviews by the research team, May2003.

Note:

1 Calculations:

(a) Total shrimp exports to Japan in 2002 were 49,350 tons valued at US$427.8 million. The 4 exporters interviewed account for 60% of the shrimp exports, or 29,610 tons in volume and US$257 million in value.

(b) Process Mechanization Investment was US$245.9/ton, or US$7,281,708 for 29,610 tons.
Depreciation over 10 years = US$728,171/year, or US$24.6/ton.

The additional costs of analysis that entrepreneurs incurred to comply with the analytical test requirements is shown in table 11. Calculations were focused on the additional testing measures to comply with the chloramphenicol and nitrofuran residue requirements. The estimation assumed that the testing fee for the two drugs would be calculated according to the current laboratory fee/sample charged by private laboratories.

Table 11. Costs to processors of additional chemical analysis

Description	*Costs*
Costs to shrimp processors	**1,804,525**
• Total cost of laboratory testing	1,653,000
chloramphenicol test ($7/sample)	385,700
Nitrofurans test ($46/sample)	1,267,300
• Cost of shrimp sample specimen (0.5kg /100 kg shrimp)	151,525
Samples collected for testing (at 0.5kg /100 kg shrimp)	27,550
Total number of sample specimen tested annually	55,100

Source: NFI computation based on interviews and secondary sources.
Note: Assumptions below:
1. Number of samples was based on total shrimp export to EU (5,510 tons) in 2002.
2. Quantity of raw material was assessed by taking 1 random sample for analysis out of 100-kg tank of iced shrimp.
3. Number of analyses made on nitrofuran was only half those made on chloramphenicol.
4. Sample specimen cost estimate was based on total sample collected (27,550 kg) x running shrimp price/kg of 2002 ($5.5 per kg).

The results indicate that the cost of compliance with the EU's tightened drug residue measure on the private sector was US$1.8 million for 5,510 tons of shrimp exports to EU ($328/ton), which is roughly 1.6 percent of the total shrimp export value to EU of US$111 million.

Compliance Costs to the Government Sector

The role of the government sector in the SPS standard improvement varies ranging from financial support provider to enabler of the various sectors by enhancing their capabilities and capacities to comply with international or national sanitary standards for shrimp production.

Based on the government budget allocated to the DOF for shrimp industry development through the department's Fishery Industry Development Project for 1998–2002, the industry was getting an average of 56 percent of the entire budget allocation for fisheries per year (table 12, columns (4) and (5)). The amount was US$5.35 million in 1998 but was down to US$0.73 million in 2002. This decline is due to the initial year's budget having been planned to set up the laboratory and purchase the necessary equipment during the first two years of operation while the succeeding years' budgets were planned to provide laboratory services to industry. The allocated budget exclude personnel and laboratory building support, which are included in the regular budget of the Ministry of Agriculture and Cooperatives. The costs of laboratory services provided to support the shrimp industry averaged US$9.95/ton shrimp export (table 12, column (7)).

Table 12. Costs to government to assist shrimp industry to comply with requirements

Year (1)	*Fishery value (US$M) (2)*	*Shrimp export (US$M) (3)*	*Fishery QC budget (US$M) (4)*	*Shrimp QC budget (US$M) (5)*	*Shrimp export (1000kg) (6)*	*Shrimp QC costs (US$/t) (7)*
1998	3,978[a]	2,303[a]	9[b]	5[c]	248,351[a]	20
1999	4,096	2,326	6	4	240,551	17
2000	4,303	2,679	2	1	249,653	4
2001	3,998	2,214	2	1	255,568	4
2002	3,611	1,715	2	1	215,144	5

Sources:
a Department of Customs, Thailand Ministry of Finance.
b Budget Office, Office of the Prime Minister (budget allocated for the two projects on "Export Development of Fishery Products" and "Quality Inspection of Fishery Products").
c Multiplying total budget for the entire fisheries by the ratio of shrimp export value to total fishery export value.

However, based on table 13 data, the costs to the government to comply with the chloramphenicol and nitrofuran residue requirements amounted to US$4,301,790. Special budget was allocated to buy the necessary test equipment for chloramphenicol and nitrofurans.

Table 13. Costs to government of additional chemical analysis

Description	*Costs*
Cost to government sector	**4,301,790**
• ELISA machine (for DOF provincial station distribution @$3,479 x 50 units)	173,950
• LC-MS-MS machine (US$0.41 million each x 10)	4,100,000
• Annual wage for scientist ($232/mo x 10 persons x 12 months)	27,840

Source: NFI computation based on interviews and secondary sources.

Presently, 4 pieces of equipment for nitrofuran analysis were already procured and are being used, but 10 additional pieces of equipment are planned for use at the provincial DOF laboratories. To deal with future problems more effectively and efficiently, the government is planning to establish a central laboratory that will coordinate all government laboratories to improve laboratory test services efficiently and will be working under the newly established single food agency of the Ministry of Agriculture and Cooperatives.

Quality Management Strategies to Comply with Tightened Standards

Government Sector Level

Although the Department of Fisheries had introduced the Good Aquaculture Practice (GAP) and the Code of Conduct (COC) for sustainable aquaculture before the restriction on chloramphenicol and nitrofurans was imposed, GAP and COC were not taken seriously until after the restriction was imposed. The major reasons for its initial implementation were that (1) farmers were abusing antibiotic use, causing noncompliance and problems to the country; and (2) reports suggested that shrimp farms were contaminating the environment.

DOF has been working with the farmers since 2000 to implement GAP and the COC for responsible aquaculture. However, because the government has not made these guidelines mandatory, there was no standard practice among the farmers. As a result, in its 2002 surveillance program for chemical contaminants, the EU found that a number of Thai export products were not in compliance with its zero tolerance for banned chemicals. To upgrade the standards of an integrated shrimp industry, which includes shrimp breeding, farming, manufacturing, raw material transportation, and processing; and, simultaneously, to improve documentation and product traceability, GAP and COC since have been reintroduced and actively promoted.

Good Agricultural Practice. To obtain Good Agricultural Practice certification, farmers must fulfill the two major requirements:

1. *Farm hygiene requirements.* Farmers must be able to show that they practice sound farm management and proper garbage disposal, and have a well managed warehouse, tool shed, GAP's hygiene standards (practiced by employees), and good environmental management guidance.

2. *Drug use requirements.* Farmers must not use prohibited antibiotics in their shrimp farms. They must observe the recommended withdrawal period for some of the permitted antibiotics and ensure that there are no excess residues left in shrimp during harvest. A guideline on the use of chemicals in shrimp farms is shown in table 14:

Table 14. Guidelines on the use of chemicals in shrimp farms

Permitted antibiotics	*Prohibited chemicals and antibiotics in fisheries*	*Precautions in using drugs*
• Registered antibiotic approved by US-FDA to cure fishery diseases Oxytetracycline - Trade name: Terramycin, Pfizer Sulfadimethoxin + Ormethoprim – Trade name: Romet-30, Hoffman-LaRoche • Drug that should be used when necessary *Tetracycline group* 1. Tetracycline 2. Chlortetracycline 3. Oxytetracycline 4. Doxycycline *Quinolone group* Nalidixic acid 1. Oxolinic acid	1 Alistolochia 2 Chloramphenicole 2. Chloroform 3. Chlorpromazine 4. Colchicine 5. Dapsone 6. Dimetridazole 7. Metronidazole 8. Nitrofurans 9. Ronidazole 10. Diethylstibestrol 11. Ipronidazole 12. Nitroimidazoles 13. Sulfonamides 14. Fluoroquinolones 15. Glycopeptides	• Do not use to prevent disease • Use only when necessary • Diagnose before use • Use drugs that are in the Thai FDA permitted list • Do not use drugs with no known specific benefits • Use drugs according to prescription • Do not use drugs at more or less than the suggested dose • Stop using drugs at least 21 days before harvest • Do not use drugs after their color has changed • Do not keep drugs under humid conditions and keep away from direct sunlight

Source: ***Fishery*** *Magazine* 2002.

Code of Conduct for Sustainable Shrimp Aquaculture (COC)**.** The COC is based on an FAO standard, the Environmental Management Systems (EMS) ISO 1400, and the Codex Alimentarius. The Department of Fisheries has initiated COC implementation in 1998 with initial funding support from the World Bank to upgrade the Thai shrimp farming system to the international standard. At present, approximately 150 nauplius station and shrimp farm operators have successfully implemented the system and obtained COC certification from DOF.

Hazard Analysis and Critical Control Points (HACCP) System for the processing industries. The Department of Fisheries is promoting the implementation of quality systems and is conducting HACCP audits on shrimp processing plants based on Codex Alimentarius standards.

Shrimp farmers' enlistment. The objective of registering all shrimp farmers nationwide is to prepare an information database of all shrimp farmers in Thailand for easy information update and traceability. Enlisting is also required to enable members to avail themselves of the DOF laboratory test services and programs offered to registered cooperative members such as facilitating farmers' attendance at relevant training courses and participation in information- and experience-sharing and networking. To encourage farmers to take the opportunities opened to them, DOF also provided each of the 24 registered shrimp farmers cooperatives funding of US$1,160 and a PCR test kit for them to do the simple shrimp disease diagnostic tests themselves.

6. Implementing traceability through the use of Marine Animals Sales Certificate. Through the amendments made on the regulation concerning marine animal sales, the Department of Fisheries can now trace back the origin of a shrimp product, which is seen as the primary step to fully control the entire shrimp food chain. Under the Marine Sales Certification scheme, farmers planning to harvest their shrimp are to notify the Department of Fisheries' officers in the district 5 days in advance before harvesting takes place. Processing plants buying directly from the farmers are also required to provide information.

Private Sector Level

Shrimp farm. When shrimp farming started in Thailand 15 years ago, most farms were established in Samut Sakhon, which explaines why most processing companies are situated in the Central region. Due to shrimp disease problems that resulted from poor pond management, the farms moved to the Southeast and the South. The life span of culture ponds usually depends on stocking density, food and feeding, quality of bottom soil, and water temperature. To avoid shrimp diseases, once their production turned unprofitable, farmers with small farm areas and small investments found it easier and less expensive to relocate to rented new shrimp farm land than to put in a quality pond management system. Box 3 shows strategies followed by farmers to cope with disease.

Box 3. Strategy adopted by Thai small shrimp farmers to prevent impact of shrimp disease

Information gathered from farmers in 2003 suggested that antibiotics were routinely used in shrimp hatcheries and farms to ward off diseases and to ensure that farmers had harvest. Shrimp disease was the reason why most small farmers relocated their farms once a disease set in their ponds and why many farmers shifted toward the more disease-resistant *P. vannamei* shrimp culture. However, most farmers who relocated were those who had put minimal investment in their farms and who were less knowledgeable about good pond management. Accordingly, farmers who practiced good pond management seemed always to make a profit from raising shrimp. Some of these farmers admitted, however, that their present harvests were lower than when they began. They gave no reason why yields are lower at present than initially.

Source: Information collected by the research team, May 2003.

Chamberlain (2003) reported that the survival rates in *monodon* ponds in Thailand and other Asian countries dropped from 55 percent in 1998 to 49 percent in 2002, and, shrimp growth from 0.175 gm/day to 0.140 gm/day. Both declines were seen as symptomatic of shrimp infection. Accordingly, cultured shrimp inherently contain several diseases, which can be found anytime. The presence of disease accounts for the big shrimp size difference found sometimes at harvest and is the reason why the use of antibiotics is largely practiced in hatcheries and, to some extent, in shrimp farms.

The gradual move over the past 10 years has been from the Central to the Southern region. Having farms in the South while most of the processing firms and the central wholesale market remain in the central region creates clustering management problems. Distance also increases the costs of transportation and the chances for quality deterioration. Ideally, to facilitate better quality control and efficient cluster management, processing firms and farms, central market, and ports to transport products all must be located within short driving distances of one another.

To lessen the risk of quality deterioration by transporting shrimp from the South to the processing firms in Central Thailand, one of the interviewed entrepreneurs opted to export fresh shrimp daily to Singapore, maintaining freshly harvested shrimp in salted ice and transporting them by air freight. Supermarkets and restaurants were said to pay premium prices for fresh shrimp. This strategy was said to require very little investment and resulted to savings in maintaining cold storage and in work force for processing shrimp.

As discussed in the previous sections, to minimize the use of chemicals and reduce the chance of leaving residues in shrimp harvest, the farmers adopted two major strategies: (1) the switch to a more disease-resistant shrimp strain (*P vannamei*), which do not require as much chemical drug as the Black Tiger strain; and (2) the switch to probiotic farming, which makes use of the microbiological formulation that could both clean up the pond of feed wastes and serve as feed nutrients to farmed shrimp.

As most of the problems on quality compliance could be traced back to the farms, research and development efforts to improve the techniques in farm management and post-harvest handling are being pursued.

Processors/exporters. Although changes have been implemented at the central markets (to which shrimp are brought for auction) to ensure that antibiotic-contaminated shrimp are weeded out, processors supplying to the high-end market do not rely on supplies obtained from the central market. The trend now is to employ quality product segmentation to supply different market segments. Large exporters normally procure product for the high-end markets from trusted suppliers or the farms that they maintain and periodically audit and monitor; while for their less critical consumers, exporters procure their raw materials from new suppliers or the central market.

3. Asparagus

Production Development

‘”Mary Washington” was the first asparagus variety introduced for experimental purposes in Thailand in 1956 by one of the professors in Kasetsart University. Later, its commercial production was promoted in Chiangmai, Pitchout, and Cholburi, primarily to supply local hotels and restaurants. However, because its cultivation technology was not transferred to the growers, asparagus cultivation was not popularized. By 1972 asparagus cultivation was reintroduced through the King’s Hupkapong project in Petchburi (120 km southeast of Bangkok), which was done in collaboration with the Israeli government. The project’s aim was to set up a model asparagus production farmers’ cooperative. The cooperative became the regular supplier for Thai Airways. Any excess production was used for export or the domestic markets (Naritom 2000). Asparagus at that time was fetching a price of THB 50–60/kg (US$2–2.4/kg) but its production remained low, amounting to only 290 kg/year (Kosom 1985)

Farmers living near the project area learned the cultivation techniques from project members and started producing and selling their produce for export via middlemen. Members of the cooperative, however, were experiencing problems because of the infertile soil and poor irrigation system, plus the presence of a number of pests and diseases that made operation costs skyrocket. Without a definite market to absorb their produce and with the competition from the neighboring groups who were selling produce at much higher prices to middlemen for export, the cooperative failed.

In 1987 the Ministry of Agriculture and Cooperative introduced to farmers high-value cash export crops to improve their revenues and also to promote diversification in agricultural production. In conformance with the government’s 6th National Economic and Social Development Board Plan to promote export-led development in the country, the ministry proclaimed 15 districts as asparagus cultivation areas. To manage the level of asparagus production and stabilize the price, asparagus farmers were required to register with their respective provincial agricultural extension offices.

Research and development activities were also initiated to develop and transfer the cultivation technology to farmers to maximize productivity. Early works were geared toward variety selection suitable to Thailand’s environmental conditions (soil and climate) and optimization of the cultivation techniques, including fertilizer formulations, watering systems.

In 1987 Taniyama Siam Company, a Japanese investor in Thailand, became the pioneer asparagus farm contractor when it sought the cooperation of the Ministry of Agriculture and Cooperatives to promote growing asparagus for export to Japan. In that same year, after conducting a feasibility study on asparagus’ potential marketability, the Ministry of Agriculture and Cooperatives announced asparagus as one of the cash crops that would be promoted for export through contract farming. By 1998 there were five asparagus contract farming groups in Nakhon Pathom. Contracting companies included Taniyama Siam, which remained the largest, and other smaller companies.

At present, there are approximately 20 fresh/chilled asparagus exporters in Thailand. The largest has a production capacity of approximately 4,000 tons/year and, on average, exports 10 tons of fresh asparagus daily—mostly to Japan, and occasionally to Taiwan. The second largest exporter has a production capacity of approximately 2,000 tons/year, 95 percent of which is supplied to European supermarkets and 5 percent to local supermarkets. A common feature of all asparagus exporters in Thailand is that most of their suppliers are small farmers whose cultivated areas of asparagus typically range from 800 to 1,200 square meters.

Important Markets and Their Sanitary and Other Market Requirements

Asparagus is one of the important fresh vegetables exports of Thailand, constituting approximately 11 percent of the country's fresh/chilled and frozen vegetable exports in 2002 (table 15). Interest in fresh vegetables, asparagus included, has increased both locally and internationally and may be associated with the growing health awareness among consumers. Other important fresh/chilled vegetable exports of Thailand include bamboo shoots, onion, shallot, and leeks.

Table 15. Thailand vegetable exports

Year	*Total vegetable export (fresh/chilled and frozen)*		*Fresh asparagus export (t)*		
	Volume(t)	*Value(US$M)*	*Volume(t)*	*Value(US$M)*	*% of veg. exports value*
1998	103,934	84	1,587	5.9	7.0
1999	109,904	97	1,537	3.7	3.8
2000	106,666	90	3,822	7.2	8.0
2001	114,023	102	7,429	10.5	10.3
2002	119,831	113	8,013	12.2	10.8

Source: Department of Customs, Thailand Ministry of Finance.

The volume of exported fresh asparagus in 2002 totaled 8,013 tons, or US$12.2 million. For the past 5 years, exports of Thai asparagus has expanded in both volume and value with an average growth of 60 percent and 40 percent, respectively. This growth is a result of the rising consumption, especially in Japan, which is a major world asparagus importing country, as well as the expansion to new markets such as the EU, India, and the United Arab Emirates.

Production has increased by more than three times from 2,300 tons annually (1998) to 8,500 tons (2002); planted areas increased from 600 ha to 2,200 ha (table 16). As of 2002, there were approximately 5,850 farmers producing asparagus (DOAE 2002), and local consumption is approximately 25 percent of the production.

Table 16. Asparagus production statistics, 1998–2002

Year	*Area (ha)*	*Production (t/yr)*	*Yield (kg/ha)*
1998	600	2,300	3,833
1999	600	2,300	3,833
2000	1,300	5,000	3,846
2001	2,200	8,500	3,864
2002	2,200	8,500	3,864

Source: FAOSTAT 2003.

Japan and Taiwan are the major markets for Thai asparagus. (table 17[3]). Based on volume traded, Taiwan is the largest market, followed by Japan and the UK. The UK, with 3.6 percent export volume share, imports mostly precut 100-gm packages destined for direct distribution to high-end supermarkets.

[3] There is a big discrepancy between the export data provided by the Thai Department of Customs and the *World Trade Atlas* with regard to Thailand's export to Taiwan. The "value by volume" ratio seems to indicate that *World Trade Atlas* figures better reflect the world price than do those of the Department of Customs, in which "value by volume" approximated the price paid to farmers locally. However, the volume traded in 2002 as recorded in the World Trade data surpassed Thailand's total export volume traded, as recorded in the Customs data. In addition, the volume data recorded for UK, obtained from the USDA Gain Report, was way below what one of the exporters interviewed exported to UK.

Table 17. Asparagus exports, 2000–02

	2002	*2001*	*2000*
Total asparagus exports			
Value (US$M)	14.1	11.4	6.2
Volume (t)	8013.4	7428.5	3822.0
Exports to Japan			
Value (US$M)	10.2	7.1	4.5
Volume (t)	3,030.3	2,294.0	1,954.8
% share of total value	72.2	62.3	73.0
% share of total volume	37.8	30.9	51.1
Exports to Taiwan			
Value (US$M)	3.3	3.6	1.1
Volume (t)	4,749.5	4,863.9	1,672.4
% share of total value	23.5	31.6	17.7
% share of total volume	59.3	65.5	43.8
**Value (US$M)	15.8	11.4	4.4
**Volume (t)	8,409.0	5,639.0	1,858.0
Exports to UK ***			
Volume (t)	288.0	219.0	111.0
% share of total volume	3.6	2.9	2.9

Sources: * = National Food Institute (estimated from the Department of Custom's data, Ministry of Finance, Thailand).
** = World Trade Atlas Figures.
*** = Data obtained from USDA Gain Report.

Japanese Market

Japanese consumption of asparagus amounts to approximately 50,000 tons annually. For years, domestic and imported asparagus have maintained almost equal market shares but, recently, local production surpassed imports as Japanese farmers shifted to using a better yielding variety, "Welcome," in 2001. As a result, Japanese production jumped to 31,500 tons in 2001 from a 7,700-ha. farm compared to 26,700 tons of production from almost the same farm area in 2000 (table16).

In 2001, Australia, Mexico, the Philippines, and the USA supplied approximately 80 percent of Japan's imports while New Zealand and Thailand supplied approximately 15 percent. Asparagus suppliers to Japan and their respective market shares of 2000 to 2001 are presented in table 18.

Table 18. Japanese fresh asparagus imports, 2000–01

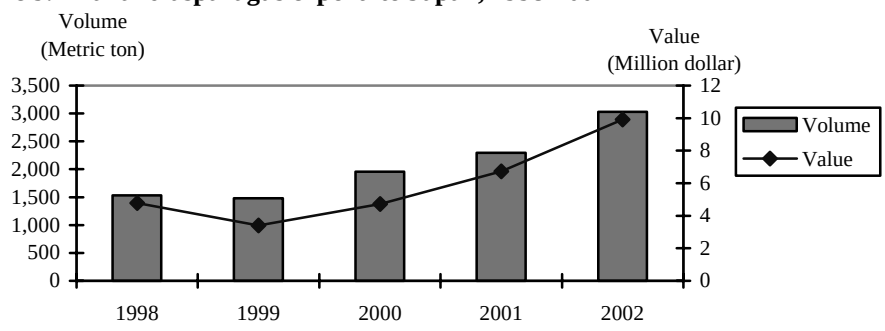
	2000		*2001*	
Supplier	*Volume (t)*	*% market share*	*Volume (t)*	*% market share*
Australia	6086	24.6	6022	27.3
USA	5454	22.0	3622	16.4
Mexico	4913	19.8	4056	18.4
Philippines	4293	17.3	4362	19.8
Thailand	**1895**	**7.7**	**2148**	**9.7**
New Zealand	1384	5.6	1273	5.8
China	437	1.8	372	1.7
Others	304	1.2	199	0.9
Total	24766		22054	

Source: JETRO 2002a.

Japan is the destination of approximately 50 percent of Thailand's total asparagus exports. In 2002 export volume and value were at 3,030 metric tons and US$13.7 million, respectively, an increase of 32 percent and 42 percent from 2001. Over the past 5 years, the growth rates have been 19.48 percent in volume and, 28.19 percent in value. Value growth exceeding volume growth suggests that Japanese demand has risen. Figure 9 shows the increasing Thai asparagus export volume and value to Japan for the last 5 years. At present, there is a demand for smaller and whiter shoots in Japan, and Thai

entrepreneurs see this as an opportunity to add value to their exports while meeting market need.

Figure 9. Thailand asparagus export to Japan, 1998-2002



Source: Department of Customs, Thailand Ministry of Finance.

Fresh vegetables play an important role in the Japanese diet and the Japanese are particularly demanding in their choice of produce. They look for the freshest items that are a rich, bright color; good shape; and insect free. Japanese consumers are also highly conscious of safety considerations, particularly pesticide residues (JETRO 1999). To control insect pests in shipped products, processors normally wash asparagus with chlorinated water and blow-dry it to prevent rotting before packing. If the presence of insects is still evident upon inspection, fumigation is normally allowed. Thai asparagus exports to Japan are sent either in bulk for catering services or in 60 or 100 grams packs for supermarkets.

Food retailers are offering consumers a far wider selection of imported foods at relatively lower prices than those locally produced. The popularity of imports is growing as consumers see the economic advantage of imports and the fact that they are available in as fresh and good state as the locally produced vegetables.

Japan regulatory requirements for fresh/chilled asparagus. The importation of vegetable produce is subject to the Plant Protection Law and Food Sanitation Law. Fresh produce for the retail market requires labeling with product name and country of origin. The Japanese authorities require that a phytosanitary and sanitary certificate issued by the exporting country accompany all fresh vegetable shipments entering the country.

Plant Protection Law. According to the provisions of this law, all imported plants and their container packages, whether or not accompanied with inspection certificate issued by the appropriate organization of the exporting country, are subject to inspection by the Japanese authorities. Plant and plant products imports are generally classified into three groups: (1) contrabands, (2) plants/plant products requiring import inspection, and (3) products not requiring import inspection.

Contrabands are plants that are known to host parasites and insects; or plants coming from areas known for noxious insects that have caused widespread damage and have not previously existed in Japan. *Plants requiring import inspection* include vegetables, fruits, saplings, decorative plants, cut flowers, bulbs, seeds, grain, pulses, wood, raw ingredients for spices, and raw ingredients for Chinese medicines. Some fruit and vegetable products of certain countries are granted automatic entry (conditional import) provided they are in compliance with the Japanese Agricultural Standards of the Ministry of Agriculture, Forestry and Fisheries. *Plants that do not require import inspection* include highly processed plant products such as lumber and processed tea.

Food Sanitation Law. Although Food Sanitation Law controls a wide range of concerns, for fresh/chilled asparagus and other vegetables, the major concern is the pesticides residue level. On

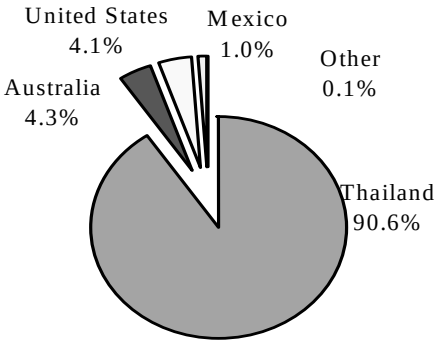
September 7, 2002, Japan put into effect a revision of its Food Sanitation Law to address the current BSE, or "mad cow disease," and pesticide problems. The revised restriction has pushed Thai authorities to strictly impose measures to meet pesticide standards, and exporters to exert strict pesticide usage control over their suppliers. This Japanese action is seen as a strong signal to reform or improve Thai farming practices.

Standard-related problems in Thai asparagus exports to Japan. Most fresh asparagus exports to Japan pass inspection with no problems. One exception occurred when on-cargo fumigation was required when the presence of thrips (prohibited insects) was detected in one of the (interviewed) exporter's shipment.

Taiwanese Market

In 2002 Taiwan imported 9,281 tons of asparagus worth US$17.34 million, an increase of 28 percent in volume and 20 percent in value from 2001. Thailand holds a 91 percent share[4] by volume in this Taiwanese market. Thailand is followed by Australia with 4.4 percent and the US with 4.1 percent share (figure 10).

Figure 10. Taiwan asparagus imports, 2002
(% volume by country)

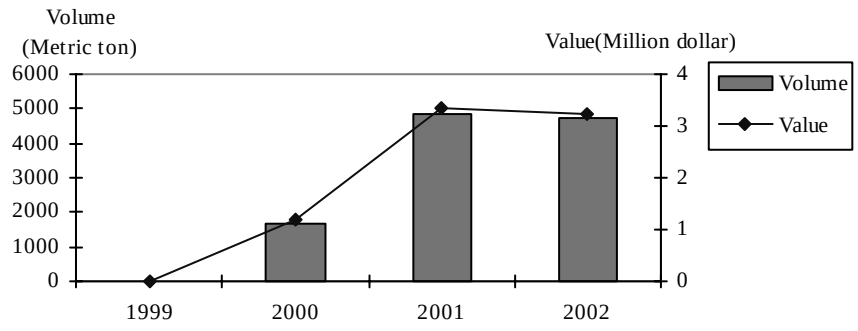


Source: World Trade Atlas 2002.

Although Taiwan is a relatively new market that started in 2000, it is now Thailand's largest market for asparagus. Figure 11 shows the asparagus export expansion of Thailand in Taiwan during 2000–02.

[4] The 91% share was derived by using the 2002 World Trade Atlas figure (8,409 tons), table 17.

Figure 11. Thailand's asparagus export to Taiwan, 1999-2002



Source: Department of Customs, Thailand Ministry of Finance.

The interviews with exporters indicated that Taiwanese importers are quite sensitive to price. Thailand's shipments to Taiwan largely comprised small and substandard-sized asparagus that are shipped in bulk. Being the nearest supplier to Taiwan, Thailand seems to be favored as the shipment cost is lower than its far-away competitors

SPS requirements. Taiwan acceded to the World Trade Organization only on January 1, 2002 and has just begun to implement the terms of the WTO Agreement. Many of its laws, regulations, and practices are still not WTO-SPS compliant, such as its periodically enforced law requiring action against nonquarantine pests. The process of reconciling Taiwan's current practices with WTO disciplines is proceeding only incrementally (FAS, USDA).

Imports of fresh produce are subject to random inspection for pesticide residues by the Taiwanese Bureau of Standards, Metrology and Inspection (BSMI) of the Ministry of Economic Affairs. The accompanying phytosanitary certificate is checked by the Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ) for completeness and accuracy. Discrepancies or insufficiencies in certificates can lead to delays in customs clearance, subject to reissuance of certificate or, in the worst case, rejection of the entire shipment.

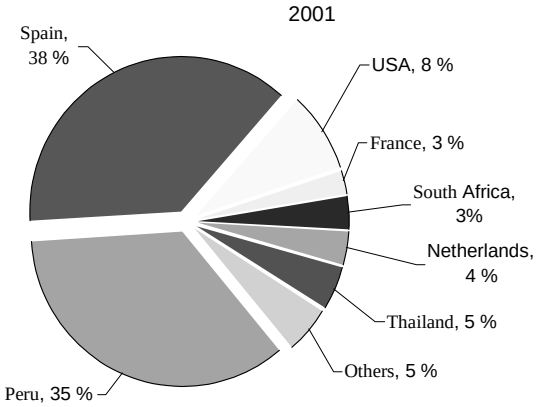
On August 1, 1999, Taiwan changed its pesticide inspection policy for imported fresh fruits and vegetables from a monitor-only policy to mandatory inspection. Inspection is done on all arriving shipments, and 1 in every 40 shipments is sampled and tested by BSMI for pesticide residues. Shipments are released after the retrieval of samples and document review. However, once noncompliance is found, the remaining unconsumed product would be recalled, and the next five shipments from the same origin (brand name/exporter) would be subject to testing and shipment and not released until testing were completed. Furthermore, that exporter's future shipments also would be placed on the watch list for more frequent sampling.

Food-standard-related problems of Thai asparagus exports to Taiwan. As of 2004, no problem with the fresh asparagus shipment to Taiwan had been reported. Exporters shipping to other markets commented that it had been easier to export to Taiwan than to other countries, provided all required documentation had been complete.

United Kingdom Market

The UK is still a small market for Thai fresh asparagus, accounting for only 3.6 percent of Thailand's total export value. Thailand's asparagus export to the UK in 2002 was only 288 tons (table 17) while in 2001, it was only 219 tons. The UK imports approximately 4,900 tons of asparagus annually and Thailand's market share (by volume) was approximately 5 percent in 2001 (figure 12).

Figure 12. Fresh asparagus imports of UK, 2001



Total import volume = 4,913 tons.
Source: USDA Gain Report, 2002.

UK fresh fruit and vegetable requirements. To be able to export fruits and vegetables to the EU, traders must be approved and authorized by the importing EU Member Country. To be an approved trader, one should be able to demonstrate a uniform and high conformity rate of fruits and vegetables to the marketing standards.[5]

Role of private standards. The UK is noted for its strong consumer power, making it a highly consumer-driven market. Moreover, under the provision of its Food Safety Act of 1990, a seller is responsible for the safety of the products s/he sells, even if the fault originated with another member of the food chain, which could be the growers, food importers, or overseas exporters. To ensure food safety, it is imperative that all parties in the food chain practice "due diligence" and carry out all reasonable precautions and checks on food, process, and condition of its supply. To prove that "due diligence" has been practiced, records and certifications are required.

For this reason, most UK supermarket operators and retailers are requiring their suppliers to have certifications from UK or EU-recognized quality system certifying bodies. This requirement implies that if an exporter is supplying different supermarket chains, s/he might be required to maintain different private quality systems. The exporters interviewed for this study actually maintain several quality systems certifications to comply with the differing private standard requirements of their clients. An exporter stated that having quality systems in place pays off because of the premium price that his products command in those high-end supermarkets in the UK. Most Thai fresh asparagus destined for the UK are supplied directly to supermarkets,. Thus, supermarkets function as both importers and distributors/retailers. Two of the major private standards required by UK or EU buyers are the EUREPGAP and the British Retail Consortium (BRC) standards compliance.

Despite the strict requirements and additional costs of implementing private standards that supermarket retailers impose on thier suppliers, Thai exporters seem able to cope. No rejection nor detention due to failure to comply with the sanitary requirement was reported in the past few years. Delays in shipment and some minor quality mishaps that occurred occasionally during transport were reported. They were settled through buyer-seller negotiation that usually ended in price reduction.

[5] Information on the common organization of the markets for horticulture, the EC Marketing standards, commodities subject to marketing standards, and the regulations on mixed fruits and vegetables packages are available in the website of the UK Department of Environment, Food and Rural Affairs (DEFRA), www.defra.gov.uk/hort/hmi.htm.

Sanitary and Quality Problems and Costs of Compliance

Responses to both questionnaires and interviews indicate that there has been no serious problem encountered by the fresh asparagus exporters group. Minor problems include the detection of thrips (insects), which can be remedied by fumigating the shipment before unloading it; damaged produce (broken asparagus tips); and bacterial damage resulting from shipment or delayed release of shipment at the port of entry. Quality defects are settled primarily through buyer-seller negotiation resulting in lower selling prices.

The Taiwanese and Japanese tightening of pesticide standards had great impacts on violators. Noncompliance products are destroyed at the port of entry at the exporters' expense, so the losses to exporters include the loss of product, shipment cost, and cost for product destruction. Most exporters are fully aware of these consequences, so they, in turn, impose strict measures on their contract farmers to abide by the buyers' pesticide regulations.

Compliance Costs to Farmers

The impacts of the stricter safety requirements are most likely to affect not only exporters but also the raw material producers. To assess the impact on farmers, in-depth interviews of the head of the Nongnguleum farmers group in Nakorn Pathom and the head of the Tamuang farmers group in Kanchanaburi were conducted. The Nongnguleum farmers group is contracted by a joint venture company with foreign investment while the group from Tamuang is contracted by a middleman dealing with a locally owned company.

The two groups used different approaches to reduce pesticide use. The group from Nongnguleum was helped by the joint venture company or its representative to understand why they need to reduce the use of pesticides. They were provided with clear instructions and training on the various farming techniques to reduce or eliminate pesticides, including land preparation, fertilizer application, natural pesticidal plant extract preparation and application, insect prevention, and the types of pesticides that are permitted for use in cases of heavy infestation of pests and impending spread of diseases. At the time of the interviews, the farmers were experimenting on the application of organic pesticides with the aim of minimizing, if not completely replacing, synthetic pesticides.

The Tamuang group gets the necessary guidance mostly from the DOAE staff, who normally visits the group twice a month to provide information or training. Since their quality system implementation is not as closely supervised as the system of the Nongnguleum group, when confronted with problems, the Tamuang farmers do not have anyone to turn to for advice. Instead, they resort to taking advice from pesticide dealers or salesmen. Aware of this risky practice, exporters protect themselves by testing produce to screen qualified suppliers before harvest.

From the information gathered, the costs of asparagus production for the two groups were roughly calculated (table 19). Data shows that farmers in Tamuang incurred approximately 2.6 percent more farming costs than did farmers in Nongnguleum before pesticide use was tightened. Fixed costs were 30 percent–33 percent, and variable costs were 67 percent–70 percent, of the total costs for both groups. The ratio of fixed to variable costs is approximately 1:2.

Table 19. Production costs before pesticide standards tightened *(US$/ha/yr)*

Expense details	*Cost type*	*Nongngulaeum*	*%*	*Tamuang*	*%*
Land preparation	Fixed	130.5	3.3	87.0	2.2
Motor (water pump)	Fixed	1,015.0	25.9	1,160.0	28.9
Watering System (sprinklers)	Fixed	-	0	-	0
Seeds	Fixed	72.5	1.8	72.5	1.8
Total fixed costs		*1,218.0*	*31.0*	*1,319.5*	*32.9*
Pesticides ($579.91/yr)	Variable	580.0	14.8	580.0	14.4
Synthetic Fertilizer (3 times a mo)	Variable	1,827.0	46.7	1,827.0	45.5
Natural glue trap (4 times a yr)	Variable	-	0	-	0
Organic Fertilizer (twice a yr)	Variable	290.0	7.4	290.0	7.2
Labor (2 workers every 15 da)	Variable	-	0.00	-	0.00
Total variable costs		2,697.0	68.9	2,697.0	67.1
Total		3,915.0	100.00	4,016.5	100.00

Source: NFI computation based on interviews and secondary sources.

After the pesticide standards were tightened, production costs increased from US$3,915 to US$11,017 for the Nongnguleum group, and from US$4,016 to US$9,960 for the Tamuang group (table 20). The ratio of fixed to variable costs for the Nongnguleum group changed a little from 30:70 to 34:66, which means that the fixed cost has a bigger percentage increase than the variable cost. For the Tamuang group, the ratio was changed from the previous 33:67 ratio to 25:75, which means that most of the additional costs incurred in complying with the pesticide requirements went to increases in variable costs.

Table 20. Production costs after pesticide standards tightened *(US$/ha/yr)*

Expense details	*Cost type*	*Nongngulaeum*	*%*	*Tamuang*	*%*
Land preparation	Fixed	130.48	1.18	86.99	0.87
Motor (water pump)	Fixed	1,014.85	9.21	1,159.82	11.64
Watering system (sprinklers)	Fixed	1,739.74	15.79	1,159.82	11.64
Seeds*	Fixed	906.11	8.22	72.49	0.73
Total fixed costs		*3,791.18*	*34.41*	*2,479.12*	*24.89*
Pesticides (2 types at $2.8/mo and $13.9/mo)	Variable	208.77	1.90	1,043.84	10.48
Synthetic fertilizer (50 t/ha/yr)	Variable	1,826.72	16.58	1,826.72	18.34
Natural glue trap (4 times a yr)	Variable	579.91	5.26	-	-
Organic Fertilizers (twice a yr)	Variable	1,014.85	9.21	1,014.85	10.19
Labor (2 hired workers to weed 15 da/yr at $3.7/day)	Variable	695.89	6.32	695.89	6.99
Monetary equivalent of farmers labor costs	Variable	2,899.56	26.32	2,899.56	29.11
Total variable costs		*7,225.70*	*65.59*	*7,480.86*	*75.11*
Total		*11,016.88*	*100*	*9,959.98*	*100*

Source: NFI Computation based on interviews and secondary sources.
Note: * = initial costs of imported hybrid seeds. Seed productivity holds for approximately 7 to 10 years before decline may be noted.

With the use of less pesticide, farmers spend more time and effort in caring for the plants, which are more liable to insect and worm threats. A monetary equivalent for the farmers' additional time and efforts was calculated as an additional variable cost. Additional work done by farmers includes the preparation and application of natural pesticide preparations, inspection and removal of worms from plants, and individually fitting each shoot with a plastic cap to protect it from attacking pests. On the

average, each farmer spends approximately 3 additional hours a day to do the above tasks. Hiring a helper to do those tasks would costs approximately US$463.93 per year, at US$0.46 an hour.

A comparison of the production costs before and after the tightening of the standards showed that the farmers' costs jumped 181 percent and 150 percent for the Nongnguleum and the Tamuang farmers groups, respectively (table 21).

Table 21. Pesticide compliance costs to farmers *(US$/ha/year)*

Costs	*Nongngulaeum*	*Tamuang*
After complying w/ stricter requirements	**11,016.88**	**9,959.98**
Before tightening of pesticide standard	3,915	4,016.5
Difference	7,101.88	5,943.48
Farmers compliance costs (%)	181	148

Source: NFI computation based on interviews and secondary sources.

With the tightening of the pesticide standards and the promotion of organic farming by the DOAE and companies such Taniyama (which introduced this type of farming five years ago, although its popularity seemed to take off only in 2002), more and more farmers have reduced the use of pesticides and other agrochemicals.

Despite the additional costs and inputs, harvests in the more organic farming method was reported to be 20 percent less than the non-organic farming but the price is higher, thereby, compensating for the reduced harvest. Pesticide-free asparagus command a higher price (US$1.35/kg) than conventional produce (US$1.04/kg), a 30 percent increase.

Table 22 compares the estimated income of asparagus contract farmers working under *direct* contract farming (Nongngulaeum group) and a *middleman-mediated* contract-farming scheme (Tamuang group). Note that farmers in direct contact with the company had higher initial farming costs but lower maintenance costs in subsequent years. Higher initial costs might be attributed to the higher seed costs while the lower maintenance costs might be accounted for by the lower pesticide costs as the farmers tended to substitute pesticide formulations with natural pesticide materials. The higher income generated by farmers under direct contract may be due to the higher buying price paid by the company for the farmers' produce.

Table 22. Estimated income of farmers *(US$/ha/year)*

Year	*Nongngulaeum**			*Tamuang***		
	Cost	*Gross income*	*Net income*	*Cost*	*Gross income*	*Net income*
1	11,016.88[a]	25,039[c]	14,022	9,959.98[a]	19,007[c]	9,047
2	7,225.70[b]	50,072[d]	42,846	7,480.86[b]	38,014[d]	30,533
3	7,225.70	66,762[e]	59,536	7,480.86	50,685[e]	43,204
4	7,225.70	50,072[d]	42,846	7,480.86	38,014[d]	30,533
5	7,225.70	25,933	18,707	7,480.86	19,572	12,091

Source: NFI computation based on interviews and secondary sources.

Notes:

a Fixed and variable costs included (see table 20).

b Only variable costs included (see table 20).

c Productivity calculated at 93.75 kg/ha/day.

d Productivity calculated at 187.5 kg/ha/day.

e Productivity calculated at 250.0 kg/ha/day (The third year gives the peak productivity. Productivity gradually declines until it returns to the baseline in the fifth year, which is maintained until the seventh year. After that, it is generally advisable that farmers discard old plants and prepare land for new seedlings).

* A grade price = US$1.41/kg.; B grade price = US$1.04/kg. (50% A grade).

** A grade price = US$1.16/kg.; B grade price = US$0.70/kg. (50% A grade).

Good and fresh asparagus are usually dark green; firm with closed compact tips devoid of any fungal or signs of insect infestation. Stalks are generally straight, tender, and glossy in appearance. Grading into A, B and C is generally based on the

diameter size, and appearance. Although the grading system of asparagus in Thailand and prices vary with the buying companies, the following is a rough general guide used in grading asparagus:

A grade shall have a diameter of at least 1 centimeter and up; length could vary from 18–25 cm. with green area ranging from 15–25 cm.

B grade shall have a diameter of 6 mm to less than 1 cm; length may vary from 18–25 cm. with green area ranging from 15–25 cm.

C or S grade cannot meet the appearance or diameter requirements for A and B grades.

Box 4. Sample gross income calculation of asparagus farmers (based on Nongngulaeum harvest)

Assumptions:
Production cycle is approximately 44 days harvest and 30 days rest, or approximately 218 production days/year
Average harvest is 93.75 kg./ha/day
Harvest consists of 50% A grade and 50% B grade
(A grade) 46.88 kg. X $1.41/kg = $66.10
(B grade) 46.88 kg. X $1.04/kg = $48.76
Total = US$114.86/ha/day
Total yearly gross income = US$114.86/ha/day X 218 days/year
= US$ 25,843.50 /ha/year

Compliance Costs to Exporters

While farmers have to spend more time and efforts to comply with market requirements, exporters have to invest more on quality system set-up, such as the EUREPGAP system on their contract farms, and BRC and HACCP standards for their processing plants. All of the abovementioned quality systems are not legally required for fresh asparagus produce, but the exporters' foreign supermarket clients require certification of certain quality systems. As previously discussed, different clients sometimes require different certifications, so an exporting company must have multiple certifications to be able to compete in supplying the higher-end markets. Exporters are most adversely affected when their shipped products are rejected or detained.

The calculations of costs in this report were based on information obtained from the two exporters interviewed. Both exporters are supplying UK and, to some extent, Hong Kong and Taiwan supermarkets. Table 23 shows the costs spent on internal audit and certification for the different quality systems using local consultants. Note that once a system has been set up and implemented for one quality system, the cost to set up another system is expected to be minimal unless additional equipment is required.

Table 23. Quality management system implementation costs

Details	*Costs (US$)*
System set up * (average estimate)	**3,480.00**
EUREPGAP System	**3,247.50**
• Internal audit (every yr)	1,624.00
• Certificate	1,624.00
BRC	**4,871.00**
• Internal audit (every 6 mos)	3,247.50
• Certificate	1,624.00
HACCP	**4,871.00**
• Internal audit (every 6 mos)	3,247.50
• Certificate	1,624.00
Total	**16,469.00**

Source: NFI computation based on interviews and secondary sources.
Note:

* For companies implementing several quality standards, system set-up may be done only once, although additional documentation may be necessary. System set-up costs depend on the original set-up of the factory. A properly planned factory equipped with necessary mechanization to ensure quality production entails minimal changes and costs.

With the tightening of the standards on pesticides, pesticide testing is now conducted by the contractors or middlemen before harvest to identify whether farmers are accepted as suppliers of the exporting company, and after grading the produce, to ensure that shipment meet the importing country's requirement. Table 24 shows the annual pesticide costs before and after the pesticide standard was tightened. A remarkable increase in expenses for private laboratory analysis is noted, amounting to US$27,836/year. This high cost may be attributed to the increased number of samples sent by exporters for laboratory testing to ensure that products meet the tolerable pesticide level imposed by their trading partners. Thus, the cost of compliance to exporters is 63 percent higher than prior to the tightening of pesticide requirements.

Table 24. Annual pesticide compliance costs to exporters

Details	*Before pesticide standard tightening*	*After pesticide standard tightening*
Sample testing by the DOA (US$927.86/mo)	11,134.00	11,134.00
Sample testing by private laboratories (US$2,319.65/mo)	0	27,836.00
Contract farming staff (10 staff at US$278.36/mo)	33,403.00	33,403.00
Total	44,537.00	72,373.00

Source: NFI computation based on interviews and secondary sources.

Compliance Costs to the Government Sector

The government has launched programs to educate producers and exporters on the new farming technology to lessen pests and reduce pesticide use and improved post-harvest handling techniques; and to inform them of the new regulatory requirements and demonstrate how they can comply with them. Extension costs in these regards are not considered a compliance cost since these are regular government service tasks. The government also provides laboratory services and issues reports of laboratory analyses done to accompany export shipments. In addition to food sanitation certification, quarantine and product standard inspection and certification are also provided.

The expenses for laboratory equipment and hiring trained and competent analysts remain the most pressing needs of the private sector, especially the small and medium-scale exporting companies. To ensure conformance with the pesticide requirements, a traceability system must be implemented. For this, the number of laboratories in Thailand needs to be increased not only to cater to the increasing needs of food exporters but also for the monitoring and surveillance program of the country's regulatory agencies. To ensure traceability, the government required all asparagus farmers and farmer cooperatives to register effective October 2002.

Because the government sector has the responsibility of ensuring public safety and supporting the agricultural sector, the services rendered to exporters cannot be included as costs of compliance. In this study, these costs are considered part of the government's regulatory enforcement monitoring costs.

The costs of compliance that could be estimated as costs to the government sector are the costs for research and development work as they developed guidance for Good Agricultural Practice (GAP), test kits for rapid pesticide analysis, pest-resistance asparagus strains, natural pesticide preparations, and improved agricultural production techniques. At present, no estimate of these costs can be made.

Quality Management of Asparagus

Diseases. Asparagus are vulnerable to diseases caused by molds, thrips, and worms. Diseases caused by molds include stem blight, Branchlet spot, wet rot, and Anthracnose. These diseases spread widely during the rainy season, particularly from May to October. If infestation is heavy, pesticides are normally used. The typical chemicals used to eradicate mold include copper oxychloride, although other organic pesticides are also used.

Insects. Thrips and insects are the most common asparagus pests. To prevent and repel insects, farmers are opting for the use of water sprinklers and glue traps instead of pesticides. With thrips, if infestation is heavy and widely spread, carbosulfan pesticide is usually recommended.

Worms. Worm is the other asparagus pest. Worms generally stay underground during the day and attack plants in the night. Two ways by which farmers deal with worms are either to spray plants with pesticide (Lannet) or with pesticidal plant extract preparations. There are a number of plants known to possess natural pesticidal properties but "sadao" seems to be the most common and popular one. However, "sadao" has a strong smell that can carry over to the produce and possibly affect the produce's sensory quality and acceptability.

Pesticide use. The first asparagus harvest generally takes approximately 8–10 months after seeding. The farmers' normal practice is to harvest asparagus in cycle: daily harvesting for 45 days followed by a month's rest, which has been reported to lengthen and enhance the productivity of asparagus plants. During the harvesting period, no use of any pesticide is allowed. In case of a widespread disease and use of pesticides, harvesting is stopped until the pesticide residue is back to the safe level. Generally, it takes approximately 7 days for the pesticide residue to return to its baseline level, but farmers usually allow 15 days to ensure that the pesticide level stays safe below the standard Maximum Residue Level (MRL).

Physiological defects. Asparagus continue to respire and develop even after harvest, which is the reason that low temperature post-harvest management is critical. Common physiological defects that can occur include the expansion and opening of tips, bending of tips, bruising and tip breakage, toughening of spears, chilling injury, darkening in spots or streaks, freezing injury, softening, and wilting.

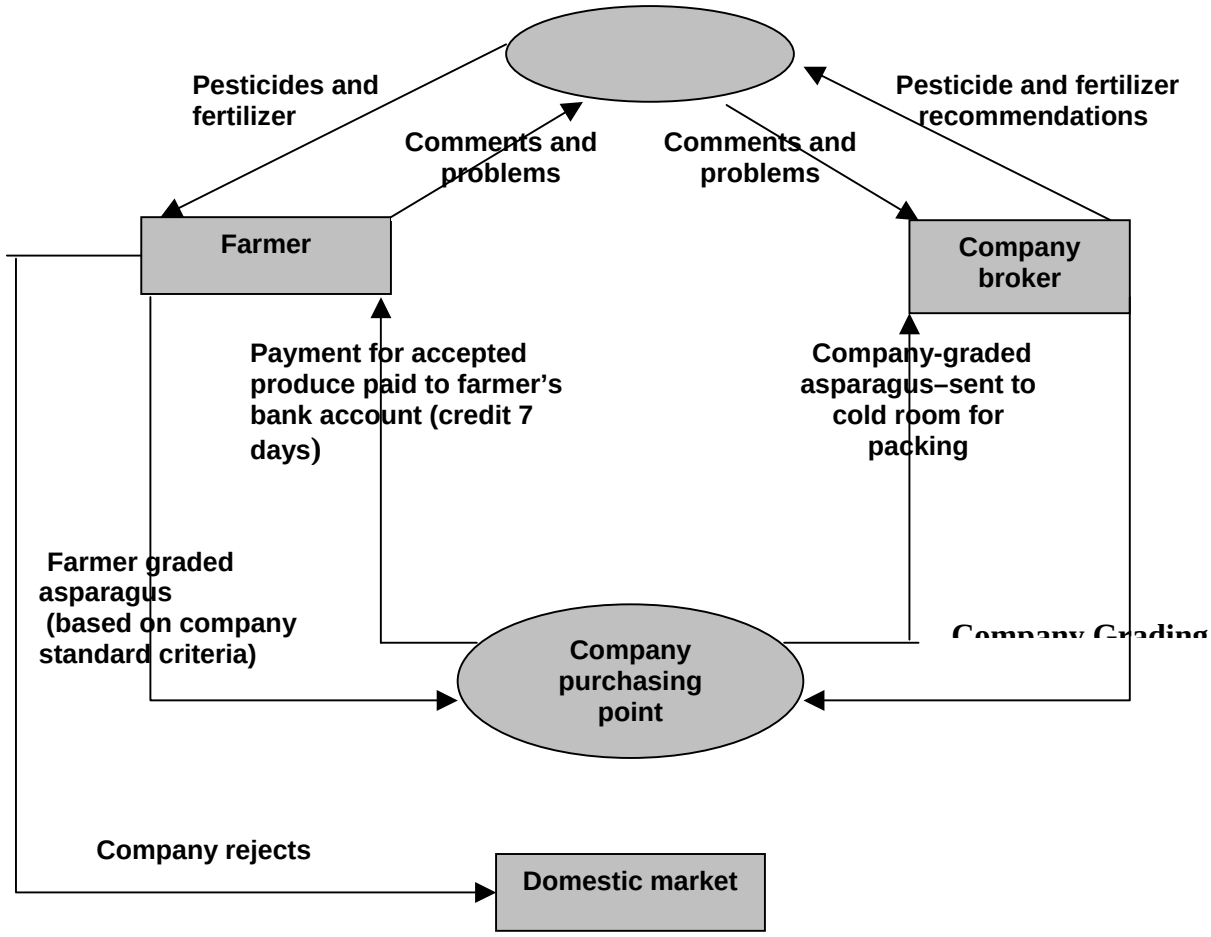
Pathological defects. Asparagus is subject to bacterial soft rot, which is induced by *Erwinia carotovora.* The tips or the butt ends of the spears are quite susceptible to bacterial decay. To prevent bacterial rot, it is necessary to keep the asparagus dry.

Private Sector Quality Management Strategies

To ensure pesticide standard compliance in fresh asparagus, a quality management system with the contract farmers is established by the exporting companies. Based on the interviews for this study, there are two types of contract farming in asparagus farm production.

Direct contract farming. A written contract is made between the contracting export company and the farmers. In the contract, descriptions of the roles of the contracting parties are spelled out with the guaranteed price for the corresponding quality of the harvest and the types of pesticide that are permitted for use (if need be). With this type of contract, the Head Farmer, usually the head of the village or a respected person in the village, is identified and asked to lead and oversee farmer members of the contracted farm (figure 13). As head, he functions as the focal point for farmer members and the contracting company and serves as an adviser to the group and conflict mediator between disagreeing members, maintains a database of his group members and, sometimes, also serves as distributor of company-prescribed pesticides and fertilizers. He also makes sure that members fulfill the contract and penalizes members who breach the contract**.**

Figure 13. Management and purchasing system under a direct contract farming system



Source: Farmer and exporter interviews by the research team, May 2003.

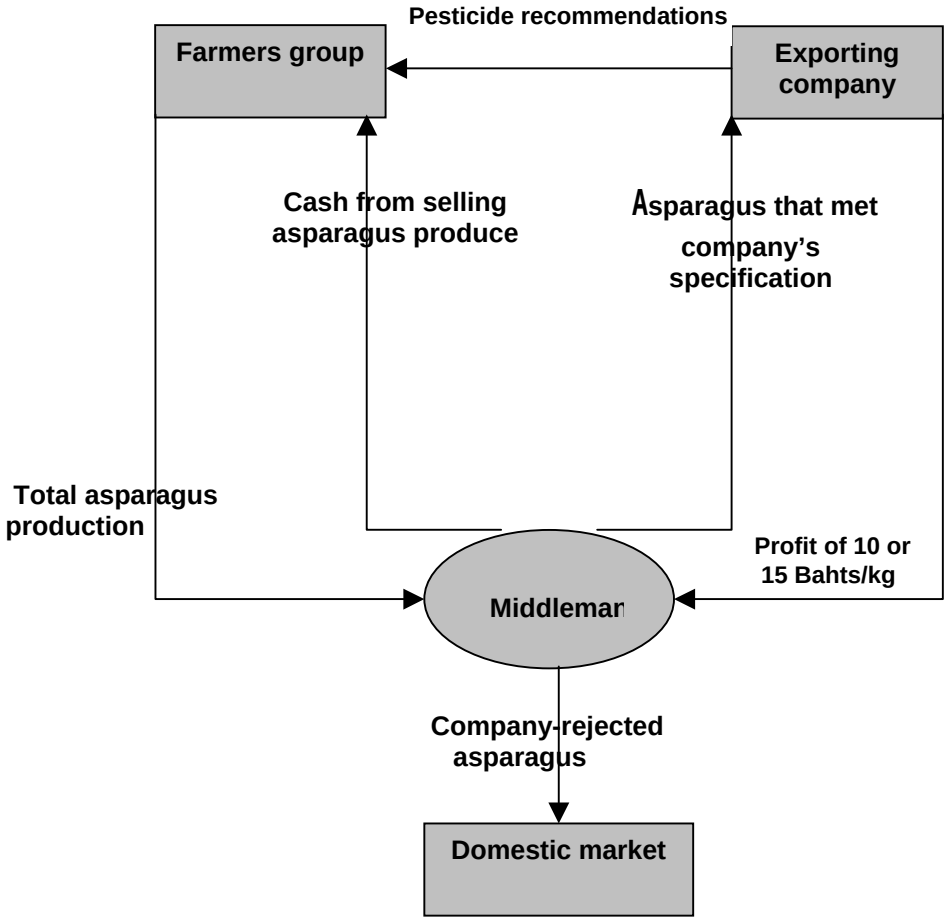
The contracting company hires a broker to supervise the contracted farmers groups to find out whether there are problems that need assistance from the contracting company and to provide technical advice or facilitate farm-related problem-solving meetings called by the head farmer. Often, a broker has to take charge of several farmers groups. To ensure that the farm is managed properly to produce products in compliance with company quality specifications, the broker regularly visits the head farmer (three to four times a week) to ensure that the farmers are following recommended ways to minimize pesticide residue and maximize product quality. Frequent broker-farmer interactions facilitate technology transfer as farmers learn the various and appropriate ways of dealing with farm-related problems. In turn, the head farmer communicates and implements the broker's suggestions to and with the rest of the group members. During harvest, group members harvest their own field, select, pack, and put their personal codes on their packed harvests to enable the company to trace back

raw material to its source in case of problems and to have the payments for their harvests deposited in their respective bank accounts. A company grading team normally receives the harvests, grades them using the criteria set by the company, and repacks them for shipment.

An important privilege accorded by the company to the village heads was a trip to Japan, where they gained an understanding of the consumers' behavior and preferences, the benefits of complying, and the fate of products that failed to meet market requirements. The trip not only taught head farmers the importance of adhering to product quality and safety management but also gave them a better knowledge of and perspective on quality vegetable production that they could use in their own villages.

Middleman-mediated contract farming. An exporting company makes use of a middleman to find its supply of produce to fulfill the delivery orders. A middleman has a good relationship with both company and farmers groups (figure 14). S/he explains to the farmers the company's requirements and arrangements regarding price, quality grading, and adherence to pesticide residue specification. A middleman serves as an adviser to farmers—providing them with practical tips on farming, mediating conflict resolutions between/among group members, facilitating problem-solving by referring the problem to the company or by seeking assistance from the Department of Agricultural Extension (DOAE), selling them fertilizers and pesticides by cash or credit, and buying their produce in cash at a pre-agreed price. The middleman gets a commission of $0.23–$0.35/kg of produce sold to the company plus occasional bonuses.

Figure 14. Marketing asparagus through middleman



Source: NFI computation based on interviews and secondary sources, May 2003.

The main difference between these two systems lies in the *degree of supervision* and *quality control*. The group with the direct contract gets close supervision and farming guidance from the company

staff, who come frequently; while the middleman-mediated group gets the necessary guidance mostly from the DOAE staff, who visit them twice a month to disseminate information or conduct farmer training. To the middleman, who is more focused on getting business, attending to the problems and needs of the farmers is a secondary priority for him. Consequently, when farmers are confronted with problems, they turn to the pesticide dealers/sellers. Therefore, quality system implementation is neither as closely supervised nor as stringent under middleman-mediated contract farming as with the direct contract farming groups.

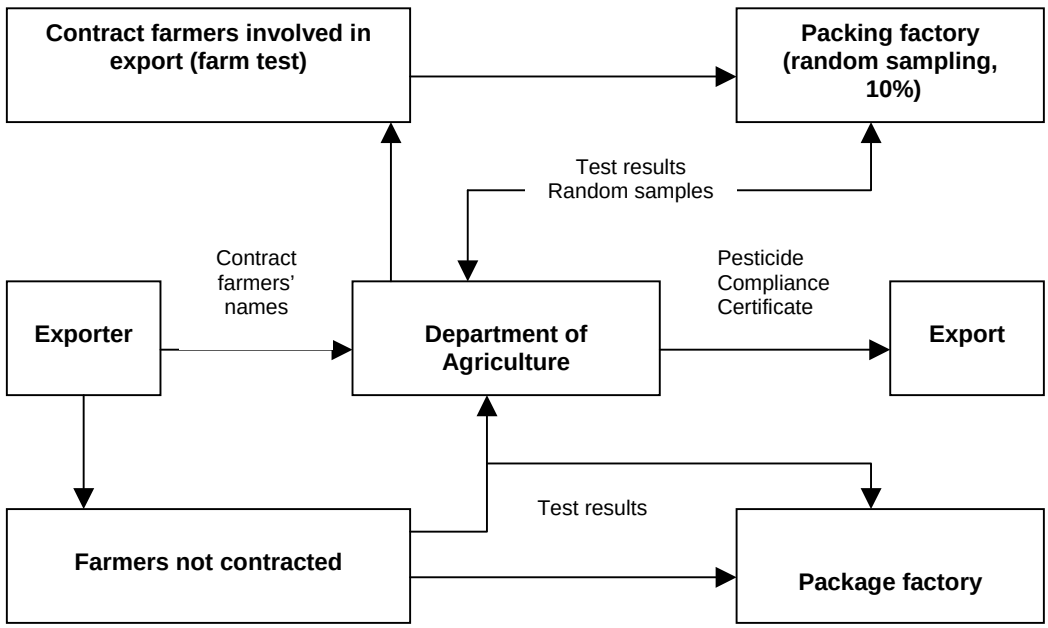
To ensure pesticide compliance in a coordinated farming system, a close monitoring system, and guidance and education for farmers to understand the importance and implementation of a quality management system are necessary.

Government Quality Management Strategies

Although most of the exporters who responded to the questionnaires did not mention any rejections for noncompliance with sanitary measures, they were aware of the food scares and scandals around the world that drive food and health protection agencies to issue stringent regulatory measures. In Thailand, food regulatory changes are either international standards requirements or are triggered by external factors such as the possibility of export product detention or rejection by major markets and receiving negative coverage in the media. Pesticide regulations in Thailand have been adopted for more than five years, but enforcement was rather weak until the pesticide regulations in Japan were made more stringent in 2000.

To monitor traceability and the pesticide residue level in fresh vegetable exports, the Thai Department of Agriculture set up a farmers registration system in which samples of an export shipment are checked for pesticides before the shipment can be issued a pesticide compliance certificate, which is used as a pass to export (figure 15). The system requires exporters to submit the names of their respective contract farmers. Harvests sent for packing are randomly sampled for pesticide testing by the DOA before a certificate can be issued. Harvests of noncontracted farmers need 100 percent testing and compliance before a pass to export can be issued.

Figure 15. DOA's monitoring system for pesticide in fresh asparagus for exports



Source: Department of Agriculture, Thailand Ministry of Agriculture and Cooperatives, May 2003.

The Ministry of Agriculture has set policy targets and programs to prevent possible noncompliance problems that may cause product rejection or recall. These programs promote:

- The use of *organic substances* to reduce the amount of chemical substances that damage the environment and the ecological balance. Organic farming has been promoted by the DOAE for approximately two years as of 2003.
- *Good agricultural practice (GAP)* at the farm level. This guideline practice is aimed at obtaining high-quality standard produce through efficient, environmentally friendly, and sustainable farming practices that are safe not only to farmers but also to consumers.
- *Plant Quality Management System (PQMS),* a quality system developed by the Department of Agriculture to improve the standards of local food plants and to ensure food safety from farm to table. This system covers primary production as well as processing. PQMS is to be implemented on 18 agricultural products for exports: durian, tangerine, lychee, pineapple, pummelo, fresh table pineapple, jasmine rice, *asparagus,* curcuma, orchid, sweet tamarind, longan, Pathumthani 1 rice, baby corn, mangosteen, mango, and rambutan.

Summary of Production Changes after the Imposition of Stricter Standards on Pesticide Use

The Taiwanese mandatory pesticide inspection rule in 1999 and the lower Japanese maximum limits for pesticide residues set in 2002 impelled Thailand to develop quality management systems, such as GAP in farm production and PQMS for both farm and processing plant, that enabled farmers to improve their implementation of standards and quality control, and establish a traceability system.

In response to the demands, there is a greater communication, information exchange, and networking among stakeholders in the food chain—made up of farmers and farmers groups, private sector, its trading partners, and the pertinent government agencies—that is leading to a general improvement in Thailand's entire production chain.

Unity was strengthened; group spirit was enhanced; and meeting the higher standards created a common interest among all stakeholders to improve and build the reputation and credibility of their products, knowing that the possible consequences for noncompliance could affect the reputation or credibility of the entire group and eventually impact on the country's economy.

4. Frozen Green Soybeans

Production Development

Research on suitable green soybean (edamame) varieties for farming in Thailand was first conducted in 1981 in Kasetsart University. By 1987 green soybean was one of the high-value cash crops introduced by the Ministry of Agriculture and Cooperative. With Thai processing companies in joint ventures with investors from Japan and Taiwan, green soybean is now grown mostly in the northern part of the country, particularly Chiangmai, Chiangrai, and Lampang. Approximately 98 percent of their production is exported frozen to Japan. Soybean cultivation is centered in the northern part of Thailand **mostly** because of its critical weather requirements for growth. Thus, expansion seems infeasible. The only way that production can be expanded is to come up with a high-yielding variety that can be grown under Thailand's conditions.

Japanese Market: Sanitary and Other Requirements

Japan consumes approximately 170,000 tons of green soybeans annually, that is, approximately 1.5kg/capita annual consumption. Its domestic production can supply only 60 percent of this demand. Knowing the great demand for green soybeans in Japan, most world green soybean suppliers have aimed at filling that demand. China, Taiwan, and Thailand with market shares (volume) of 50 percent, 34 percent, and 12.7 percent, respectively, were Japan's leading suppliers of green soybeans in 2002 (table 25).

Table 25. Green soybean suppliers' market shares in Japan

Country	*Volume (ton)*						*Value (million dollar)*					
	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
China	27,395	35,157	39,163	39,793	44,958	34,617	44.56	55.13	60.72	49.68	71.99	50.70
Taiwan	25,586	24,238	24,025	24,166	22,696	23,587	47.29	41.96	42.23	42.97	43.36	41.42
Thailand	6,949	7,941	9,079	8,690	7,768	8,836	12.29	13.70	15.77	14.64	13.55	13.79
Others	321	923	809	2,337	1,779	2,470	0.44	1.22	1.02	12.44	2.77	na
Total	60,251	68,260	73,075	74,985	77,200	69,510	104.58	112.01	119.75	119.72	131.67	na

Source: JETRO 2003b.

The corresponding market prices of soybean in Japan for the respective suppliers are presented in table 26. Green soybean price is generally based on quality and season. During the out-of-season months (January–February), the demand for green soybeans is greater than the supply; thus, price is higher. Thailand grows soybeans in three seasons: (1) April–May, (2) July–September, and (3) December–February. Most Thai farmers, though, practice two green soybean croppings a year, alternating them with rice or yellow soybean crop.

Table 26. Selling price of green soybean in Japan, 1997–2002

Country	*Selling price (US$/kg)*					
	1997	*1998*	*1999*	*2000*	*2001*	*2002*
China	1.79	1.57	1.55	1.25	1.47	1.46
Taiwan	2.03	1.73	1.76	1.78	1.75	1.76
Thailand	1.94	1.73	1.74	1.68	1.60	1.56

Source: NFI computation based on JETRO data 2003.

Most Japanese consumers are opting for health and natural foods. The recent trends in vegetable consumption in the Japanese markets are organically grown produce and convenient precut vegetables for use in salad and other food preparations. Although Japanese consumers enjoy the benefits of imports, they also express concerns over the huge volume of low-priced vegetables coming from China, fearing its food safety.[6]

Presently, land planted with green soybean in Thailand is approximately 3,000 ha with a yearly average production of 10,000 tons (table 27). There are approximately 8,250 green soybean farmers in Thailand. Roughly 98 percent of their total production is exported in frozen form to a single market (Japan), for which Thailand held a market share of 12.7 percent by volume in 2002.

Table 27. Green soybean production, plant area, export, 1996–2002

Year	*Plant area*	*Production*	*Domestic consumption*	*Export volume*
	(ha)	*(t)*	*(t)*	*(t)*
1996	1,892[a]	10,033[a]	201[b]	9,832[b]
1997	3,153	8,051	161	7,890
1998	2,200	11,786	236	11,550
1999	2,624	14,445	289	14,156
2000	1,275	10,305	206	10,099
2001	3,009	8,250	165	8,085
2002	-	9,392[c]	188	9,204[c]

Sources:
a Department of Agriculture Extension, Thailand, 2003.
b Interview (domestic consumption = 2 percent; export = 98 percent of total production).
c Estimate.

On the 5-year average, Thailand was exporting 2.5 times more fresh than frozen vegetables in volume but the value generated was 1.5 times less (table 28). Frozen green soybean was approximately 32 percent of the entire Thai frozen vegetable exports.

Table 28. Frozen green soybean exports compared to total fresh vegetable exports

Year	*Total fresh/chilled vegetable exports**		*Total frozen vegetables**		*Frozen green soybean exports to Japan*		
	Volume (t)	*Value (US$M)*	*Vol (t)*	*Value (US$M)*	*Volume (t)*	*Value (US$M)*	*% of value/ total frozen*
1998	68,732	38.47	35,202	45.90	7,941	13.81	30.08
1999	72,452	42.48	37,452	54.07	9,079	15.96	29.52
2000	75,350	46.04	31,316	43.87	8,690	14.78	33.69
2001	86,666	60.73	27,357	41.09	7,768	12.53	30.49
2002	89,925	72.23	29,906	40.64	8,836	13.78	33.92

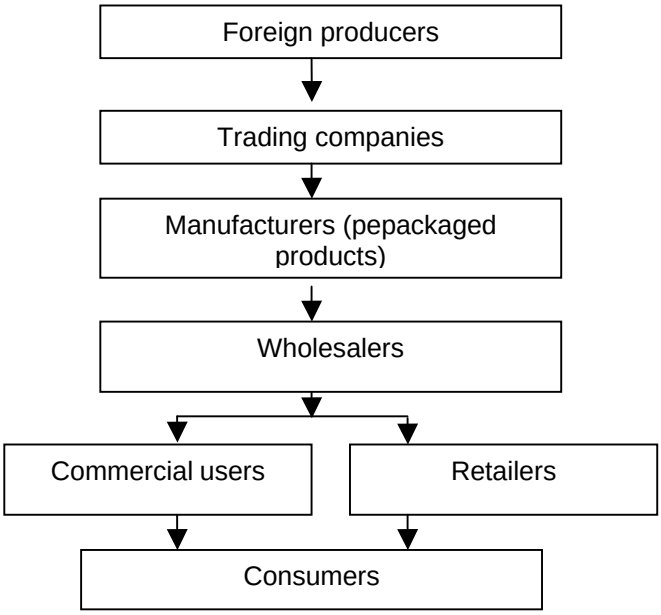
Source: Department of Information Services, National Food Institute based on Department of Customs data.
Note: * = includes bamboo shoots, asparagus, onion, shallot, and leeks.

Distribution Channels of Frozen Vegetables

Thailand exports green soybean to Japan through trading companies. The vegetables are then packed into smaller packages before they are distributed to wholesalers, retailers/supermarkets, and commercial users such as hotels and restaurants (figure 16). The major trading companies in Japan are Itosho, Mitsui, Mitsubishi, and QP, but approximately 95 percent of the Thai shipments are distributed by Itosho. Contract production overseas for large service companies and direct imports by mass merchandisers seem to be also on the rise.

[6] Jetro 2002a.

Figure 16. Frozen vegetable channel distribution in Japan



Source: JETRO 2002a.

Regulatory Requirements

Plant Protection Law. All vegetables imported into Japan ,whether fresh or frozen, are subject to the provisions of the Plant Protection Law and Food Sanitation Law. For frozen green soybean, therefore, a phytosanitary certificate issued by Thailand's Competent Authority, the Department of Agriculture, is required. To qualify, samples of shipment must be tested for the presence of prohibited pests or diseases.

Food Sanitation Law. The export of frozen green soybeans requires a Health and Sanitation Clearance from the Department of Agriculture, Thailand's Competent Authority for frozen vegetables. Japan's vegetable imports for sale or commercial purposes may be inspected at the port of entry. For frozen imports, freezing must be adequate, or the vegetable will fail the plant quarantine inspection. Frozen vegetables are also inspected for compliance with bacterial content standards. Exporters must ensure that their products meet exacting requirements for freshness, breakage and spoilage, size, and color.

Most Thai producers and distributors tailor their products to Japanese consumers' preferences. The Thais employ cultivation methods that would aid compliance with Japanese residual pesticide standards. To ensure that they meet market requirements, exporters have to perform stringent inspections prior to exporting. Samples of the intended exports are sent for analysis to designated official laboratories in Japan or in the exporting countries. Test results may substitute for inspection at the port of entry, thereby expediting the quarantine clearance process. Notifications may also be submitted by computer to the Japanese Food Automated Import Inspection and Notification System.

Sanitary and Quality Problems and Costs of Compliance

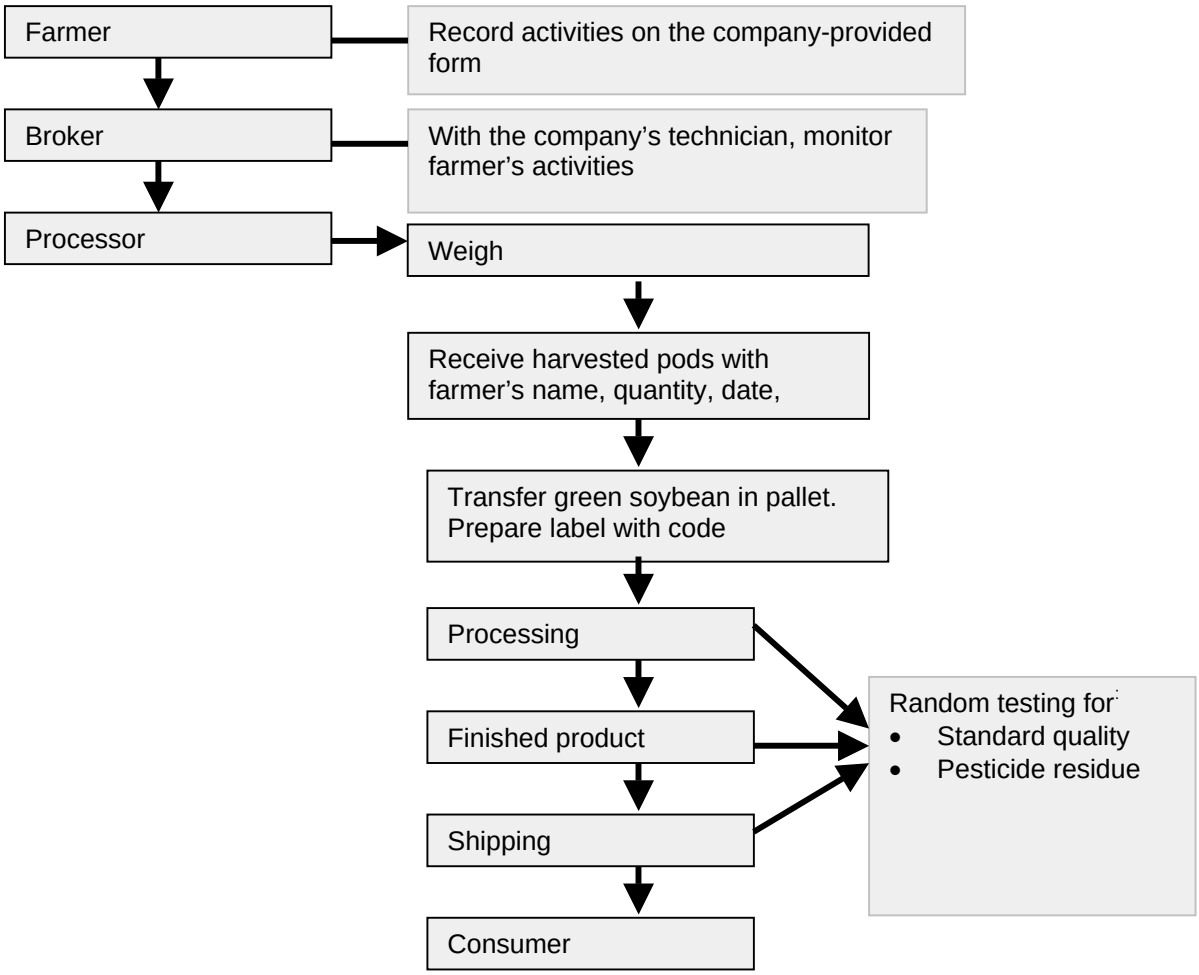
Compliance Costs to Farmers

A major concern in exporting green soybean is the maintenance of both physical and chemical quality of the product. Quality is heavily dependent on the agricultural practices, harvest, and post-harvest handling of the product. To ensure that all the contributing factors to product quality are incorporated

in the farming practice, the company invests in research and development to solve the problems and develop techniques that meet the requirements of their markets.

The benefits that can be derived from contract farming are that the company or the exporter is able to control standards and quality of green soybean. Contract farming gives farmers new knowledge and skills as well as greater confidence in the quality of their products. In contract farming, the contracting export company is responsible for keeping up with any changes related to SPS regulations. However, the farmers are also responsible for certain of the additional costs for adapting to regulatory or market changes. For example, in implementing traceability (figure 17), the company must develop new forms to record relevant information and to hire additional staff to monitor farmers and check by laboratory analyses whether the suggested practices are followed accordingly. Farmers, on the other hand, must learn to keep records and to, perhaps, adopt new farming techniques that would ensure pesticide-free products.

Figure 17. Green soybean traceability system



Source: Exporters' interviews by the research team, May 2003.

In the past, growing green soybean relied heavily on chemicals. Fertilizers and pesticides, for example, were used to increase yield and to control insects and diseases. These chemicals contaminated and left harmful residues on green soybean. Today, because of food safety and consumer health concerns, consumers are demanding farmers to reduce chemical use and to rely more on natural or biological control and organic supplements to control pests and diseases and increase production yield.

When chemical substance use was restricted, the switch to other materials directly increased the cost of green soybean production by approximately 10 percent (tables 29 and 30).

Table 29. Farming techniques before and after chemical substance use was restricted

Method	*Before*	*After*
Chemical substances	No limitation on the use of pesticide in the field No testing required	Some chemicals prohibited in field due to effects on human beings Random testing implemented
Fertilizers: organic and inorganic	Inorganic fertilizer used under the company's recommendation	Inorganic fertilizer used under company's recommendation Organic fertilizer used to improve soil quality
Labor	Labor and chemicals used in field	Labor increased to replace chemicals
Production cost	Total production cost is US$1,114 /ha with 7% fixed cost and 93% variable cost	Total production cost is US$1,220 /ha with 6% fixed cost and 94% variable cost. Variable cost higher since new chemicals used cost more. In addition, organic and other nutrients to replace chemicals are more expensive
Net income	US$1,242 /ha	US$1,324/ha
Pest check	Random checks weekly 1 mo before harvest	Company checks each crop in the field weekly after green soybean are planted

Source: Information collected by the research team , May 2003.

The increase in costs is due primarily to the use of better quality chemicals. The second reason is that farmers mix organic fertilizer with chemical fertilizer for better results. Good quality green soybeans fetch higher prices. In 2003 at the time of the interview, farmers sold their product at US$ 0.31/kg, which was 6.25 percent higher than the price of the previous year.

Table 30. Production costs before and after chemical substances use was tightened

Expenditure (US$/ha)	*Before*			*After*		
	Cash	*Non-cash*	*Total*	*Cash*	*Non-cash*	*Total*
1 *Fixed costs*	-	72.49	72.49	-	72.49	72.49
1 Land rental	-	72.49	72.49	-	72.49	72.49
2 *Variable costs*	592.2	449.4	1,041.7	698.5	449.4	1,147.9
1. Growing	275.5	72.5	348.0	275.5	72.49	348.0
Plowing	101.5	-	101.5	101.5	-	101.5
Planting	-	72.5	72.5	-	72.49	72.5
Seed (75 kg)	174.0	-	174.0	174.0	-	174.0
2. Maintenance	316.8	-	316.8	423.1	-	423.1
Fertilizer (inorganic)	-	-	-	-	-	-
Formula 15-15-15(312.5 kg)	75.4	-	75.4	75.4	-	75.4
Formula 4-14-21 (312.5 kg)	76.8	-	76.8	76.8	-	76.8
Formula 46-0-0 (312.5 kg)	58.0	-	58.0	58.0	-	58.0
Fertilizer (organic)	-	-	-	70.0	-	70.0
Pesticide	63.1	-	63.1	99.3	-	99.3
Hormone	43.5	-	43.5	43.5	-	43.5
3 Harvesting and grading	-	376.9	376.9	-	376.94	376.9
3 Total costs (1+2)	592.2	521.9	1,114.2	698.5	521.92	1,220.4
4 Total production (kg per ha)	8,125			8,125		
5 Selling price (dollar per kg)	0.29			0.31		
*6 Total income (4*5)*			2,355.9			2,544.4
7 Net income (6-3)			1,241.7			1,323.9

Source: Exporters' Interviews by the research team, May 2003.

Compliance Costs to Exporters

There are only three companies exporting frozen green soybean. All three are joint ventures with investors from Japan and Taiwan. The investment ratio of Thai to foreign investment is 51:49. Approximately 98 percent of the country's production is exported, while the remaining 2 percent is sold locally. To ensure the quality of green soybean, Thailand's Japanese and Taiwanese partners brought in technology and equipment to Thailand.

To comply with Japan's strict pesticide standards, Thai soybean exporters invested in three major areas (table 31):

Table 31. Cost before and after chemical use on green soybeans was tightened

Description	*Investment/expenses*		
	Before	*After*	*%changes*
1 Testing equipment			
1.1 Number of equipment	4	5	25.00
1.2 Value (US$M)	0.28	0.37	33.33
2 Personnel	29	39	34.48
2.1 Quality control (person)	3	9	200.00
2.2 Farm advisory (person)	26	30	15.38
3 Quality control and testing			
3.1 Testing cost (US$/mo)	820	11,598.24	1,314.43
Number of samples tested/day	5	40	700.00
Number of samples tested on field/day	4	all	100.00
7 Volume exported (t)	7,767	8,836	13.76
8 Value exported (US$M)	14.04	14.93	6.33

Source: Exporters' interviews by the research team, May 2003.

1. *Technology.* Exporters increased investment on technology and test equipment. Equipment was increased by 25 percent in quantity or 33 percent in value.
2. *Human resources.* Exporters increased their staff by 35 percent. Quality control and testing staff increased by more than 200 percent while farm advisors increased by 15 percent.
3. *Training.* Staff are sent for training at government laboratories to learn the techniques and standard analytical method of measuring pesticide residues while contract farmers are sent for training on agricultural production and product quality maintenance.

Quality Management Strategies

Contract farming plays an important role in the agricultural production of green soybean according to the frozen green soybean producers/exporters in Chiangmai. A typical company buys crop from the farmers, then processes, packages, and markets the product. Farmers' quotas and product price are normally communicated at the beginning of the first growing season of the year. Production volume depends on the number of advance orders received. Normally, advance orders are received one year before the targeted shipment date. Price, however, depends on the ongoing market price of the shipment date.

Contracts with farmers normally are made on a yearly basis through a broker, who is a mediator between the farmers and the company. The broker communicates the company's production plan; suggestions, and recommendations including the selection of cultivar to use, the chemicals and pesticide permitted, the type of fertilizer, harvest and post-harvest handling, and grading. The company procures and provides the recommended inputs through the broker, and the contracted farmers buy them from the broker either with cash or credit to ensure that the required quality of the

product is strictly controlled. Credit payment is normally collected when farmers turn in their harvests to the broker, who then brings them to the contracting company.

A broker takes care of several contract farmers' groups. To be able to closely monitor contract farmers, a "Collector," who serves as subcontractor, is normally identified to oversee a smaller group of farmers within his village. His main responsibility is to collect the harvested and graded pods from the farmers and hand them to the broker (figure 17). Most contract groups rely more on the broker for technical advice than on the provincial government officers. During harvesting, villagers usually help without charge. Only "Standard Pods" will be sold to the company. Substandard pods are sold in the local markets at a much lower price.

As previously mentioned, soybean is highly susceptible to pests and diseases, and pesticide use is unavoidable. However, the type, amount, and time by which pesticide must be withdrawn before harvest are worked out by the company and communicated to farmers through the broker to ensure that these stipulations are followed closely.

To ensure that no detectable residue is left in the product, the company randomly checks pods for chemical residue 5 to 7 days before harvest. The company checks every farm to screen out farms that are likely to cause problems for their exports. The company absolutely will not accept green soybean from farms that tested positive for pesticide residue.

To ensure the safety of food throughout the food chain, traceability is now implemented to farm level. The system enables the exporter to trace the product backward or forward. The exporting company requires farmers to provide product information regarding the farm, crop varieties, planting, irrigation, fertilizer application, insect or disease emergence, pesticides/chemicals used, harvest date, costs incurred, problems, and selling price.

To ensure both physical and chemical quality of green soybean, it needs to be processed as fast as possible, possibly within 8 hours after harvest. Delay in processing can significantly affect the flavor. Random checks are done in every stage of processing to ensure physical and chemical quality.

All companies interviewed have obtained GMP, HACCP (Hazard Analysis and Critical Control Point), and ISO 9000 certifications to ensure their customers of the safety and quality of their products.

5. Private Sector View of Public Food Standards

The food scandals around the world are making people understand the importance of having food standards and regulations. Most interviewees were aware that the EU's ban on Thai shrimp products resulted from noncompliance with the EU chemical residue regulation. Many of the interviewees are now aware of the new policy of the Thai government to avoid similar problems in the future by tightening regulations through requiring product traceability and restricting the use of chemicals.

Although most entrepreneurs interviewed for this study recognize the importance of food sanitary measures to protect consumers' health, they are also of the opinion that the implementation of such measures must be supported by sound scientific evidence. They feel that the use of precautionary measures and zero tolerance for nongenotoxic chemicals must be temporary and that they need to be reviewed within a definite timeframe or as soon as more conclusive evidence is collected. Some entrepreneurs think imposing zero tolerance on banned nongenotoxic chemicals was an EU non-tariff barrier, because the EU did not impose it strictly on European producers. These entrepreneurs base this view on independent analytical tests made by the Thai and Chinese authorities on a number of food imports from Europe.

Priorities in Shrimp Trading Relations

The majority of the respondents rated "overall quality" and "consistency of quality" as the most important factors in shrimp trading. These are followed in decreasing order by "compliance with food safety regulations," "efficiency of the border procedures" and "compliance with the environmental directives." The major driving factor is the fact that approximately 45 percent of the shrimp exports are distributed directly to supermarkets, which are quite stringent in their quality requirements; and another 45 percent to wholesalers, who distribute to retailers whose private standards require both quality and safety assurance. As more Thai exporters supply the higher-end markets, private standards will, perhaps, have a more important role in the future.

Priorities in Vegetable Trading Relations

Among vegetable exporters, "overall quality" and "compliance with food safety regulations" were rated the most important in trading. With regard to Thailand's law, regulations, and policy to support the producers' sanitary measures, respondents have different opinions. Soybean exporters think that the government provides little support while asparagus exporters think that government provides strong support. All vegetable exporters, though, think that developing countries, being mostly exporters, take into consideration the needs of the developed countries in their SPS measures. They also indicated that their Japanese trading partners provide them with sufficient technical assistance and information.

Factors Important in Sanitary and Phytosanitary Compliance

Most of the exporters think that compliance with the sanitary and other market requirements largely depends on the capabilities of the private sectors themselves, with some support and cooperation from the government. To some extent, unpredictable weather—about which they can do nothing—can also impact the quality of the product and their compliance with their markets' sanitary measures. For example, warm humid weather is conducive to microbial growth and diseases, so private sectors, in anticipation of climatic changes, must have measures to avoid, if not lessen, humid weather's impact on their crops.

Public Standards vs. Private Standards

Public standards are legal standards or measures based on the appropriate level of protection for consumers in general, while private standards not only provide food safety but also differentiate market product quality. Because retailers are liable for the quality and safety of the products they sell, most retailers set their standards higher than the public standards. To ensure that they get what they require from their suppliers, they audit supplier activities.

Advantages of Private Standards

The retailers believed that, despite the costs involved in implementing private quality standards, there are benefits that can be derived. By imposing uniform quality and safety requirements across the produce groups, an industry-driven global standard is implemented. A more consistent approach to managing food safety and quality throughout the supply chain will prevent suppliers from accusing retailers of using dual standards. Eventually, a private system will reduce the costs of managing food safety and quality and, simultaneously, enhance traceability along the food chain and better communication with suppliers.

Possible Disadvantages of Private Standards

There are also some disadvantages in imposing private standards. Varying safety requirements in different countries could make an international private scheme difficult to implement. Uniform private product standards could affect product differentiation and limit product choices. There is the possibility of language/interpretation difficulties. Last, there are concerns over who would own the "standard scheme," relevant to the current politics and power bases within the supply chains.

6. Conclusions and Recommendations

The food scares that took place in the EU led it to issue the precautionary zero tolerance on banned chemicals in shrimp products that has affected many of the Asian shrimp suppliers, including Thailand. Rapid global reporting of the fate of the Thai shrimp shipment to EU prompted immediate and overwhelming response from both government and private sectors to correct the problem for fear that the news would impact other Thai export markets and damage the country's reputation as a quality product supplier.

Meeting Sanitary and Market Requirements

Differences among food producers in terms of investment, technologies, staff capability and capacity, quality management, and operational budget allocations; and differences in their capability and capacity to meet sanitary and quality market requirements resulted in product differentiation and market segmentation. Bigger companies with sufficient capital generally equip their factories with the needed process mechanization, and employ skilled and knowledgeable staff to train operational staff to implement and maintain their quality systems. These companies educate and maintain trustworthy and reliable raw material suppliers and customize products to meet different market segment requirements. These larger companies tend to supply the higher-end markets while smaller companies with insufficient capital investment to implement good quality management systems supply local markets as well as countries with less stringent sanitary requirements.

Consumers with high purchasing power demand that supermarkets provide them with proof that the products they are buying have traceability records and safe and quality assurance certifications with labels that contain the necessary information to enable them to make informed choices. To meet the demand, supermarkets are offering specialized and premium-priced products such as organic products, pesticide-free vegetables, and ready-to-cook or -serve products; as well as products that conform with social demands and standards including animal welfare, environmental protection, and labor law provisions. To meet all these market requirements, private standards were developed and imposed on suppliers. Most private standards are set higher, and are harder to fulfill, than public standards. Private standards take into consideration not only safety but, more importantly, physical quality attributes of the products such as freshness, and other sensory qualities, as well as packaging. On the other hand, public standards are set as the minimum requirements for food safety. To ensure that suppliers meet their requirements, the implementation of quality management systems is required at the suppliers'/exporters' expense while buyers pay for their own expenses for factory or farm supplier audits.

Important Developments Affecting Compliance

Two major developments affect the compliance of Thai food exporters. The first is *consumers' increasing food safety awareness*, which is pushing both regulatory bodies and food supermarkets and other retailers to impose more stringent food safety requirements. For example, the Thai government is now requiring the registration of farmers to promote traceability.

Private Sector's Response

Imposing stringent sanitary requirements has both positive and negative impacts on Thai exporters. The positive impact is that sanitary standards are pushing the private sector to adopt and improve quality management systems that can give their products a competitive edge. As a consequence, exporting companies are selecting their own raw material suppliers and helping these suppliers to

implement quality systems and to be in compliance with their markets' requirements. More exporters are avoiding open market as their raw material sources, because traceability and product quality are hard to control in such a setting. The negative impact is that the cost of implementing quality systems is often not reflected in the market prices unless the product is customized for the high-end market segment (box 4).

The second development is the *greater integration in the market distribution structure*. As more exporters are supplying supermarkets, suppliers need to be competitive by complying not only with the supermarkets' more stringent food safety requirements but also with the demands regarding the quality and sensory attributes of the product. To ensure product quality, quality management systems and traceability must be in place in the entire food chain. To control and manage both quality and operational costs, exporters and food processors are moving toward integrated or coordinated supply chains.

With the globalization of supermarkets and the shortening of the market distribution chain, supermarkets are able to provide consumers with safe, quality products at far more affordable prices.

Box 5. Compliance costs: Are entrepreneurs compensated in product price?

One exporter of asparagus in bulk to Japan commented on the increasing costs of complying with the increasing requirements of importing countries, which, he believed, were not compensated in the price, since market prices were continuously falling due to competition.

However, another exporter commented that he avoided the impact of market price fluctuations by customizing his product to meet the requirements of the high-end supermarkets in the UK. He put a quality management system and traceability in place in the entire supply chain, maintained product freshness, packed in attractive packages, and shipped by air freight. The benefits that he obtained were not only a premium price that was unaffected by market price fluctuations but also the credibility for his company as a high-value product supplier, which is now earning him more high-end market clients. He said that by doing a little bit more than the minimum requirement, a producer/exporter can differentiate his product from the rest by making it more attractive to consumers who are willing to pay more for the extra efforts made to ensure food quality and safety.

Source: Information collected by the research team, May 2003.

Public Sector's Response

In recent years**,** the pertinent public food agencies in Thailand, including DOA, FDA, and the Thailand Industrial Standard Institute (TISI), were reorganized to:

- Provide a single one-stop service agency for the food not only to expedite the inspection, certification, and exporting process but also to coordinate activities that would support the development of the food industry
- Establish a national committee on food safety that would be responsible for mapping the direction of food-related developments and to assign the respective agency that would take the necessary actions
- Strengthen national capacity to actively participate in international food safety fora and negotiations
- Align national sanitary standards with international standards
- Strengthen Thai food safety monitoring by surveillance programs

- Actively educate and create greater food safety and quality awareness in the general public and in pertinent private and government sectors.

The government further encouraged the private sector to develop subregional clusters. To establish shrimp clusters, in 2000 the private sector submitted a proposal to the National Economic and Social Development Board of the Office of the Prime Minister to create an independent Shrimp Institute, which would facilitate shrimp cluster development.

Enhancing Food Safety in the Entire Food Chain

The business sector uses the traceability system in three ways: (1) to differentiate and market foods with subtle quality attributes; (2) to facilitate traceback or trace forward of products found to have food safety or quality problems; and (3) to improve its supply chain management. Product coding long has been used in industrial production and merchandising to facilitate the recall of products that proved defective or failed to meet standard requirements. However, the new traceability system is extended to include primary production in the food chain. For buyers, maintaining a traceability record can help them establish a list of reliable and trustworthy suppliers. Fo suppliers, this record can be used as a tool to identify at what point in the food chain food safety problems have occurred or are likely to occur. As discussed earlier, record-keeping systems to promote traceability are being implemented for asparagus and shrimp by the DOA and DOF, respectively,

To comply with the demands of the market, changes are taking place on the suppliers' side. Suppliers with big capital investment are moving toward integrated supply chain management – exporters are expanding and networking vertically to include all aspects from primary production to marketing. Through vertical integration, the management has full control of the quality of the product and the costing of the entire system. In contrast, to be able to compete in the market, small-scale exporters need to resort to coordinated supply chain management, as exemplified by contract farming, to ensure product quality that is in compliance with the public and even private standards. For example, a number of small-scale vegetable suppliers interviewed for this study who have successfully supplied supermarkets in UK rely on contract farming.

The willingness of some market segments to pay more for certified products has turned food safety into a marketing tactic to differentiate quality product from mass products, as can be noted with multinational retailers operating in many parts of the world. In Thailand, one supermarket chain advertises having a HACCP-certified fresh food section, while another is offering free diagnostic tests to prove their food safety claims.

Recommendations

The following are recommendations to ensure compliance with sanitary requirements:

For the government sector:

- *Promote widely the implementation of food safety measures from farm to table*. These measures include GAP (Good Agricultural Practice) for the agricultural producers, HACCP for the processors, PQMS for the entire food production chain (farm to processing), COC for the hatchery and shrimp farmers, or GAP (Good Aquaculture Practice) for shrimp farmers.
- *Strengthen food regulatory monitoring and enforcement programs*. To ensure that regulatory measures are carried out as intended, monitoring is necessary.
- *Increase the availability of laboratory services*. To be able to monitor the safety of the food products in the market, and assist, particularly, the small and medium-scale food sector to comply with sanitary requirements, more laboratory services must be established.

- *Follow and disseminate pertinent local and international food developments to all involved*. To keep everyone in the food business informed and aware of the pertinent developments and concerns in the food area, regular dissemination of information must be promoted.
- *Provide or facilitate training relevant to quality food production management*. To improve the capability of the food sector in implementing quality production management, short training courses with practical exercises must be provided.
- *Promote research and development*. To assist entrepreneurs to stay in compliance with ever more stringent international regulatory requirements, research should be done to develop more sensitive and accurate diagnostic tests for contaminants, less chemical-dependent farming techniques, and disease-resistant plant varieties or shrimp strains.

For the private sector:

- *Implement quality management*. To ensure food safety, quality management systems must be implemented in the entire food chain.
- *Develop and implement traceability*. To improve supply chain management, and to protect business in case of safety or quality problems, a suitable traceability system should be developed and implemented. ("Suitable" means that the system serves each business's needs or intention; there is no need to spend for a highly expensive and complicated system.)
- *Promote networking for sharing information and experience*. Sharing information and experience can be quite rewarding, especially when there are problems.

For international organizations and donor agencies:

The potential role of international organizations and donor agencies could be to focus on the promotion and encouragement of the development of the "agricultural cluster." This cluster is formed by the three concerned sectors: farmers, private sector, and public sector. Clustering can strengthen supply chain management of processed food products in Thailand.

Appendix 1. Thailand Shrimp Exports to the United States, Japan, and the European Union, 1993–2002 *(quantity in tons, value in US$ million)*

Table A1. Exports to the United States

Year	*Chilled/frozen*		*Prepared or preserved*		*Others*		*Total*	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1993	46,028.64	466.65	18,967.13	198.71	783.13	8.90	65,778.90	674.26
1994	53,330.90	627.50	22,785.34	276.31	407.13	3.89	76,523.37	882.70
1995	44,360.42	541.98	24,564.29	303.30	490.98	6.35	69,415.69	851.63
1996	41,810.63	476.25	28,052.72	360.89	494.11	5.96	70,357.46	843.10
1997	37,990.82	461.12	32,426.28	472.64	215.21	1.74	70,632.30	935.50
1998	52,406.25	494.34	40,424.41	477.03	267.80	1.82	93,098.46	973.19
1999	52,745.39	521.85	53,484.44	578.93	247.04	1.70	106,476.86	1,102.48
2000	65,261.25	722.58	52,719.41	671.83	134.43	1.03	118,115.09	1,395.44
2001	67,158.63	611.34	56,613.64	521.88	174.52	1.21	123,946.79	1,134.42
2002	42,258.21	360.33	65,290.62	550.14	72.98	0.40	107,621.80	910.86

Source: Department of Customs, Thailand Ministry of Finance.

Table A2. Exports to Japan

Year	*Chilled/frozen*		*Prepared or preserved*		*Others*		*Total*	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1993	53,847.03	645.66	4,943.43	49.30	591.06	7.66	59,381.52	702.62
1994	66,078.03	722.43	7,016.51	75.13	935.18	11.72	74,029.72	809.28
1995	50,727.79	744.56	12,602.82	151.69	1,102.27	18.00	64,432.88	914.25
1996	35,572.08	492.86	15,520.26	173.95	338.71	4.50	49,277.17	671.31
1997	27,802.75	389.99	16,472.32	197.39	196.34	2.27	44,471.41	589.65
1998	28,019.90	305.91	17,771.34	199.28	113.45	1.22	45,904.69	506.41
1999	21,803.85	291.66	18,759.53	207.05	135.35	1.16	40,698.74	499.86
2000	23,052.18	325.33	21,898.34	226.72	103.36	1.00	45,053.88	553.05
2001	24,855.73	261.71	25,052.29	238.54	68.07	0.57	49,976.09	500.82
2002	26,423.74	223.10	22,884.44	204.35	41.93	0.33	49,350.11	427.77

Source: Department of Customs, Thailand Ministry of Finance.

Table 3A. Exports to the European Union

Year	*Chilled/Frozen*		*Prepared or Preserved*		*Others*		*Total*	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
1993	13,106.32	111.62	9,001.58	49.14	420.93	2.54	22,528.83	163.30
1994	15,164.16	138.72	8,601.39	61.17	496.96	3.37	24,262.51	203.26
1995	20,338.37	196.68	9,463.32	72.58	280.20	2.64	30,081.89	271.90
1996	18,187.56	166.58	10,531.75	83.73	112.71	1.34	28,832.02	251.65
1997	13,383.09	122.77	9,156.08	71.40	80.63	0.89	22,619.80	195.05
1998	15,843.33	143.53	9,824.33	67.64	146.08	1.00	25,813.74	212.17
1999	8,073.06	70.93	8,409.18	62.47	67.66	0.62	16,549.90	134.01
2000	6,848.13	60.40	7,841.02	58.21	105.43	0.97	14,794.57	119.58
2001	7,122.84	55.00	7,013.21	48.75	108.69	1.09	14,244.75	104.84
2002	1,812.67	13.04	4,251.82	23.87	1.45	0.01	6,065.95	36.92

Source: Department of Customs , Thailand Ministry of Finance.

References

Bicknell, P. 2002. USDA Gain Report No. UK2010. ”UK Asparagus Annual 2002.” http://www.usda.gov/fas.

Budget Office, Office of the Prime Minister. 1994. 1995–2001 Yearly Budget Allocation, Ministry of Agriculture and Cooperatives. Bangkok.

Chamberlain,G. 2003. “World Shrimp Farming: Progress and Trends.” *World Aquaculture 2003.* Salvador, Brazil.

Chanratchakool, P., J.F. Turnbull, S.Funge-Smith, and C. Limsuwan. 1995. “Health Management in Shrimp Ponds.” Department of Fisheries, Kasetsart University, Bangkok.

Department of Customs. Export-Import Statistics. Thailand Ministry of Finance, Bangkok.

Department of Customs. 2002. Import-Export. Tokyo. html://www.customs.go.jp.

Department of Food Safety, Ministry of Health, Labor and Welfare, 2002. Food Sanitation Law. Tokyo. html://www.jetro.org.jp.

Food Market Exchange. 2003. “Shrimp: A Review of the News in 2002.” http://www.foodmarketexchange.com.

Global Trade Information Services, Inc. 2002. “World Trade Atlas.” Columbia, SC. http://www.gtis.com/.

JETRO. 1999a. Fresh Vegetables Market Information. http://www.jetro.org.jp.

_____. 1999b. The Japanese Market for Shrimp and Prawns. http://www.jetro.go.jp.

_____. 2002a. Fresh and Frozen Vegetables Market Information. http://www.jetro.org.jp.

_____. 2002b. Marketing Guidebook for Major Imported Products–Shrimp and Crabs. http://www.jetro.go.jp.

_____. 2003a. “Handbook for Agricultural and Fishery Products Import Regulations.” JETRO Standard Information Service. Tokyo.

_____. 2003b. Fresh and Frozen Vegetables Market Information. http://www.jetro.org.jp.

Konovsky, J., T.A. Lumpkin, and D. McClary. 1994. “Edamame: The Vegetable Protein.” Washington State University, Pullman, Washington. http://stratsoy.uiuc.ed.

Kosom, P. 1985. “A Study of Cost and Rate of Return on Investment in Asparagus Plantation at Hupkapong.” Master’s degree (Accountancy) Thesis. Chulalongkorn University, Bangkok.

Naritom, C. 2000. “Contract Farming in Central Plain: A Case Study of Asparagus Grower Groups in Nakhom Pathom Province.” The International Conference on the Chao Phraya Delta. 12–14 December. Kasetsart University, Bangkok.

National Food Institute. 2002. Compiled food statistical data. Thailand National Food Institute. Bangkok.

National Marine Fisheries Service. 2002. Fisheries statistics. Washington, DC. http://www.st.nmfs.gov/st1/trade/index.html.

Nguyen, V.Q. 1998. “Edamame (vegetable green soybean). The New Rural Industries.” http://rirdc.gov.au/pub/handbook/edamame.pdf.

Ohio State University Extension. N.d. “Production Management and Marketing.” Bulletin 826. Horticultural and Crop Sciences. http://ohioline.osu.edu.

“Shrimp Culture Newsletter.” 2000. April. Charoen Pokphand (CP) Group. Bangkok.

_____. 2002. May. Charoen Pokphand (CP) Group. Bangkok.

_____. 2002. September. Charoen Pokphand (CP) Group. Bangkok.

“Thai Frozen Food Association (TFFA) Report and Directory.” 2001.

Thailand Department of Agricultural Extension. 2002. “Green Soybean Report.” Bangkok.

Thailand Department of Export Promotion. 2001. “Fresh, Chilled or Frozen Shrimp, Prawns and Lobster.” http://www,thaitrade.com/en/doc/report_shrimp.doc. Bangkok.

Thailand National Food Institute and Office of Industrial Economics. 2002. “Report on Competitive Benchmarking for the Thai Shrimp Industry.” Bangkok.

Thailand National Statistical Office and Department of Fisheries. 2000. “The 2000 Intercensal Survey of Marine Fishery Marine Shrimp Culture.” Bangkok.

Tukvinas, S. 2002. “Research and Development for Shrimp Industries in Thailand.” *Warasan Pramong* [*Fishery Magazine]* 55 (3) (May–June).

UK Department of Environment, Food and Rural Affairs. 2003. “Marketing Standards for Asparagus.” March. http://www.defra.uk.

USDA. 2003a. Foreign Agricultural Service GAIN Report No. JA3033. US Department of Agriculture. Washington, DC. June. http://www.usda.gov/fas.

_____. 2003b. Foreign Agricultural Service GAIN Report No. JA3050.. US Department of Agriculture. Washington, DC. July 25. http://www.usda.gov/fas.

Wivatchaiset, Y. 2002. Fishery Product Strategy Plan. *Warasan Pramong* [*Fishery Magazine*] 55 (4) (May–June).

Additional websites:

http://www.fao.org. FAOSTAT.

http://www.doa.go.th. Thailand Department of Agriculture.

http://www.fda.gov .US Food and Drug Administration.